WOMEN IN SCIENCE
ASSESSING PROGRESS, PROMOTING ACTION

CONFERENCE REPORT

Smith College

Association for Women in Science National Conference for Women in the Science, Technology, Engineering, and Mathematics (STEM) Disciplines

23-24 June 2005
Smith College, Northampton, Massachusetts
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A. Ester Sztein, PhD, Writer

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EXECUTIVE SUMMARY

The National Conference for Women in the Science, Technology, Engineering, and Mathematics (STEM) Disciplines held at Smith College in June 2005 was organized by the Association for Women in Science (AWIS) to

- Assess the progress made on the seven recommendations of the 1995 National Science Foundation (NSF) Conference “Women & Science: Celebrating Achievements, Charting Challenges,” a joint effort of the seven directorates of NSF (see box below).
- Present and discuss current data on the status of women in science and engineering.
- Select the most important remaining barriers to the success of women in their STEM careers.
- Make specific recommendations for a research agenda for the next decade.

### Seven recommendations issued by the 1995 NSF Conference
*(National Science Foundation, 1997)*

1. Communicate with women and girls about the importance of being scientifically literate. Increase public understanding of the role that women do and can play in science and engineering while dispelling myths and stereotypes.

2. Rather than relying on quick fixes to local problems, seek to transform the systems of education and the sciences by holding institutions accountable for their performance as employers and places of learning for all people.

3. Recognize and reinforce the importance of mentoring and being mentored at all levels of education and career.

4. Enable women and girls to participate fully in science and engineering by making available a greater variety of resources. These resources include career awareness and career planning assistance and opportunities to interact within and across disciplinary fields and sectors of the economy.

5. Accommodate the needs of women by recognizing a diversity of approaches to learning and the multiple paths women take to becoming literate citizens and career professionals in science and engineering.

6. Strengthen connections between organizations that have a stake in the participation of women in the sciences and engineering, such as the corporate and academic worlds, the formal and informal education sectors, associations of women and associations of sciences, and between higher education and K-12 schools.

7. Place greater emphasis on determining what works best in increasing opportunities for women and girls and how this knowledge can be shared and used by others.
Attending the conference were 150 STEM discipline professionals including academic and government administrators, faculty, corporate managers, and nonprofit leaders. Invited speakers from academia and from the nonprofit and corporate worlds reported on completed research projects that address issues affecting women at various career stages in the STEM disciplines and on the identification of policies and practices that encourage and support women in these technical careers.

Smith College President Carol T. Christ and AWIS President Elizabeth S. Ivey opened the conference by welcoming the participants. Following their remarks, Shirley A. Jackson, President of the Rensselaer Polytechnic Institute, addressed the audience in her keynote speech “Women and Science: The Talent Imperative,” in which she discussed the crisis looming over the American innovation enterprise and described some initiatives that can help remediate this situation, including programs based on the Building Engineering and Science Talent (BEST) initiative. Jackson emphasized the need for a change in the culture of science in all institutional settings and at all levels, including family-friendly policies and mentoring.

In the course of her plenary session speech “How Do We Achieve Systemic Institutional Change?” Rita R. Colwell, Distinguished University Professor at the University of Maryland and former director of NSF, focused on the changing research environment. Drawing on her own career experiences, she noted that science now involves international networking, multidisciplinary collaboration, and integration of science and technology. She presented current data on the situation of women in science and stated that girls, especially, must be encouraged to study mathematics and science. Lastly, Colwell emphasized the need to change the framework within which science is performed.

The conference continued with a STEM panel of corporate, foundation, and academic leaders’ presentation and discussion moderated by Thomas Litwin, Director of the Smith College Clark Science Center. Margaret E. Ashida, Director of University Talent Programs at International Business Machines Corporation (IBM), delivered her presentation entitled “Developing the Diverse Talent Needed to Drive Innovation and Growth.” Ashida noted that industry needs individuals who can be characterized as diverse, global, adaptive, collaborative, and expert in more than one discipline. Noting the forces that marginalize women in the workplace, she discussed some of the successful initiatives implemented by IBM to increase workplace diversity and improve outreach to young women in educational institutions.

Liane Pedersen-Gallegos, Director of Ethnography and Evaluation Research at the University of Colorado, shared with the audience the work on “Research Associates Career Paths” funded by an NSF-ADVANCE institutional transformation grant awarded to the University. The investigators identified factors that contribute to the departure of women from the tenure-track pipeline, and described the reasons and perceptions that underlie the choice of nontenure track positions at that institution.

Marianne Hudson, Director of Entrepreneurship at the Ewing Marion Kauffman Foundation, spoke on “Entrepreneurship: A Career Option for Women in Science.” She emphasized the positive aspects of entrepreneurship, including autonomy, time flexibility, and increased economic power. But she also noted key challenges that remain, such as access to networks, capital, credit, and markets. Finally, Hudson discussed the Kauffman Foundation's support for the establishment of businesses as career options for women in the STEM disciplines.
AWIS President Elizabeth S. Ivey, who is also Provost Emerita at the University of Hartford, concluded the panel presentations. In her remarks on “NSF ADVANCE Grants as Institutional Change Agents,” Ivey summarized the goals and the activities of the ADVANCE program of the National Science Foundation. Grants under this program intend to increase the representation and advancement of women in academic science and engineering careers and promote institutional transformation to better support female students and faculty.

After the panel presentations, conference participants separated into eight break-out sessions to discuss in detail specific issues in corporate and academic workplaces. Among the topics discussed were the persistence of barriers to women’s career advancement and the identification of policies and actions that could improve the situation for women and other underrepresented groups. Representatives from each of the break-out sessions shared the results of their group’s deliberations at the Conference’s wrap-up session. Summaries of the discussions undertaken by participants at the academic/corporate, academic, and corporate workplace groups and a list of the action items resulting from these deliberations appear elsewhere in this report.

This report offers a window on the progress made toward the seven NSF Conference recommendations (see box), and points to the tasks ahead in removing the inequities that persist in the treatment of women scientists and engineers both in academic and corporate workplaces.

Concerted action through creative, innovative development and application of best practices at all points along the pipeline will effect change in the number and standing of women in the STEM disciplines. Implementation of these initiatives could lead to the realization of women and minorities’ full potential and help fulfill the national need for skilled scientists and engineers.
CONFERENCE PROCEEDINGS

Introduction

The Association for Women in Science (AWIS) organized this Conference on Women in Science, Technology, Engineering, and Mathematics (STEM) disciplines. AWIS was founded in 1971 and is dedicated to achieving equity and full participation for women in science, mathematics, engineering and technology. Smith College, the host institution, was an ideal venue for this conference because of its successful application of best practices in diversity. Of special mention is that Smith College is the only women’s undergraduate institution with an engineering program, and that fifty percent of the school’s science and engineering faculty are female. This institution also houses the Smith College Project on Women and Social Change, an interdisciplinary faculty research group that explores women’s contributions to social change and the ways in which women are affected by change.

In her address to the conference attendees, Smith College President Carol T. Christ underlined the commonality of the goals for the advancement of women in science shared by both organizations, and congratulated AWIS on its efforts towards the achievement of these objectives (Frechette, 2005).

