NCWIT Scorecard 2007

A Report on the Status of Women in Information Technology

national center for women & INFORMATION TECHNOLOGY™

What is NCWIT?

The National Center for Women & Information Technology (NCWIT) is a growing coalition of more than 100 respected corporations, academic institutions, government agencies, and non-profits working aggressively to increase women's participation in information technology (IT).

We believe that women's lack of participation in information technology is a phenomenon with deep implications for our country's preparedness, competitiveness, economic well-being, and quality of life. At a time when information technology pervades our work, education, health, entertainment, and safety, and when the U.S. Department of Labor is predicting that more than one million IT jobs will be added to our workforce by 2014, women can and must participate in innovating and advancing IT. Women are a valuable, untapped resource whose under-representation can only be measured in jobs not filled, technology not created, and problems not solved.

NCWIT's goal is professional IT workforce parity, and our work connects efforts along the entire pipeline from K-12 and higher education through industry and academic careers. To find out more about NCWIT, please visit www.ncwit.org.

What is the Scorecard?

The NCWIT Scorecard is a metrics-based report that informs the public on the status and progress of girls and women in information technology. The Scorecard will serve as a critical tool in our collective efforts to increase the visibility of women's participation in information technology; to track long-term, national progress; and to educate all concerned stakeholders – including employers, legislators, teachers, and parents. The Scorecard is a free, nationally distributed report that will be published annually.

This report – our inaugural Scorecard – establishes a baseline for girls' and women's status in information technology fields and will serve as a benchmark for progress. In compiling this report we looked rigorously and critically at numerous sources of data and information. Most of the metrics included in the Scorecard are drawn from esteemed third parties, and we present them in a manner we believe will be useful and interesting.

For your convenience in locating important information within the Scorecard, we've started with early education (K-12) and moved through post-secondary education and into the workforce. In addition to metrics that quantitatively gauge women's participation, the Scorecard includes case studies and trends that provide a more qualitative picture and highlight important issues, obstacles, and achievements.

There are several metrics we would have liked to include in this report – for example, more data on K-12 girls, or the percent of female IT patent-holders, or the number of women in mid-level technical positions within industry – had we been able to find accurate and current information for them. Currently we are working to develop the sources for many of these metrics and hope to include them in future reports.

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Introduction

Information technology is changing the world. Unlike anything since the printing press, IT is revolutionizing the way we work, communicate, learn, entertain, and protect ourselves.

The continued under-representation of women in a field as critical and pervasive as IT is having costly consequences.

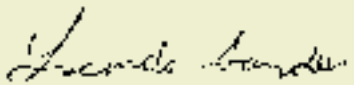
As you will see inside this report, the statistics are alarming:

- *Girls comprise fewer than 15 percent of all AP computer science exam-takers – the lowest representation of any AP discipline.*
- *Between 1983 and 2006, the share of computer science bachelor's degrees awarded to women dropped from 36 to 21 percent.*
- *Women hold more than half of professional positions overall, but fewer than 22 percent of software engineering positions.*
- *Within the top Fortune 500 IT companies, fewer than five percent of Chief Technical Officers are women.*