After Christ’s welcome to the participants, AWIS President Elizabeth S. Ivey, chair of this conference, set the tone of the meeting by sharing up-to-date national statistics on the participation of women in academia. While over 50% of the undergraduate degrees in biology and psychology are earned by women, they receive less than 20% of the undergraduate degrees in physics and engineering. At the faculty level, only 14% of the science and technology faculty at large research institutions and 22% at undergraduate institutions are women. Ivey referred the audience to the AWIS website, where other relevant statistics on women in science appear. In closing, Ivey challenged the audience to suggest ways to address the gap that still exists between the percentage of women graduating from undergraduate schools and the percentage of women faculty at those same institutions.
Keynote Speaker Presentation

Women and Science: The Talent Imperative

Shirley A. Jackson, PhD, President of Rensselaer Polytechnic Institute and 2004-2005 President of the American Association for the Advancement of Science, is a recognized leader in government, industry, research, and academia. A theoretical physicist, she was chair of the U.S. National Regulatory Commission from 1995-1999 and now serves on the boards of many prestigious national organizations.¹

There Are Gains, But Not Parity

Jackson reported that in Spring 2005 the National Academy of Sciences elected 19 women out of the total 72 new members selected for this honor — the largest number of female scientists ever elected in a single year. Today, women comprise 9% of the total membership of the Academy, an institution that has recently signaled its interest in electing more diverse members.

As examples of the high level of achievement of female scientists, Jackson mentioned molecular biologist Claire Fraser, PhD, mathematician and computer scientist Annie J. Easley, molecular geneticist Marlene Belfort, PhD (who is also a member of the National Academy of Sciences), researcher and astronaut Ellen Ochoa, PhD, and the leaders of major research institutions such as the Massachusetts Institute of Technology, the University of Michigan, Princeton University, Rensselaer Polytechnic Institute, and four campuses in the University of California system.

On the other hand, she noted, only about 10% of the U.S. university faculty members in tenure-track science and engineering positions are women, a percentage that does not reflect the increasing number of women earning doctoral degrees in those disciplines.

The Quiet Crisis

To guide the deliberations of the conference participants, Jackson offered as framework a set of concepts that she called the “quiet crisis.” Considerable numbers of scientists and engineers are retiring, the flow of international scientists to the U.S. is slowing and, overall, fewer Americans are studying science and engineering. As a result, the American innovation enterprise may soon lack the critical mass necessary for its adequate development.

As this crisis took time to develop, Jackson asserted, it will take time for these trends to be corrected. Women and members of underrepresented groups, which comprise the “new majority” among all the young people in the country, can become highly qualified scientists if properly fostered, encouraged, and mentored.

A National Call to Action

Building Engineering and Science Talent (BEST) is an initiative of the Council on Competitiveness launched in September 2001 as a result of the September 2000 recommendations of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development (summarized in Building Engineering and Science Talent, 2002). BEST is one of several public-private collaborations established to redress the demographic imbalance of the U.S. technical workforce by increasing the participation of underrepresented groups.

Three Blue Ribbon panels, one each for K-12, higher education (chaired by Jackson), and the workplace, were charged with finding programs that effectively engage women and minorities in science, engineering, and technology, foster them through the formative years, and result in employment in these fields. As a result of the panels’ analysis, BEST found a set of common design principles effective in the production of diverse talent for science and engineering (see box and BEST, 2004), which can be applied and adapted at each of the aforementioned levels. Comprehensive financial assistance, a component that cannot be easily designed into a program, is often crucial for success (BEST, 2004). It should be also considered as an important design tool.

BEST Effectiveness Design Principles

- Institutional Leadership
- Targeted Recruitment
- Engaged Faculty
- Personal Attention
- Peer Support
- Enriched Research Opportunities
- Bridging to the Next Level
- Continuous Evaluation

(Building Engineering and Science Talent, 2004)

Meeting the Talent Imperative

Jackson identified some examples of the impact of the BEST report. Both the U.S. Army and the U.S. Navy, aware of the importance of diversity and eager to improve the effectiveness of their outreach initiatives, asked BEST to evaluate their diversity programs. The BEST evaluation of the U.S. Navy resulted in an increased commitment to making their scholarship, internship, and research partnerships with universities much more productive. The evaluation of the U.S. Army programs is slated to begin in October 2005. In addition, the U.S. Department of Defense asked BEST to help scale up a Materials Science Program that partners its technical workforce with middle- and high-school science teachers.

BEST’s interest in system-wide improvement in communities has led to its specific focus on closing the achievement gap in math and science education. One such city is San Diego, California,
which shows a wide gap between the city’s prominent science and engineering institutions based there and its K-12 system. In partnership with the San Diego Foundation and other organizations, BEST identified effective programs that already exist in that community’s educational system, and is working to invest in their implementation and expansion. Supporting such programs builds a culture of success, and increases the pool of students ready for the study of science at the college level. Metropolitan regions, Jackson noted, provide a platform for the alignment of local, state, and national agendas, and community-based initiatives can help integrate the interests of all involved constituencies. Jackson’s presentation stressed the importance of applying the BEST principles at all levels of the educational enterprise and of reinforcing the notion of the education-workforce continuum.

Through citing the story of Lise Meitner, PhD, an Austrian physicist who was consistently ignored in her lifetime despite her seminal contributions in the field of nuclear fission, Jackson stressed the importance of recognition for women scientists.

Making Real Change Happen

The belief that changing demographics would on its own bring more women and underrepresented minorities to the sciences has not been supported by facts, Jackson asserted. Change will only happen when mindsets change all along the pipeline, and the culture of science as it is practiced also changes. Family-friendly policies will help men and women alike. Women should be mentored throughout their whole careers just as many men have been and should be allowed opportunities to assume leadership positions.

In Jackson’s inspirational words: “The price of advancement for women, perhaps, is similar to the price of liberty,” she concluded, “eternal vigilance… and action.”

2For the full text of the speech, see Jackson, 2005.
Plenary Speaker Presentation
How Do We Achieve Systemic Institutional Change?

Rita R. Colwell, PhD, Distinguished University Professor, University of Maryland, and Johns Hopkins University Bloomberg School of Public Health, and former director of the National Science Foundation, is now chair of Canon US Life Sciences, Inc. Her research on cholera met with resistance for decades, but she persevered, and her groundbreaking studies are offering new hope for the control of cholera outbreaks in the poorer regions of the world.

From the “Glass Ceiling” to the “Crystal Ball”

Colwell began by stating that fundamental science and engineering initiatives and science and math education are suffering heavy budgetary cuts and the prognosis is not good. She described a $1 billion, five-year Math and Science Partnership Initiative to link K-12 education with higher education that she, then NSF director, included as part of the NSF 2002 budget request. The budget for that initiative has now been reduced to just a fraction of that original amount.

Colwell mentioned some highlights of her life history and recounted some early roadblocks in her career and the effect they had on her resolve. She suggested that the glass ceiling metaphor should be discarded and replaced with the crystal ball, an image more symbolic of women’s ability to — in her words — “see through and beyond established strictures that keep girls even today from taking flight through the discovery of science and engineering.”

Stating that knowing about the past can be an inspiration to change the future, Colwell recounted some women’s stories going as far back as Sister Maria Celeste, Galileo Galilei’s daughter, who might have become a scientist in her own right had she not lived under the constraints that women endured in the 12th century. Among other scientists, Colwell discussed Alice Evans and her studies on bacterial milk contamination, Rosalind Franklin and her great contribution to the elucidation of the structure of DNA, Barbara McClintock and her discovery of mobile genetic elements, and the six women who programmed the Electronic Numerical Integrator and Computer (ENIAC) during World War II.