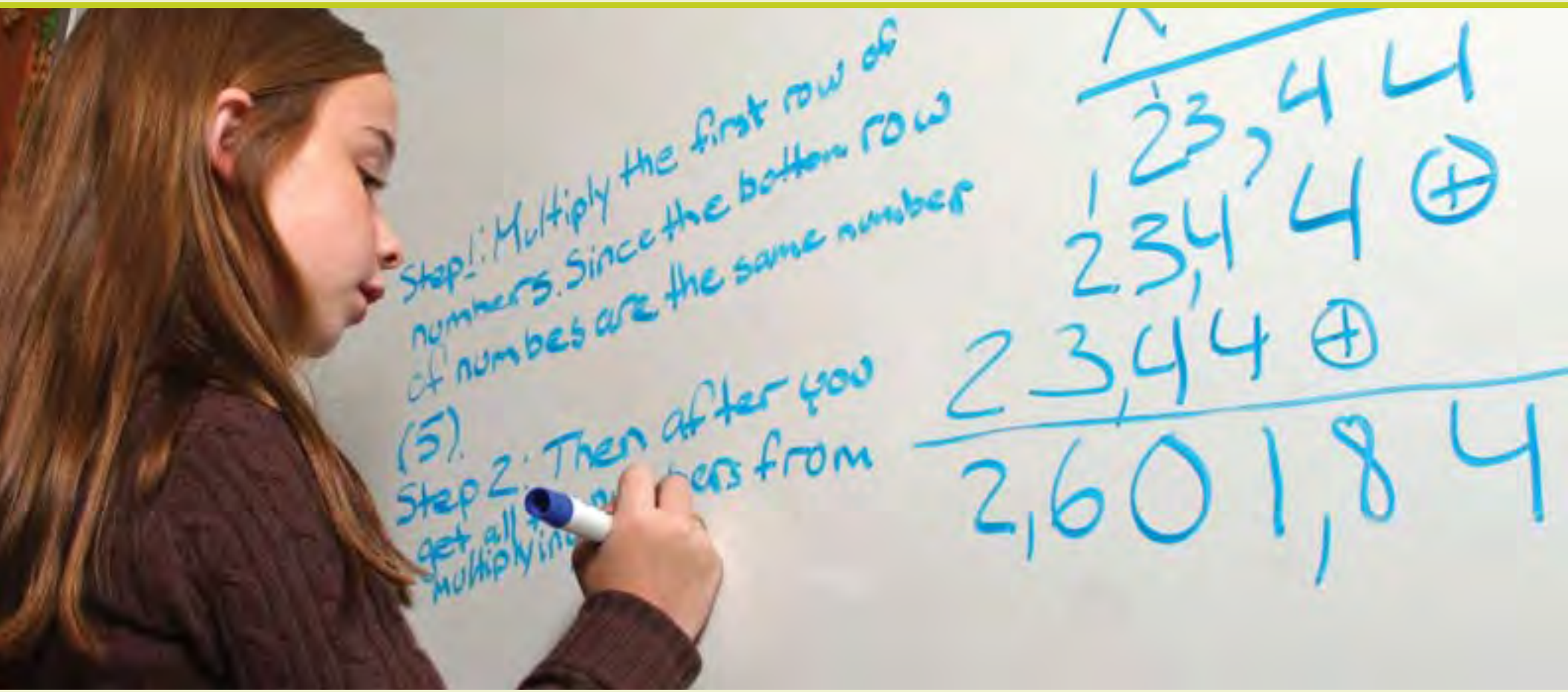
The technical design process is a creative one, and hence it benefits greatly from the diversity of thought that comes when men and women are both at the design table. Because so few women are inventing the technology upon which our society increasingly depends, we have no idea the types of problems they would solve or products they would conceive. From a workforce perspective, women's lack of participation in the IT workforce is leaving the computing professions with a shrinking pool of qualified professionals.

We' ve created the NCWIT Scorecard not just as a barometer for women's participation in IT, but as an educational resource, a national conversation piece, and the impetus for you to create fundamental change within your own space.

We are extremely grateful to Microsoft, Inc. for its generous support of the Scorecard and for its commitment to a future technology workforce that is innovative, competitive, and diverse.



Lucinda Sanders, CEO



K-12 Education

A Talent Source at Risk

Girls represented 56 percent of all Advanced Placement (AP) exam-takers in 2006. Yet girls comprised fewer than 15[1] percent of all AP computer science exam-takers – the lowest representation of any AP discipline.[2]

Recent data from the Higher Education Research Institute (HERI) show that the number of American high school students considering the study of computer science has declined 70 percent over the last five years.[3]

Unfortunately, this decline is especially steep for women. Among female college-bound high-school seniors taking the SAT in 2006, only one percent – fewer than 5,000 students – indicated computer and information sciences as an intended major. This is a nearly 50 percent decline from 1996, when women comprised one-quarter of all students intending to major in computer and information sciences.[4]

AP Exam-takers: 2006 Results

	Percent Female	Percent Change from Previous Year	
French Language	71	7	
Studio Art, Drawing	69	2	
Art History	67	7	
Spanish Literature	66	4	
English Literature/Composition	64	8	
Psychology	64	16	
Spanish Language	64	3	
English Language/Compostition	63	11	
Biology	58	9	
Environmental Science	56	17	
World History	56	31	
Human Geography	55	49	
U.S. History	55	9	
European History	54	7	
Government & Politics, U.S.	53	11	
Statistics	50	15	
German Language	49	11	
Calculus AB	48	6	
Chemistry	47	11	
Macro Economics	45	9	
Music Theory	44	19	
Micro Economics	42	2	
Calculus BC	40	8	
Physics B	35	9	
Computer Science A	18	5	
Computer Science AB	10	-3	

[1] *Weighted average of Computer Science A and Computer Science AB exams.*
[2] *College Board, 2006.*
[3] *2005 CIRP Freshman Survey, Higher Education Research Institute.*
[4] *2006 College Bound Seniors, College Board.*

K-12 Math | *Building the Foundation for Success*

A look at course study among SAT exam-takers reveals that girls are as or more likely than boys to take math and computer literacy courses in high school, but still are less likely to study computer math and computer programming, the building blocks for college-level study in computing.[5]

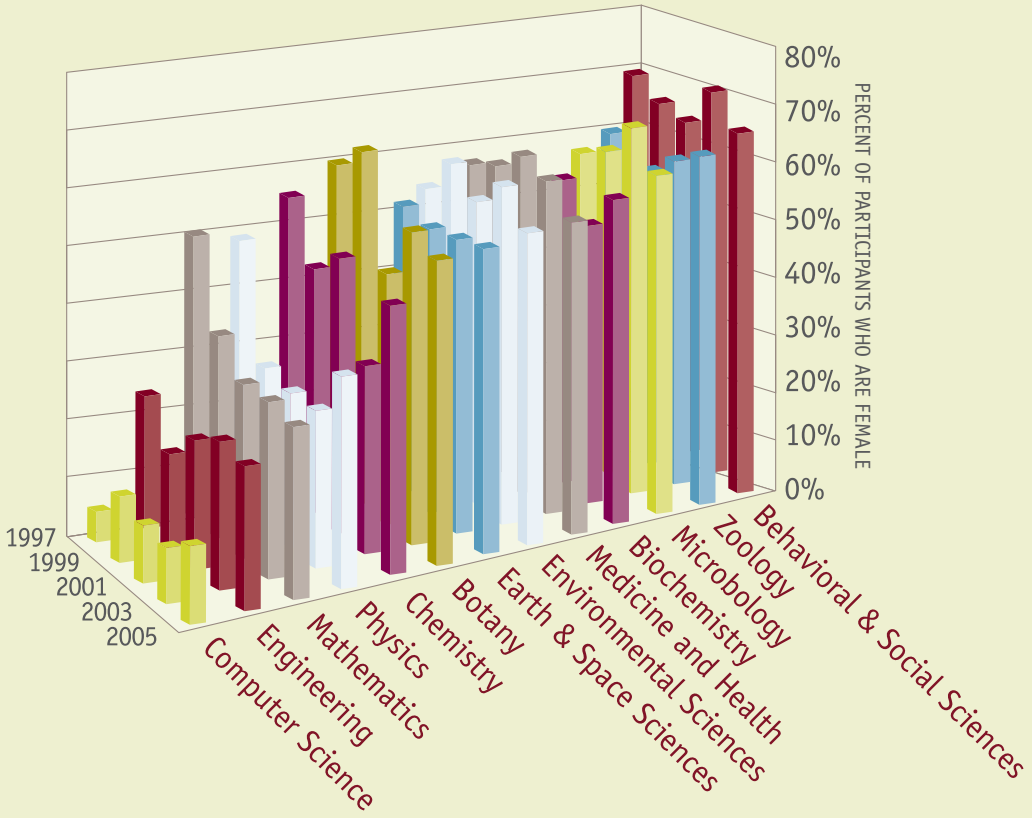
Why don't more young women take an interest in computer science? Perhaps due to a lack of awareness, combined with misconceptions about the field. In one study of high school calculus students,[6] only two percent could accurately describe what a computer science major studies. And several studies have shown that more female than male students worry that a computing degree will not allow them to work with people. Even women with very high mathematics ability may be more likely than men to believe computer science is too difficult.[7]

Coursework of SAT Exam-takers by Gender

Mathematics	Percent	
Years of Study	Male	Female
More than 4 Years	49	51
4 Years	46	54
3 Years	42	58
2 Years	47	53
1 Year	50	50
1/2 Year or Less	52	48
No Response		
Course Work		
Algebra	45	55
Geometry	45	55
Trigonometry	47	53
Precalculus	47	53
Other Math Courses	44	56
Calculus	50	50
Computer Math	60	40
Honors Course Taken	46	54
Computer Course Work or Experience		
Computer Literacy	45	55
Computer Programming	60	40
Word Processing	44	56
Internet Activity	45	55
Using Computer Graphics	51	49
Creating Spreadsheets/Databases	47	53
None	39	61

[5] *College Board, 2006.*
[6] Carter, L. (2006). Why students with an apparent aptitude for computer science don't choose to major in computer science. *ACM SIGCSE Bulletin, 38*(1), pp. 27-31.
[7] Weinberger, C. J. (2004). Just ask! Why surveyed women did not pursue IT courses or careers. *IEEE Technology and Society Magazine 23*(2), pp. 28-35.