Dr. Colwell speaks with a conference participant after her presentation.
Parity Is Still the Goal

Colwell noted, however, that far too few girls even start studies in science and engineering, probably due to the obstacles and stereotypes that leave their mark very early in life. Girls are greatly discouraged from pursuing scientific interests especially between grades four and eight, and the gap widens as these children get older — a trend that has shown little change in the last two decades.

Colwell mentioned statistics that reveal that between ages 25 and 34 the typical American female is more educated than her male counterpart, with women obtaining more than half of the college degrees. Women earn over one-half of the degrees granted in the life sciences and well over 40% of the math and chemistry bachelor degrees; however, she pointed out a worrying trend. The number of bachelor degrees in computer science has been dropping in the last 20 years, even more precipitously for women than for men.

It is important to stress that since 1970 there has been a continual increase in the overall proportion of women receiving doctoral degrees in science and engineering, with the life sciences providing the major portion of this growth. In 1998, women earned about 40% of all doctorates, with wide divergence in proportion according to the field of study. While women earned more than 40% of the PhDs in life sciences, they received fewer than 20% of the doctorates in physical sciences and mathematics, and, in 2002, about 17% of the engineering doctoral degrees.

In 1995, the Committee on Women Faculty in the School of Science of the Massachusetts Institute of Technology (MIT) was formed to study the status of women in the six departments in the School of Science. The results, released in 1999 (Massachusetts Institute of Technology, 1999) motivated MIT’s President, Charles Vest, PhD, to introduce it as follows: “I have always believed that contemporary gender discrimination within universities is part reality and part perception. True, but I now understand that reality is by far the greater part of the balance.” The study found that women in the science faculty were marginalized through discrimination in salary, awards, space, and other parameters. Between 1985 and the summer of 1994, the percentage of women faculty hovered at about 8%; in the period following the study (1994-2002) that percentage increased to 16%.

Colwell stressed the need to put the problem in academia into an even broader context. Women currently comprise less than 25% of the science and engineering labor force, and the nation needs the contribution of all its workers to compete and prosper.

Discussing the importance of mathematics in science, Colwell noted the fragile nature of the U.S. world leadership in mathematics due to the country’s reliance on overseas talent, the limitations currently put on the number of foreign students in the United States and the need to attract and retain American students in scientific disciplines. Among the ways to improve this situation are gender equity programs such as the one for Hispanic girls in Carson City, Nevada, and through the development of computer games such as “The Adventures of Josie True,” (Flanagan, 1997-2005) which are more appealing to girls because they contain less violence and more opportunities for communication and collaboration.
The Interconnectedness of Science and Scientists

Both reductionist and integrative approaches are needed to understand scientific problems, Colwell asserted, using her own work with cholera as an example. She explained how work at various complexity levels can result in the accurate prediction of the time and location of an epidemic, and how a relatively simple filtration method can reduce the incidence of cholera. Colwell also discussed the blending of boundaries in scientific endeavors at the astronomy and physics frontier.

Colwell drew attention to the number and importance of the responses to the statements by Harvard University President Lawrence Summers about women and science, and highlighted astronomer Vera Rubin's comments on the matter (Frey, 2005).

In conclusion, she emphasized the need to change the education of the people who will carry on the research of the future. Their education needs to take into account a world that is moving towards international networking, multidisciplinary collaboration, study of complexity, and integration of perspectives in science and technology (Colwell, 2005). To explore the seemingly endless frontiers of science and engineering we need the participation of men and women, Colwell asserted, adding that women's perspectives in science and engineering need to be welcomed more warmly than in the past.3

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3For the full text of the speech, see Colwell, 2005.
Panel Presentation and Discussion: STEM Panel of Corporate, Foundation, and Academic Leaders

Thom Harry Litwin, Co-chair of the conference and Director of the Smith College Science Center, moderated this panel and introduced participants Margaret Ashida, Liane Pedersen-Gallegos, Marianne Hudson, and Elizabeth Ivey.

Developing the Diverse Talent Needed to Drive Innovation and Growth

Ashida’s presentation was rooted in her experience leading worldwide university relations for IBM. Ashida stated that the company’s foremost priority now is to establish the collaborations needed to develop the diverse talent base crucial to drive innovation and growth. Across the world, mutual value is created through partnerships among government, industry, and academia.

Industry trends such as network ubiquity, open standards, and new business designs directly correlate with IBM’s talent needs: its employees must be diverse, global, adaptive, collaborative, and expert in more than one discipline. Ashida emphasized that a discussion about talent cannot be separated from a discussion of diversity, since diversity itself has many dimensions, and diversity of thought is key to innovation and growth. After giving a historical overview of the inclusion of women in IBM’s corporate activities since the 1930s, she stressed the parallels between the diversity initiatives established at IBM in the last decade and meetings such as the 1995 NSF Conference on Women and Science and this AWIS National Conference for Women in the STEM Disciplines.

Ashida enumerated the main issues that women encounter in the workplace, but placed special emphasis on the opting out and being opted out situations, which ultimately lead to the marginalization of women. She then proceeded to point out certain correlations between success in the corporate world and the personal lives of women, where fewer women are married and more are childless.
than men at the same achievement level. Ashida summarized the Harvard Business Review article “What's holding women back?” (Wellington, Brumit Kropf, and Gerckovich, 2003) based on a survey of 120 CEOs (mostly male) and 705 female executives conducted by Catalyst (Catalyst Inc., 2005). Lack of general management experience, exclusion from informal networks, unawareness of organizational politics, failure of leaders to assume responsibility, lack of role models and mentoring, assumption of a bigger share of family responsibilities, and the persistence of stereotypes are among the main reasons why women do not advance in their careers at the same rate as men.

IBM has established a comprehensive portfolio of programs to develop talent at various levels in the pipeline. There is an internal Women in Technology (WIT) website, a newsletter, and a biannual leadership conference. Employees have access to mentors and can select from an extensive menu of flexible work options. MentorNet, WIT Campus liaison programs, and other targeted recruiting events such as Project View also help IBM find diverse talent needed to drive innovation and growth. The company is also involved in K-12 level activities, in which WIT Chapters do outreach to local schools. IBM also organizes Exploring Interests in Technology and Engineering camps for middle school girls (IBM, 2005), and underwrites MentorPlace, an IBM program through which these girls can stay in touch with women in technical careers at IBM during the school year (IBM and EdReach, Inc., 2003-2005).

Ashida noted that all these programs share a set of key elements: institutional leadership together with grassroots support, an underlying rationale for these policies and programs grounded in research, the need for collaboration across the whole ecosystem (employees, business partners, suppliers, and even clients), the need to measure results and have accountability, and the fundamental need to reach back and pull through as an effective way to influence women's careers.

Research Associates Career Paths: By Choice or by Necessity?

Pedersen-Gallegos brought to the panel the insight gained from research carried out under an NSF ADVANCE institutional transformation grant awarded to the University of Colorado (Leadership Education for Advancement and Promotion, 2001-2005). As part of this grant, Pedersen-Gallegos and her team conducted in-depth interviews with 35 female and 15 male PhD research associates (including some postdoctoral researchers) in 22 different scientific disciplines to analyze their career paths at that institution. The goal of this study was to identify the factors that contribute to prevent the entrance to or increase the departure of doctoral degree-holding women from the tenure-track pipeline.

The career aspirations of these professionals include the desire for a balanced life, altruistic elements, and a preference to do science rather than develop an administrative career. Pedersen-Gallegos reported on issues that block the tenure-track option, such as the two-body problem (i.e., both members of a professional couple wish to develop academic careers), the need to stay in a given area for personal reasons, and in some cases, a lack of confidence to apply for a tenure-track position. In addition, the University of Colorado has policies restricting the hiring of their own graduates and postdocs. Some of the interviewees mentioned that because there are too few tenure-track positions for all graduating PhDs, they had to adjust their aspirations accordingly.
Other research associates interviewed spoke about rejecting the tenure-track career option because they thought that applying for tenure was "gambling their careers," and mentioned the unpleasant aspects of the job, such as lack of balance in their lives, the two-body problem, and lack of autonomy that they would suffer in their own work.

Among the benefits of the research associate position, the interviewees noted, are flexibility, the opportunity to lead a more balanced life, the freedom to do interesting work less influenced by the system, and the opportunity to contribute meaningfully to larger projects. The costs associated with these positions, however, are considerable: ill-defined status, threatened intellectual property rights, reduced influence in the department, the stresses of grant writing, poor pay and benefits, no upward mobility, and lack of resources to do the work well.

Some research associates recognize the existence of alternatives, including tenure-track positions, but others wonder when the window of opportunity closes for such possibilities. Entrepreneurial options and positions in industry also occur to others.

The definition of career success for these professionals has many facets. Among the top characteristics of a successful career they mentioned are a sense of accomplishment, altruism, job security, cooperation with colleagues, and publishing. As challenges to their careers they described gender discrimination, shortage of jobs, problems associated with dependency on soft money, and their own marginalized status. They saw as positive career influences one's own abilities, support from others, inspirational advice and mentoring, and quality education.

In closing, Pedersen-Gallegos asked whether the research associate option is keeping good professionals from entering tenure-track careers, and whether it would be feasible to revisit life balance and teaching/research issues in tenure-track positions. She also suggested studying the effects of regularizing research associate positions, as well as weighing the benefits and drawbacks of limiting the eligibility of a faculty member's own graduates as tenure-track candidates, a policy that disproportionately affects women and minorities. Lastly, she suggested considering whether career pathways should open between research associate and tenure-track positions.

**Entrepreneurship: A Career Option for Women in Science**

Hudson put before the audience the Ewing Marion Kauffman Foundation's entrepreneurship perspective and its link to women's education and talent development.

After a short overview of the history and mission of the Kauffman Foundation, Hudson presented the organization's entrepreneurship agenda and stated that advancement of entrepreneurial success is based on the building and development of three main elements:

- Awareness of the benefits of entrepreneurship to society by people of all ages.
- Capacity, through the education of the next generation of entrepreneurs, the closure of the performance gap for women and minorities and the focus on science and engineering innovations.
- Infrastructure, through the encouragement of a supportive policy environment, provision of access to capital, and facilitation of the movement of innovation from the universities to the marketplace.
The trends in business are changing, Hudson said, citing increases in women-owned U.S. businesses from 5% in 1970 to 30% in 2003. Today, women-owned firms account for 40% of all start-up companies, and the rate of increase in women starting new firms is three times that of men. While emphasizing the positive aspects of entrepreneurship for women, such as autonomy in the development and implementation of ideas, greater time flexibility, and increased economic power at all levels, Hudson underlined the persistence of barriers to success. The key challenges for female business owners relate to knowledge, skills, and recognition as contributors; access to networks, life balance, and entrepreneurship; and infrastructure issues (such as barriers to access to capital, credit, and markets). At present, there are fewer women than men in STEM discipline-based businesses, which are the ones that usually grow larger.

The Kauffman Foundation’s support for women entrepreneurs includes college programs in which female students at George Washington University, Smith College, and the University of California at Berkeley partner with professionals in their local area; Women Business Centers; Springboard enterprises (which enjoy wide coverage by the media); Boston’s Women Entrepreneurs in Science and Technology (WEST); and the Kauffman FastTrac entrepreneurship educational program, which is delivered by 300 partners across the country (Ewing Marion Kauffman Foundation, 2005).

Together with its partner Disney Online, the Kauffman Foundation introduced the “Opportunity City” interactive exhibit at the Epcot Center to raise youth’s entrepreneurship awareness. This initiative is linked to “Hot Shot Business,” an online entrepreneurship simulation game that is very popular among 9-12-year-olds (Ewing Marion Kauffman Foundation and Disney Online, 2002). The Kauffman Foundation has also established educational programs to foster entrepreneurship research and opportunity. Through the Kauffman Campuses Initiative, it has awarded $25 million in competitive grants for course development, outreach, and mentoring activities to eight colleges across the United States. This program also encourages universities to facilitate the movement of technology from their laboratories to the marketplace.

Hudson cited the iRobot company as an example of a successful company co-founded by a female scientist (Helen Greiner). The Kauffman Foundation is considering the establishment of a specific pipeline for women in science in the next group of campuses to be integrated into its existing Kauffman Campuses network. This initiative would include female students, faculty, and members of the community; support graduate studies in the STEM disciplines, and advance entrepreneurship.

NSF ADVANCE Grants as Institutional Change Agents

Ivey presented a brief overview of the NSF ADVANCE program. Concentrating on institutional transformation and the increase of the representation and advancement of women scientists and engineers in academia, ADVANCE awarded its first grants in 2001, with a second round in 2003. This program has supported ground-breaking work at 19 postsecondary institutions. Abstracts of these projects can be found online on the ADVANCE portal (Virginia Polytechnic Institute and State University, 2005), an in-depth resource for detailed program information and updates on the projects supported by the ADVANCE initiative. Conference participants were reminded that the NSF has already issued requests for proposals for its 2005-2006 awards.
Ivey noted that among the initiatives at the institutions that received the 2001 awards is an emphasis on the establishment of committees to gather data on the status of women faculty and monitor progress, the elimination of obstacles, and the identification of ways to support the advancement of women in tenure-track positions in science, mathematics, and engineering, all part of the projects at the Georgia Institute of Technology, New Mexico State University, University of Washington, and the University of Wisconsin-Madison. The University of Colorado’s Leadership Education for Advancement and Promotion program places emphasis on the development of effective leaders and on the retention of women in science and engineering, while initiatives at institutions such as the University of Michigan focus on the improvement of campus climate. Being in the first cadre of ADVANCE grant awardees, these institutions are furthest along on the development and implementation of their projects.

Concluding her brief remarks, Ivey stressed the need for a change in campus culture(s) and encouraged the audience to envision what people can do with good leadership to effect change that better supports women in science, technology, engineering, and mathematics.
Break-out Discussion Sessions: Current Situation at Academic and Corporate Workplaces

Energy was palpable throughout the meeting; the discussions after each presentation were lively; and the participants actively engaged in the question and answer sessions. This dynamism was most noticeable in the eight break-out discussion sessions that took place in the afternoon of the second day of the meeting. Participants grouped themselves into sections focused on academic and corporate workplaces (three groups), academic workplaces (four groups), or corporate workplaces (one group).

Each of the groups was asked to address a workplace-specific set of questions (see boxes). After their deliberations, participants reconvened in a wrap-up session, and representatives of each of the groups shared a summary of their group’s findings and suggestions with the rest of the attendees. A list of Action Items derived from the participants’ contributions can be found below.

Issues Common to Both Workplaces

In the summary of the discussions by the break-out groups, participants consistently cited a number of issues as common to both workplaces and realized that many of the barriers that block women from reaching their full potential are similar and are deeply embedded in both cultures. There is not sufficient communication yet between academia and the corporate world on how to resolve these issues. The discussions are summarized in the following eight recommendations.