ISEF Female Participation: 1997-2005



Intel Science and Engineering Fair
Female Participation

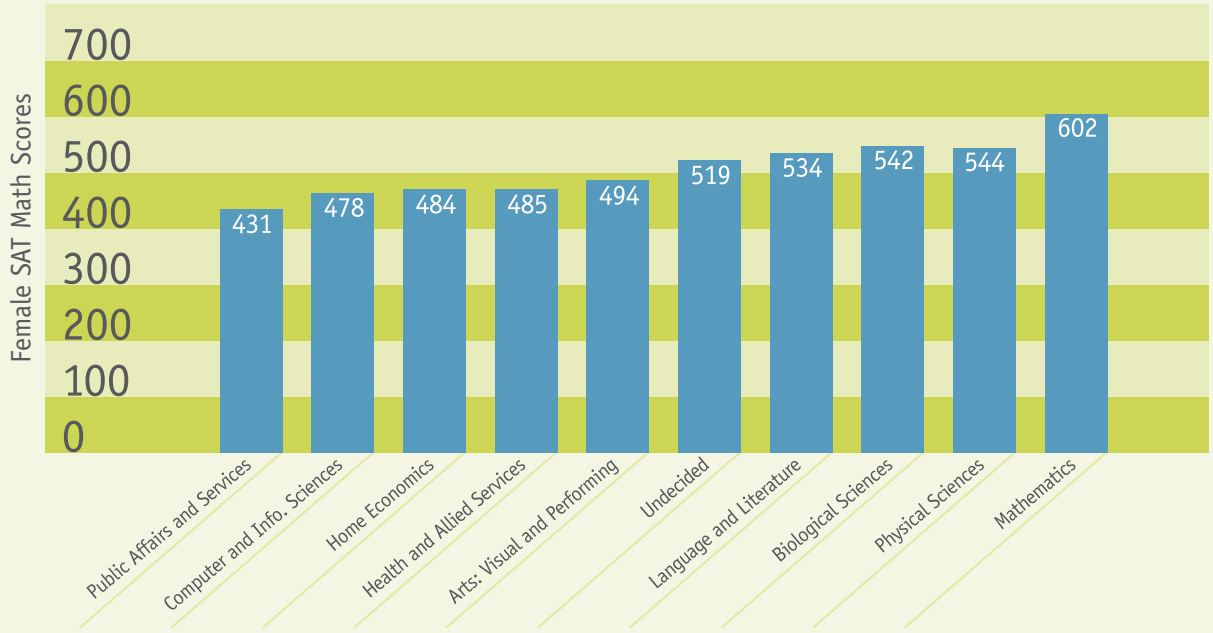
The Intel Science and Engineering Fair (ISEF) is the world's largest pre-college science competition, featuring nearly 1,500 students from over 47 countries competing for over $4 million in awards and scholarships.

A look at results from the ISEF between 1997 and 2005 reveals that while girls are nearing parity in other science, technology, engineering, and math (STEM) competition areas, in computer science their participation remains among the lowest.

An Untapped Student Talent Pool

Although it is widely assumed that the study of computer science requires strong quantitative abilities, recent data from the College Board's SAT test indicate a surprising disparity between math aptitude and a female student's choice of computing and information sciences as her prospective major. This disparity highlights an overlooked opportunity to attract skilled students to the field and to encourage those with developing career interests to explore their talents in computing-related fields.

Female SAT Math Scores and Intended Major, 2006



Case Study | *The Role of Encouragement*

Why Encouragement Matters

Anyone who has participated in sports or physical training knows the positive effects of encouragement. Research in sports medicine has measured the substantial improvements in effort and persistence that result from frequent exhortations like, "Great job!" and "Keep going!" Whether it works through positive reinforcement or instructions, this type of communication motivates people to work at a task harder and longer, so it can be a powerful tool in an overall effort to bring gender balance to computing. In workforce settings, career encouragement promotes women's training and development, which is linked with managerial advancement. In academic settings, where women in computer science set higher standards for themselves than men do, encouragement from faculty members helps retain women in undergraduate computer science at the same rates as their male classmates. In addition to retention, women's participation could even increase through encouragement, because women are more likely than men to say they entered the field as a result of encouragement from a teacher, family member, or friend.

Encouragement increases self-efficacy (belief in one's ability to successfully perform a task). Because we are more likely to engage in tasks that we believe we can perform successfully, encouragement may be especially useful in male-stereotyped fields such as computing, which is marked by men's over confidence and women's under-confidence. Encouragement is essential to retention when women express doubts about whether they belong in computing. At this point, the instructor/supervisor response can make the difference between women's persistence and departure.

How to Provide Encouragement

Everyone knows how to encourage others. It involves expressing positive, supportive, motivational sentiments. Written encouragement is particularly needed after a disappointment or setback. It is particularly motivational after successful completion of a task. It's fundamental that communicating encouragement should be *personal*. It need not be private; however, public encouragement may be particularly effective.

Encouragement from parents or teachers plays a large role in students' choice of a CS major." (N. Zarrett, O. Malanchuk, P. E. Davis-Kean, and J. Eccles; "Examining the Gender Gap in IT by Race: Young Adults' Decisions to Pursue an IT Career," in Women and Information Technology: Research on Underrepresentation, *J. M. Cohoon and W. Aspray, Eds. Cambridge: MIT Press, 2006.; Tillberg, Heather K. and Cohoon, J. McGrath. "Attracting Women to the CS Major." Frontiers: A journal of Women Studies. Special Gender and IT Issue. (26.1, 2005) pp. 126-140.)*

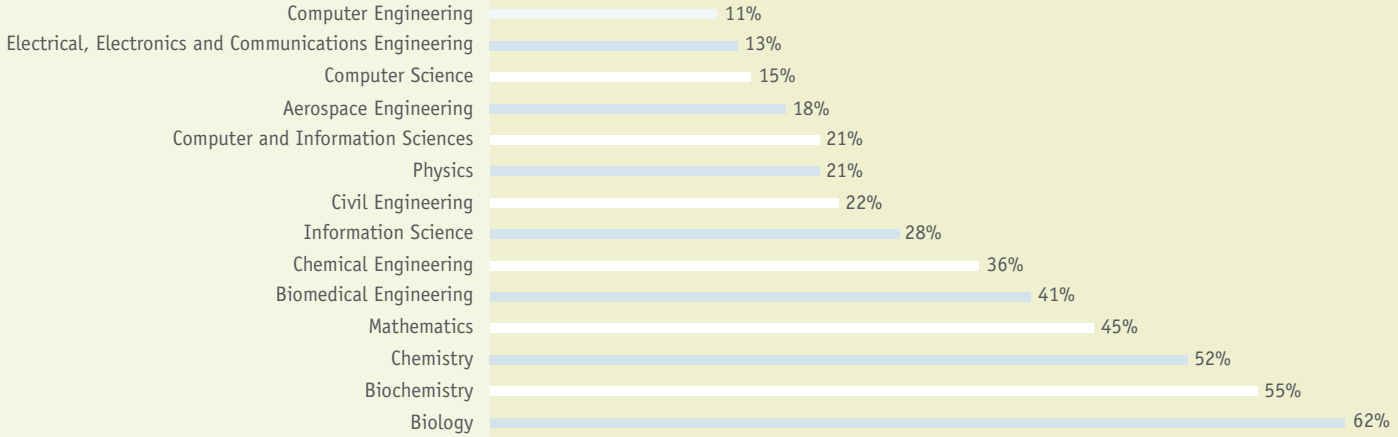
Post-secondary Education

Preparing the Future Workforce

Women earned nearly 60 percent of all undergraduate degrees at American colleges and universities in 2006, and yet in computing and information sciences they earned only 21 percent of bachelor's degrees. There are few STEM disciplines in which women are more poorly represented.

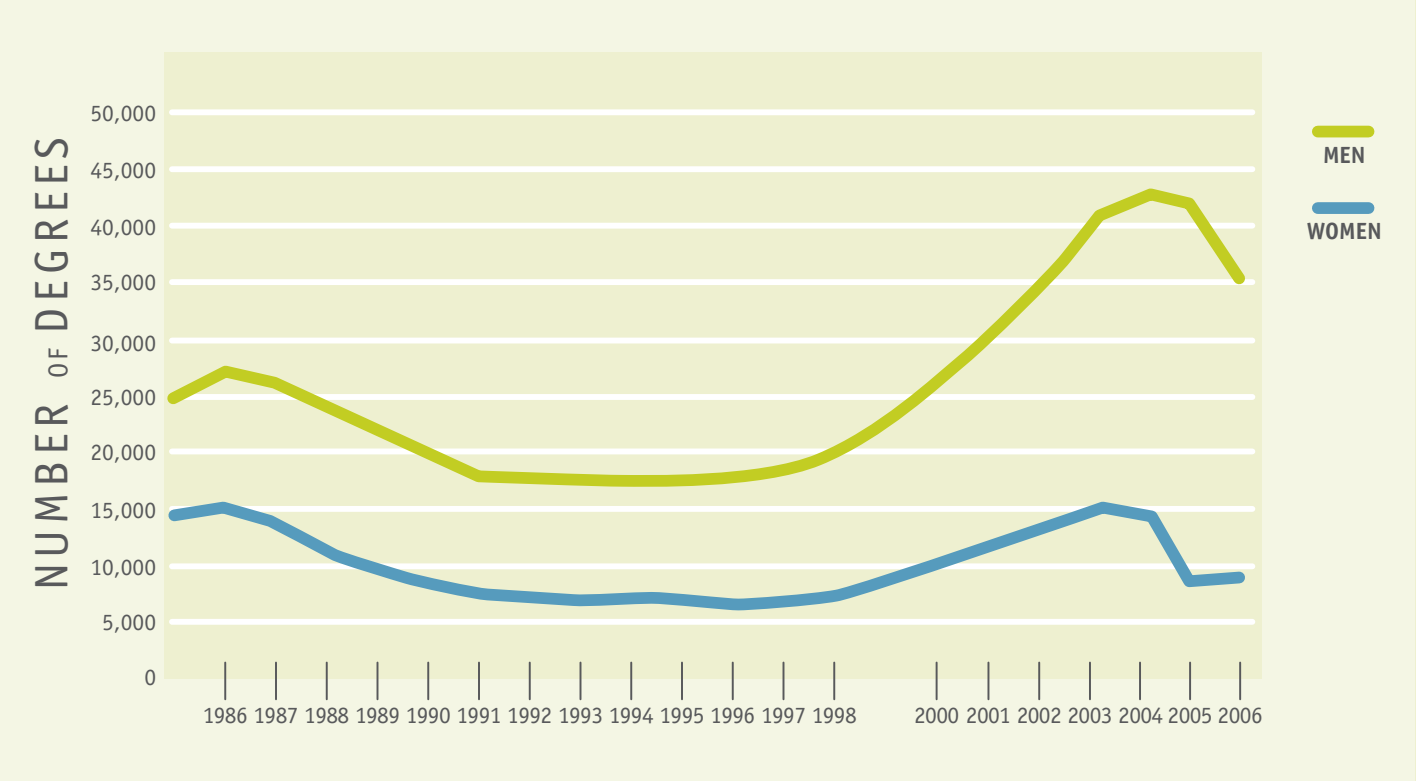
In fact, a comparison of degree data from various scientific fields reveals that women now obtain a majority of the degrees in biological disciplines and are near parity in mathematics.