1. Make a list of best practices widely available in academic and corporate workplaces, including appropriate examples and advice on implementation. Participants cited the need for readily available resources on best practices in hiring, retention, and promotion of women and minorities. Websites of professional and governmental organizations and initiatives, and scholarly articles provide such information (see BEST, 2002; Catalyst Inc., 2005; Virginia Polytechnic Institute and State University, 2005; Thomas, 2004; and U.S. Government Accountability Office, 2004). Lists of best practices should also appear in unexpected places, such as posters at

<table>
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<th>Questions posed to groups discussing both the academic and corporate workplaces</th>
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<td>1. Are the people in your institution/business who are responsible for recruitment, retention, and promotion aware of best practices? If so, do they use them? If not, should they be made aware? And if so, how?</td>
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<td>2. Are incentives needed, or even a good practice, to ensure that managers/ administrators follow best practices?</td>
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<td>3. How can the current lists of best practices be expanded and promulgated?</td>
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<td>4. Are there policies in place at your workplace that provide for alternative pathways for addressing the issue when a department (or other group) appears to have discriminated against one of their own?</td>
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professional meetings or as links in requests for proposals. Corporations and institutions of higher education could be asked to post their best practices and policies in a central website, along with any tools they use and/or have developed for this purpose.

Some participants stated that the corporate world needs to increase contact with academia to profit from the research in diversity and best practices already performed in these institutions, while others said that academia should learn from companies how to apply best practices. This apparent contradiction may be rooted in the fact that the corporate workplace is not uniform and that while some large companies may well have a lead in the application of best practices in certain aspects of their operations, such as recruitment, other large and small companies lag behind. Other professionals noted that while those practices may have been in place officially, they are not necessarily applied in the workplace.

In academia, many faculty members involved in the hiring process are not familiar with best practices, and it was suggested that information on how to maintain diversity through retention and promotion efforts be included in faculty policy manuals. Participants also noted that not all leaders agree on what constitutes best practices and that academia is not uniform in their awareness or practice of these initiatives.

2. Support the use of best practices through positive reinforcement and set goals at all administrative levels for the hiring, retention, and promotion of women. Hold managers accountable for reaching those goals. The use of creative incentives to encourage administration to implement best practices is advantageous in all workplaces but is absolutely essential in industry, where it could be tied to performance appraisal and compensation. Best practices should be part of every institution’s value statement and incorporated as part of the culture.

Recruitment should be an active pursuit not limited to placing advertisements. Some suggestions include asking professional, minority, and women organizations for nominations, bringing into play person-to-person contacts, and using staff’s own networks to scout for women to hire. Unspoken rules affect promotion in the workplace: for example, many women do not ask for promotion, but most men do. Encouraging people in charge to invite women to apply for promotion might be a solution. Asking mentors to offer advice about dealing with unspoken rules would also be helpful.

3. Rethink the advertisement of positions to improve access to diverse pools of applicants and avoid creating a very narrow job description. Limiting the advertisement of open positions to highly specialized information channels mostly consulted by men effectively reduces the diversity of the pool from which applicants are selected. Advertisements in magazines and newsletters of women’s scientific organizations may help solve this problem.

4. Make participation in diversity and cultural awareness training a mandatory and rewarding experience for all. Workshops to address these issues could be advertised as targeting potential leaders, with participants receiving small honoraria and/or certificates of attendance. These workshops should not be seen as remedial but instead as activities to be rewarded. Nevertheless, there should be some quality control in diversity training programs, and follow-up should be conducted to determine whether action has been taken and progress made as a result of attendance. Participants stated that, in general, academia lags behind industry in the implementation of training to recognize and eliminate unintended discrimination.
5. Foster communication and create formal mentorship opportunities between new hires and senior staff members, especially for members of underrepresented groups. Offer mentorship training to managers at all levels and create a climate in which being mentored is seen positively. While certain large companies such as Bell Labs and Pfizer have long-standing mentoring programs, academia as a whole is just starting to establish formal mentorship channels. These beneficial mentorship activities need to be supported across the board in both types of workplaces, offered to both men and women, and established as a win-win situation for the parties involved. Some participants suggested that mentors can be chosen from inside or outside of the department or division, or even from outside of the employee’s workplace. Some participants stated that women might be (and have been) hesitant to have a mentor because they could be perceived as weaker professionals. In contrast, mentorship relationships among men are usually perceived as ways to carry junior staff further in their careers.

In academia, team teaching by a junior and a more experienced faculty member can also be a mentoring experience. Faculty should invite their graduate students to attend conferences with them to increase their awareness and exposure.

6. Encourage corporations and universities to collect hiring and retention data to help identify problem areas. Most companies work on a goal fulfillment program for diversity hiring, but that agenda is not necessarily enforced when hiring at the local level. Even in cases where hiring of women and minorities occurs, best practices are not necessarily applied after the hiring process is complete, resulting in reduced retention and promotion at the company. In academia, administrators should be encouraged to establish goals for the hiring and retention of women faculty and to collect data on the progress made.

7. Create an environment in which taking advantage of family-friendly policies and work-life balance opportunities does not penalize (and is not perceived as penalizing) the employee. Clearly state in human resources policies regarding family leave, on-site childcare, and other similar family-friendly initiatives, that they are available to all employees, and that their use is encouraged by the institution. Use by a high-ranking male employee can help support a climate of social acceptance for the practice, especially considering that some data indicate that women take advantage of such policies less often than men because of the fear of being perceived as weak. One participant mentioned that male faculty are encouraged to use family leave policies on her campus and that female faculty are discouraged from doing so because they are told that taking family leave harms a female’s chance of promotion and tenure.

8. Establish institutional policies regarding discrimination and inform employees of their rights and the actions they may take should discrimination occur. Explore ways to redress systematic bias. There are legal options in corporations and academia and also Title IX in academia to deal with discrimination. Participants did not see the use of ombudspersons as an effective alternative pathway to address incidents of discrimination within a unit or department, partly because even when ombudspersons are part of the staff, employees do not know that they are available to address these issues. The institution of safe places where the two parties can discuss the incident and perhaps solve a minor violation was suggested as one potential solution. Participants underscored the reality that junior employees can find themselves in a vulnerable position. Ideally, employees should feel that they are working in a supportive environment that does not tolerate inequities in treatment.
Issues Specific to the Academic Workplace

Four of the break-out groups focused on issues in academia. Paramount among the topics discussed were the issues of academic climate and the establishment and enforcement of clear and appropriate hiring policies for both tenure- and nontenure track positions. The processes of hiring, retention, and advancement of women in academia are still fraught with problems, but some institutions of higher education have already stated clear policies in this arena. The contributions of the participants are summarized in the following twelve recommendations.

Questions posed to groups discussing issues in academia

1. What actions and policies can upper level university administrators adopt to successfully promote the use of best practices and to serve the goal of equity through the hiring, retention, and advancement of women?

2. What are the structural barriers to the promotion of women faculty? (e.g. academic climate on campus)

3. Do faculty have a role to play in supporting the advancement of women faculty? If so, what is such a role and how would you encourage faculty to participate?

4. What incentives can be developed and employed to support/encourage administrators and faculty to use best practices?

5. Having learned about some best practices, what can the academic sector learn from the business sector?

1. Define a set of criteria to be used in evaluating policies and practices regarding hiring, retention, and advancement of women, and for describing a favorable climate at academic institutions. Perform the research, analyze the data, and disseminate a list of the 25 best academic institutions for women faculty in science and engineering. Once created, this list would be part of a campaign to distinguish and place in the public’s view the successful efforts of these institutions to hire, retain, and promote women and the positive results it generates for the institution and for the scientific community as a whole.