Percent of Bachelor's Degrees Obtained by Women in Selected STEM Fields, 2005-2006[8]



[8] *U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System.*

Bachelor's Degrees in Computer Science, by Gender: a Longitudinal Look



The National Center for Education Statistics has tracked the number of bachelor's degrees awarded in computer science since the 1960s. Their data show that in computer science, the core discipline that prepares students for information technology creation, women's representation remains lower even than in computer and information sciences, which comprises a broader set of disciplines. In computer science, the number of bachelor degrees awarded to women between 1985 and 2004 dropped from 37 percent to 25 percent. In fact, the number of these degrees awarded to women was nearly the same in 2004 as it was in 1985.[9]

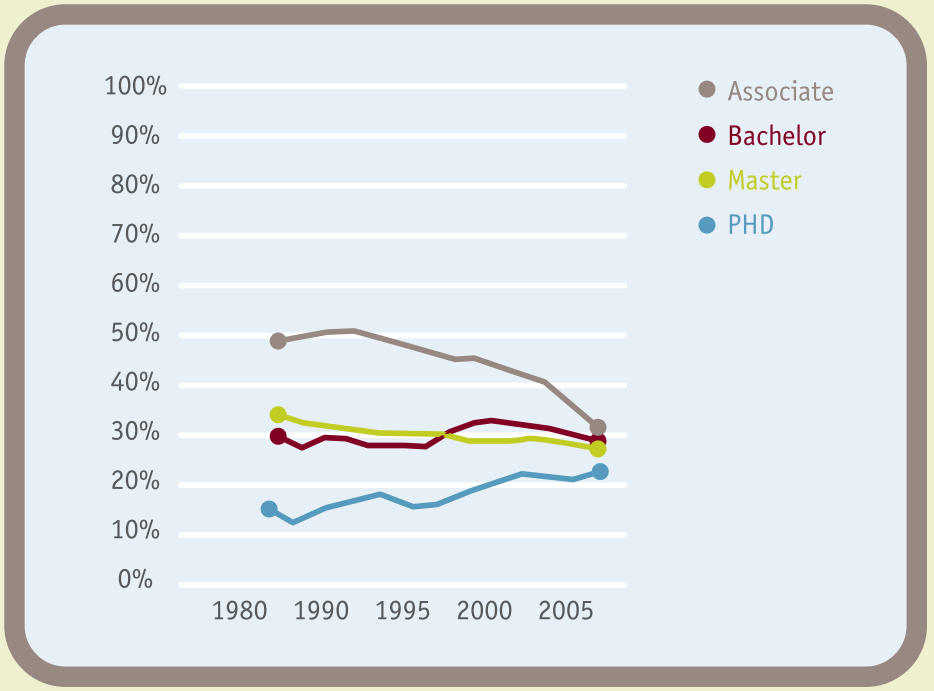
Meanwhile, women's share of computer science bachelor's degrees granted by PhD-granting institutions, which award approximately 30 percent of all U.S. bachelor's degrees in computer science and which tend to be major research institutions, has held steady at less than 20 percent.[10]

[9] *National Science Foundation, Division of Science Resources Statistics,* Women, Minorities, and Persons with Disabilities in Science and Engineering: 2007 *(no national data are available for 1999).*
[10] *Computing Research Association, 2005-2006 Taulbee Survey.*

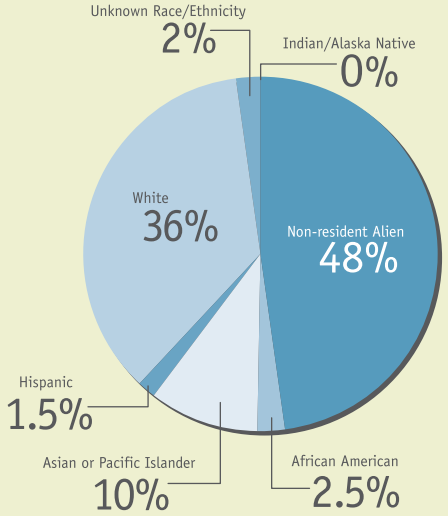
Women's share of master's and PhD degrees in computer and information sciences (CIS)[11] has grown since 1985, but so has the percentage of these degrees earned by women who are not U.S. citizens. Female non-resident aliens earned 48 percent of all CIS doctoral degrees in 2004.