2. Institute flexible hiring practices such as shared and/or part-time tenured positions and create half-time research positions. Establish clear and appropriate dual-hire policies. Among the actions that academic institutions could take to hire more women, the participants listed assistance to prospective female hires in finding appropriate positions for spouses or life partners, creation of half-time positions more focused on research and less on teaching while raising children, and the institution of maternity/paternity policies. Few institutions have clear policies regarding dual-hires, which proportionally impact more women than men. One exception mentioned during the session was the University of Wisconsin–Madison, where there is official policy regarding faculty hiring, mentoring, and tenure, and the issue of academic climate is openly discussed (Board of Regents of the University of Wisconsin System, 2004).

Some participants mentioned that colleges whose student body was formerly exclusively male but that now accept women may have an institutional memory that slows down necessary changes in academic climate. Another participant noted a disturbing trend: Very good young female assistant and associate professors are not staying in their institutions due to an adverse academic climate.
3. When establishing search committees, include faculty members from departments other than the department that is hiring. Participants stated that the establishment of diverse search committees is a way to achieve the goal of equity in academia. The inclusion of faculty from other departments helps ensure a fresh perspective on the prospective candidate. Also mentioned in the discussions was the need to train search committees on how to read evaluation letters, since reference letters written for women may be less enthusiastic and have a different tone than the ones written for men.

4. Hold chairs accountable for establishing equity in start-up packages for newly hired male and female faculty. Published evidence (such as Massachusetts Institute of Technology, 1999) documents that newly hired women faculty get lower salaries and smaller start-up packages, less advantageous lab space, and higher teaching loads than their male counterparts. Deans should hold chairs accountable and make equity a goal in the chair's annual review.

5. Find resources for departments to hire members of underrepresented groups and reward the faculty members who identify such candidates. Faculty should play an important role in the recruitment of graduate students and junior faculty from underrepresented groups. Department faculty who identify postdoctoral or newly-minted PhDs from these groups for junior faculty positions could be rewarded through a mini-grant program, bonus, or other type of recognition. Department chairs who make efforts to support female and minority junior faculty in their interactions with other members of the department and activities such as grant writing and proposal submission should also be recognized and rewarded.

6. Senior faculty members should play a major role in the advancement of women faculty members. They should act as advocates, where appropriate, and work to set institution-wide standards for the hiring, retention, and promotion of women. Participants energetically stressed the importance of mentoring. Senior faculty members should encourage administrators to set goals for the hiring, retention, and promotion of women, and develop and implement a plan to guide junior faculty on the importance of becoming recognized outside of their institution. Senior faculty can provide junior female members with opportunities to review grants and manuscripts, present platform presentations at national and international meetings, and nominate them for appropriate awards and recognition. The participants also discussed the reduction in the number of women available to serve as mentors and role models. Some women scientists in top administrative positions leave their teaching positions, thus limiting the number of female full professors available to foster younger faculty.
7. **Clarify and communicate the criteria for tenure and non-tenure track promotion policies.** The participants noted that in academia, equal employment opportunity does not apply in tenure and promotion; it only applies to hiring. Moreover, as Pedersen-Gallegos stated in her presentation, there are few promotion opportunities for faculty in non-tenure track positions. Improvement in retention and promotion could be achieved through increased transparency, that is, making clear what is really necessary compared to what faculty manuals may state. Several participants expressed concern that women and minority faculty members have been denied promotion or tenure despite fine credentials because they did not represent a good *departmental fit*, possibly meaning that their research was outside the mainstream direction of the department. They suggested, therefore, that the issue of *departmental fit* be discussed during the hiring process.

8. **Delay the tenure clock for primary caregivers and women on maternity leave and create an environment that does not penalize them for exercising that option.** The inflexibility of the tenure system exerts a higher impact on a woman's career, due to her need to respond to a bigger share of family and child-rearing responsibilities, as Ashida and Pedersen-Gallegos emphasized in their presentations.

9. **Offer child care on campus and make it also available in the evenings.** This option may increase the flexibility with which the faculty member can plan her day, and result in higher productivity. Difficulties in balancing family and career issues disproportionately affect women's careers.

10. **Provide department chairs and deans with professional development to inform their leadership decisions regarding departmental climate and evaluation issues, particularly in reference to hiring, retaining, and promoting women faculty.** Participants recommended focusing on areas such as different communication styles of men and women, life balance issues, and the analysis of their campuses' data on the status of women and minorities in the STEM disciplines. Also stressed was the need to discuss the importance of supporting a diverse environment and the understanding of how underrepresented groups are affected when the climate is adverse. Participants suggested that performance evaluations and/or merit increases of chairs and deans include a measure of their efforts to increase diversity in their departments.

11. **Educate students and faculty of both genders to identify and correct unintentional biases in the evaluation of female job applicants and faculty.** Statistical evidence confirms that both males and females evaluate women *more harshly*. The phenomenon of harsher evaluation of women is not limited to hiring committees. It is also at work when students evaluate female faculty as teachers, when papers are submitted for publication, and when faculty make tenure and promotion decisions.

12. **Provide junior female faculty with opportunities to present their work at other institutions and in important professional meetings, and nominate them for awards and recognition to increase their visibility.** Protect them from overwork on service committees. The importance of exposure for junior female faculty cannot be overstated. The isolation in which some women faculty work is detrimental to them both within and outside their own institutions. Lack of internal visibility commonly results in reduced opportunities for leadership and the lack of a network may mean less access to important information, such as grant opportunities.
Issues Specific to the Corporate Workplace

The break-out session dealing with the corporate workplace took a different approach from other discussion sessions. The participants listed positive and negative issues at their workplaces. The positive issues included sustained change from the top to hire women, a powerful women leadership network within the company, entrepreneurial spirit and creativity, and strong work-life balance policies at all levels. Other participants noted that those same issues, in addition to problems in the retention of women and lack of understanding of and awareness about the benefits of diversity, are still unresolved in their own workplaces. These conflicting perspectives reflect the experiences and observations of the individual participants, and speak to an uneven application of best practices in the workplace. The discussion yielded the following 11 recommendations.

1. **Enunciate the business rationale for corporate diversity and family-friendly policies and facilitate the exchange of information on best practices with companies that are already successful in hiring, retaining, and promoting women scientists and engineers.** These professionals stated that employees suffer because of an imbalance between family life and career, but many are afraid of taking advantage of work-life balance opportunities because they fear that it will be detrimental to their careers. As part of the solution, it was suggested that companies communicate more with each other and share policies that result in the successful hiring and retention of women and minorities. Some participants noted misunderstanding and unawareness of the broader meaning of diversity in the workplace, especially in smaller companies.

2. **Develop open position descriptions and hire on the basis of merit and talent. Hiring only on the basis of diversity is not an effective policy.** Another suggestion of this discussion group was that, in order to attract diverse talent, companies advertise open position descriptions more widely and in places such as the AWIS Magazine. Some suggested that companies hire well-qualified people from underrepresented groups, and then create the jobs for them. Participants did not recommend the hiring of a diverse workforce only for diversity's sake or because the prospective employee fits a profile; merit and talent should be the primary criteria for hiring.
3. Evaluate the application of company-wide goal fulfillment programs for diversity and female hiring, which are not usually applied at the local level. Provide a reward/incentive program for those who perform well. The various levels of management should be accountable for hiring their own diverse workforce and a system of rewards/penalties should be put in place for this purpose. Incentives could include promotion, advancement, and public recognition of company-wide progress.

4. Make promotion criteria as objective and clear as possible. Work actively from the top management down to eliminate those activities that isolate female employees. Women who feel isolated may become disenchanted and leave the company. Members of the existing male network decide the parameters for promotion, according to some participants, and are successful in helping junior men become part of the network, and get the introductions they need to get established and promoted within the company. “Men get promoted on the basis of potential, women get promoted on the basis of proven talent,” one of the participants said, noting the frequent application of a double standard on the criteria for promotion. Retention of women and other minorities is difficult per se, a problem that is compounded by the confusing application of promotion criteria. Clarification of these parameters and the establishment of women’s networks can help female employees advance in their careers in the corporate workplace.

5. Collect employees’ suggestions and opinions through yearly anonymous surveys. Participants believed that such instruments could candidly point out existing problems to management and generate suggestions for change.

6. Develop, promulgate, and use tools that help employees and managers have fair relationships. Companies should find ways to eliminate social obstacles in order to facilitate interactions critical to communication such as employee-supervisor relationships. Structural barriers, including social avoidance of people belonging to other cultures, races, or gender, should be eliminated from the workplace. Corporations should improve contact with the academic sector to learn tools and strategies for dealing with male-female supervisor-employee relationships and to gain knowledge about academic research on diversity.

7. Offer support for career-broadening activities to all employees and ensure that women have knowledge of and access to such opportunities. New employees should take the initiative in seeking those opportunities, which should be implemented and widely publicized by the company. For example, Ashida mentioned that IBM has a tuition reimbursement program for employees seeking an advanced degree if it will be advantageous in the employee’s current or future job. If the corporation does not have established training programs, it should seek out professional organizations that can share their training programs and other activities. Women in smaller companies should network with women in other small programs and perhaps establish a regional program. Companies should facilitate collaboration among entry-level hires and middle- and upper-level management. Networking at conferences and tapping into professional associations were also encouraged.

8. When high female attrition rates are observed in the workplace, companies should perform a structural analysis of the causes and follow up on the career of the women that leave the company. As one of the participants said, “Change too often occurs as a result of talented women leaving the company — only then does management pay attention.” The loss of mid-career women was also highlighted as a problem.
There is a need for talent that is diverse, global, adaptive, collaborative, and expert in more than one discipline.

9. Increase representation of women at higher levels in the company, especially in the technical fields. Poor representation of women at higher levels in the company, especially at the technical level, is commonplace. Some senior women managers (who tend not to be in technical tracks) appear to be caught in a bind: while on one hand they are insufficiently supported by management, on the other they do not make the time to mentor, thus making poor role models for other women in the company. The representation of senior women in technical fields who have been and will continue to be good role models should be increased.

10. Continue to communicate to academia the need for a diverse workforce. Industry already foresees problems regarding its need for a diverse workforce to fulfill its business goals. There is a need for talent that is diverse, global, adaptive, collaborative, and expert in more than one discipline. As Ashida stated, discussion about talent cannot be separated from discussion about diversity, since diversity of thought is key to innovation and growth. Industry needs to clearly communicate this need to academia. The comments by the participants echo Jackson and Colwell’s comments on the crucial importance of outreach to undergraduate institutions so they can contribute to the generation of a diverse talent pool for the future.

11. Formalize outreach to K-12 students and institutions and be active citizens in the community. Some companies are acutely aware of the need to reach out to groups presently underrepresented in the technical fields, and they are making efforts to train and recruit individuals from such groups. One effective way is through the establishment of science and technology camps such as the IBM camps mentioned by Ashida and the Smith Summer Science and Engineering Program for high school girls offered at Smith College, where students are introduced to the world of science and technology and have the opportunity to see that both women and men can be successful scientists.
ACTION ITEMS

The implementation of the initiatives listed below will help create a climate in which women and underrepresented groups can realize their full potential. The Association for Women in Science will spearhead some of these initiatives and will work closely with other organizations with similar missions to implement other actions. AWIS encourages individuals and institutions to step forward and also take a leadership role in the advancement of women and underrepresented groups in the STEM disciplines.

BEST PRACTICES IN ACADEMIA AND CORPORATIONS

- Make a list of best practices widely available in academic and corporate workplaces, including appropriate examples and advice on implementation.
- Ask corporations and institutions of higher education to post their best practices and policies in a central website.
- Develop, promulgate, and use tools that help employees and managers have fair relationships.
- Encourage corporations to increase contact with academic institutions that are recognized for their research and application of best practices.
- Ensure that the practices officially in place are actually applied in the workplace.
- Support the use of best practices through positive reinforcement and set goals at all administration levels for the hiring, retention, and promotion of women.
- Enunciate the organization’s rationale for diversity and family-friendly policies.
- Increase understanding and awareness of the meaning of diversity in the workplace, especially in smaller companies, and facilitate the exchange of information on best practices with companies already successful in hiring, retaining, and promoting women scientists and engineers.
- Offer workshops addressing diversity and cultural awareness issues to employees.
- Exercise quality control in diversity training programs, and conduct follow-up to determine whether action has been taken and progress made as a result of these programs.
- Establish institutional policies regarding discrimination and inform employees of their rights and actions they may take should discrimination occur.
- Explore ways to redress systematic bias.
- Reinforce the role and visibility of ombudspersons.
HIRING PROCESS

- Ask professional, minority, and women's organizations for nominations for open positions and use direct person-to-person contacts and networks to scout for qualified women to hire.
- Rethink the advertisement of positions to improve access to diverse pools of applicants and avoid creating a very narrow job description. Broaden the advertisement of open positions to include advertisement in magazines, listservs, and newsletters of women's scientific organizations.

Academia:

- Provide department chairs and deans with professional development to inform their leadership decisions regarding departmental climate and evaluation issues, particularly when hiring, retaining, and promoting women faculty.
- Include diversity goals as part of chairs' and deans' position descriptions and in performance evaluations and/or merit increases.
- Encourage administrators to establish goals for the hiring and retention of women faculty and collect data on the progress made.
- Institute flexible hiring practices in academia such as shared and/or part-time tenured positions and create half-time research positions.
- Establish clear and appropriate dual-hire policies.
- Establish diverse search committees and train search committees on how to read evaluation letters written for women. Include faculty members from departments other than the one hiring to ensure a fresh perspective on the candidate.
- Discuss the issue of departmental fit during the hiring process.
- Hold chairs accountable for establishing equity in start-up packages for newly hired male and female faculty.

Corporations:

- Develop open position descriptions and hire on the basis of merit and talent.
- Establish and enforce goal fulfillment in diversity hiring both company-wide and at the local level.
- Make all levels of management accountable for hiring a diverse workforce.
- Reward increases in women and diversity hiring with incentives such as promotion, advancement, and public recognition of company-wide progress.
RETENTION AND PROMOTION

- Encourage corporations and universities to collect hiring and retention data to help identify problem areas.
- Foster communication and create formal mentorship opportunities between new hires and senior staff members, especially for members of underrepresented groups.
- Offer mentorship training to managers at all levels and create a climate in which being mentored is viewed positively.
- Offer support for career-broadening activities to all employees and ensure that women have knowledge of and access to such opportunities.
- Create an environment where taking advantage of family-friendly policies and work-life balance opportunities does not penalize (and is not perceived as penalizing) the employee.
- Eliminate structural barriers, including social avoidance of people belonging to other culture, race, or gender, from the workplace.