Associate's degrees are earned mostly through two-year programs at community colleges. Over the last few decades the number of students obtaining associate's degrees in CIS rose from fewer than 10,000 in 1983 to more than 23,000 in 2002. In 1985 women earned 50 percent of associate's degrees in CIS; in 2004 this number had dropped to 33 percent, although the number of women earning associate's degrees in CIS doubled in that time period.

Percent of CIS Degrees Earned by Women



Female CIS Doctoral Degrees by Race/Citizenship, 2004



[11] *All data on this page are from the U.S. Department of Education National Center for Education Statistics. The Classification of Instructional Programs (CIP) codes describe the majority of post-secondary instructional programs reported to the U.S. Department of Education National Center for Education Statistics. The Scorecard uses the 2-digit CIP code (11: Computer and Information Sciences) for two reasons. First, while the more fine-tuned six-digit codes have been available since 2000, many institutions still report into the two-digit umbrella category (11) rather than the category that is more specific to their degree programs. Second, the kinds of degree programs that tend to have a higher proportion of women are relatively small and do little to raise the mean of the total. Computer science alone, however, depresses the mean.*

Case Study | *Compelling Education and Introductory Courses*

The content of computing curriculum, especially introductory courses, is believed to contribute to the under-representation of women in IT. Research suggests that women are more interested in using computing as a tool for accomplishing a goal than they are in the workings of the machine. Data from a five-university study showed that women's average representation was lower in computer science than it was in management information systems, informatics, instructional systems technology, and information science/studies, though it was still below parity in these fields. Similarly, reports suggest that women's participation in computing might increase when media applications are used for teaching fundamental concepts.[12] According to Margolis and Fisher in their 2002 book, *Unlocking the Clubhouse: Women in Computing*, introductory courses at Carnegie Mellon University that were tailored to different experience levels resulted in higher satisfaction for both more and less experienced students and for both male and female students.

The challenge to educators is to develop engaging assignments and curricula that appeal to a variety of students with different learning styles, interests, socio-cultural backgrounds, and abilities while maintaining the rigor of the discipline. Putting the concepts of computing in appealing contexts and building on existing competence can reduce the barriers of entry and level the playing field for those with limited experience.

The Media Computation approach to teaching introductory computing developed at Georgia Tech is being effectively implemented now at over a dozen institutions. The two-course sequence aims to make computing more attractive to a wider range of students, especially women, by focusing on computing in an interesting context that is relevant to students' everyday lives.

Like traditional introductory courses, the two-course sequence introduces computing concepts and data structures, but in a context of creating and manipulating media. Multi-year evaluation results of the Media Computation approach have been encouraging: retention has improved dramatically, and the introductory course is about 300 students per semester and has a 51 percent female population.

[12] *For more information about research on women's underrepresentation in computing, see "A Critical Review of the Research on Women's Participation in Postsecondary Computing Education." J. McGrath Cohoon and W. Aspray (Eds.) Women and Information Technology: Research on the Reasons for Under-Representation. Cambridge, MA: MIT Press, 2006*

Trend | *Life Doesn't Happen in Pipelines*

The school that awarded the most undergraduate information technology and computer science degrees in 2001 was also the school that awarded more of these degrees to women than any other. This institution is not a prestigious research university or a large public university, but Strayer University, a for-profit institution with multiple campuses in the Washington, D.C. area.

What does this tell us about women and IT? Perhaps, that institutions catering to non-traditional students are particularly good at attracting women and minorities into information technology. (Nontraditional students are defined as those who delay enrollment to college at least a few years after graduating high school; attend college part-time; require more than six years to earn their degree; work full-time during their college tenure; or have families and dependents to support.)

Unfortunately, it may also remind us of the extent to which women and minorities are being left out of information technology innovation. "If women and minorities... are overwhelmingly choosing for-profit institutions for their IT/CS education, their ability to participate in research and development of new IT/CS applications may be cut short... these students, the IT/CS field, the IT workforce, and the nation as a whole will likely miss out on the creative talent these students could bring to the IT/CS enterprise."[13]

[13] *"The Poverty of the Pipeline Metaphor: The AAAS/CPST Study of Nontraditional Pathways into IT/CS Education and the Workforce," Jolene K. Jesse; Aspray, William and Joanne M. Cohoon, eds: Women and Information Technology – Research on Underrepresentation, chapt. 8.*

Women in the Workforce

Untapped Talent

Women are an increasingly dominant power in the American marketplace: they influence or control more than 83 percent of all consumer purchases, including 66 percent of all home computers. In 2003 women spent approximately $55 billion on consumer electronics products, outpacing men. Among gamers over the age of 40, women spent more time gaming online in 2004 than men.[14]

Despite their consumption of IT, however, women are underrepresented in its creation. As a result, many of the same IT products and services women consume are conceived and designed mostly without women's input. Women currently hold 56 percent of professional positions in the U.S. workforce. U.S. Department of Labor statistics predict that women will account for more than half the increase in total labor force growth between 2004 and 2014, and that three of the ten fastest-growing occupations between 2004 and 2014 are computing-related.[15] Yet women hold only 27 percent of professional computing-related positions.