Academia:

- Clarify and communicate the criteria for tenure and nontenure track promotion policies.
- Senior faculty should act as advocates, where appropriate, and work to set institution-wide standards for the hiring, retention, and promotion of women.
- Senior faculty should develop and implement a plan to guide junior faculty on how to increase their visibility and become recognized outside of their institution. This could entail providing them with opportunities to review grants and manuscripts and give platform presentations at national and international meetings, and nominating them for appropriate awards and recognition.
- Educate students and faculty of both genders to identify and correct unintentional biases in the evaluation of female job applicants and faculty.
- Protect junior female faculty from overwork on service committees.
- Establish mechanisms for mentorship from both inside and outside of the academic department.
- Delay the tenure clock for primary caregivers and women on maternity leave and create an environment that does not penalize them for exercising that option.
- Offer child care on campus and make it also available in the evenings.

Corporations:

- Prevent new hire attrition by continuing to apply best practices after the hiring process is complete.
- Work actively from the top management down to eliminate those activities which isolate the women in their midst.
- Clarify promotion criteria and establish women’s networks to help female employees advance in their careers.
• Collect employees’ suggestions and opinions through yearly anonymous surveys.
• Perform a structural analysis of the causes when high attrition rates for women are observed in the workplace.
• Increase representation of women at higher levels in the company, especially in technical fields.
• Continue to communicate to academia the need for a diverse workforce.
• Formalize outreach to K-12 students and institutions and be active citizens of the community.

DEVELOPMENT OF THE ROLE OF WOMEN AND MINORITY PROFESSIONAL ORGANIZATIONS

• Improve visibility of professional organizations that represent women and minorities in science so recruiters can use them to access those applicant pools.
  – Set up a clearinghouse of women/minority in science organizations.
  – Improve connections between organizations with shared goals.
• Define a set of criteria to be used in evaluating policies and practices regarding hiring, retention, and advancement of women, and for describing a favorable climate at academic institutions. Perform the research, analyze the data, and disseminate a list of the 25 best academic institutions for women faculty in science and engineering.
CONCLUSIONS

This conference provided scientists and other professionals interested in the status of women in STEM disciplines with a forum in which they could discuss the progress in this field and define the work needed to improve the standing and representation of women both in the academic and the corporate worlds.

According to the presenters and participants of this meeting, some progress has been made on the seven recommendations issued as a result of the 1995 NSF Conference “Women & Science: Celebrating Achievements, Charting Challenges,” but there is still more to be done.

Among the success stories are BEST, whose activities have already resulted in the commitment of specific organizations to increase their outreach to educational institutions, and the NSF ADVANCE program, which is paving the way for increased hiring, retention, and promotion of female faculty in U.S. academic institutions. Companies such as IBM have explored the issue of diversity in detail and instituted sweeping changes that are resulting in an improved work environment for a more diverse workforce, better use of available talent, and, even, higher profits.

There is more awareness of the value of diversity in the workplace as a whole, but barriers to advancement still remain. Many are related to the persistence of stereotypes, the insufficiency of role models and mentors, and a workplace climate that contributes to the isolation and marginalization of female staff members. Leadership ineffective in the creation of a fair environment for the employees was also a factor. Inequalities and lack of flexibility in the hiring and promotion of women faculty for tenure and nontenure track positions are still some of the main reasons for women’s under-representation in academia.

Not enough progress has been made in the strengthening of connections among organizations that have a stake in the participation of women in STEM disciplines. Several participants mentioned there is not enough research data on best practices in hiring, retention, and promotion of women and diversity, and that, at a practical level, there is not enough sharing of existing data among institutions in the corporate and the academic worlds.

Jackson and Colwell, among others, presented and discussed current data on the status of women in science and engineering that confirms that, despite the progress made in certain arenas, there is still no parity. The large increase in the number of women with graduate degrees in the sciences and engineering is not yet mirrored in the number of female academic faculty. In a broader context, the speakers noted that in spite of the increase in the percentage of women with undergraduate and graduate degrees, women currently comprise less than 25% of all the science and engineering labor force, and below 10% of the faculty in those disciplines.

Women and girls are more likely to study and advance in the STEM disciplines as a result of increased communication and formalization of mentoring relationships, which have a positive effect on women’s careers at all levels. Outreach activities by academic institutions and corporations to K-16 education levels are successful in keeping young women in the science pipeline. Family-friendly policies at the workplace help both men and women. The comprehensive list of
The contributions of women to the scientific enterprise are crucial to the creation and development of the next innovations in science and technology upon which the growth of the nation depends.

action items synthesized from the contributions of the participants of the break-out groups could well serve as a set of guidelines for action (at all levels) for corporations and for academia.

Tapping all of our science and technology talent is critical to the future of the United States. The flow of talented international scientists and students into the country is slowing because of the effect of globalization and of science and technology policy changes in the United States and abroad. This situation, combined with a declining enrollment of American students in mathematics, engineering, and physical sciences, and the beginning of baby boom scientists’ retirement wave, may soon result in the lack of the critical mass of brainpower needed for science and technology development in the United States and the consequent loss of international competitiveness.

Concerted action through creative, innovative development and application of best practices at all points along the pipeline will effect change in the number and standing of women in the STEM disciplines. The contributions of women to the scientific enterprise are crucial to the creation and development of the next innovations in science and technology upon which the growth of the nation depends.
REFERENCES


APPENDIX

CONFERENCE PROGRAM

AWIS National Conference for Women in Science, Technology, Engineering, and Mathematics (STEM) Disciplines
23-24 June 2005, Smith College, Northampton, Massachusetts

June 23, 2005

Introductory Remarks

Carol T. Christ, PhD, President, Smith College
Elizabeth S. Ivey, PhD, President, AWIS, and Provost Emerita, University of Hartford

Keynote Speaker Presentation: “Women and Science: The Talent Imperative”
Shirley A. Jackson, PhD, President, Rensselaer Polytechnic Institute and 2004-2005 President of the American Association for the Advancement of Science

June 24, 2005

Plenary Speaker Presentation: “How Do We Achieve Systemic Institutional Change?”
Rita R. Colwell, PhD, Distinguished Professor, University of Maryland, and Johns Hopkins University Bloomberg School of Public Health, and former director of the National Science Foundation

Panel Presentation and Discussion:
STEM Panel of Corporate, Foundation, and Academic Leaders

Thomas Litwin, PhD, Director, Smith College Science Center, Moderator

Participants:
Margaret E. Ashida, MBA, Director, University Talent Programs, International Business Machines Corporation. “Developing the Diverse Talent Needed to Drive Innovation and Growth”

Liane Pedersen-Gallegos, PhD, Director of Ethnography and Evaluation Research, University of Colorado. “Research Associates Career Paths”

Marianne Hudson, MA, Director, Entrepreneurship, Ewing Marion Kauffman Foundation. “Entrepreneurship: A Career Option for Women in Science”

Elizabeth S. Ivey, PhD, President, AWIS, and Provost Emerita, University of Hartford. “NSF ADVANCE Grants as Institutional Change Agents”
Break-out Discussion Sessions:
Current Situation at Academic and Corporate Workplaces

Academic and Corporate Workplaces

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Academic Workplaces

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Corporate Workplaces

Discussion Facilitator: Donna Dean, PhD, Lewis-Burke Associates, LLC. Discussion Recorder: Darby Dyar, PhD, Mount Holyoke College.

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