Female Participation in IT-related Occupations

Occupation	Women as a percent of total employed in 2005
Professional and related occupations	56.3
Computer and mathematical occupations	27.0
Computer scientists and system analysts	30.3
Computer programing	26.0
Computer software engineers	21.9
Computer support specialists	33.2
Database administrators	32.6
Network and computer systems administrators	18.5
Network systems and data communications analysts	24.5
Operations research analysts	50.0
Computer hardware engineers	11.1

Numbers in the thousands

Department of Labor Bureau of Labor Statistics, 2005.

[14] *Wow! Quick Facts, 2005.*
[15] *Occupational Outlook Handbook, Department of Labor Bureau of Labor Statistics, 2004-2005*

Racial Diversity of Women in the IT Workforce

29%
Percent of Computer Scientists in 2004 who were female.

4%
Percent of Computer Scientists who were female and African American.

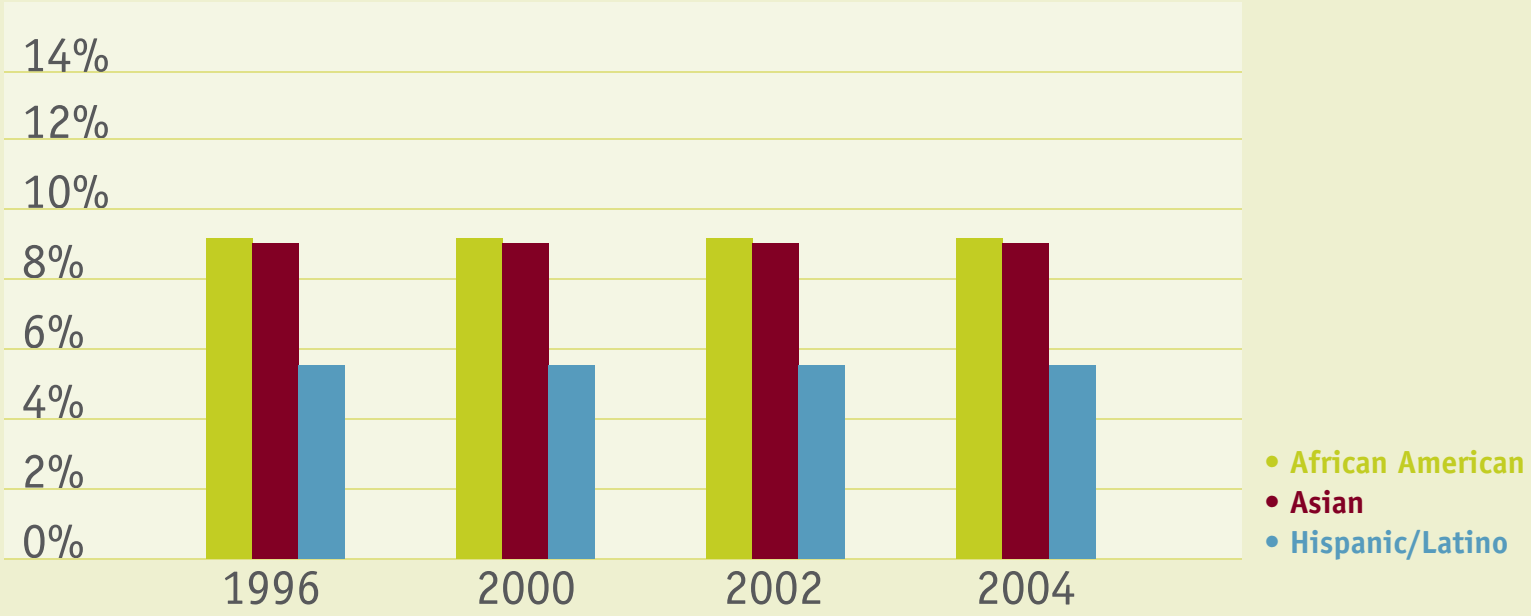
2%
Percent of Computer Scientists who were female and Asian.

1%
Percent of Computer Scientists who were female and Hispanic.

The number of African American, Asian, and Hispanic women in IT careers is disproportionately low, even considering their presence in the U.S. population and workforce in general.

Some trends worth noting, however include the fact that nearly 40 percent of African American computer scientists are female; and underrepresented groups can be found training for their occupations in higher proportions at community colleges and technical schools.

Racial Diversity in the IT Workforce, 1996-2004 (both genders)

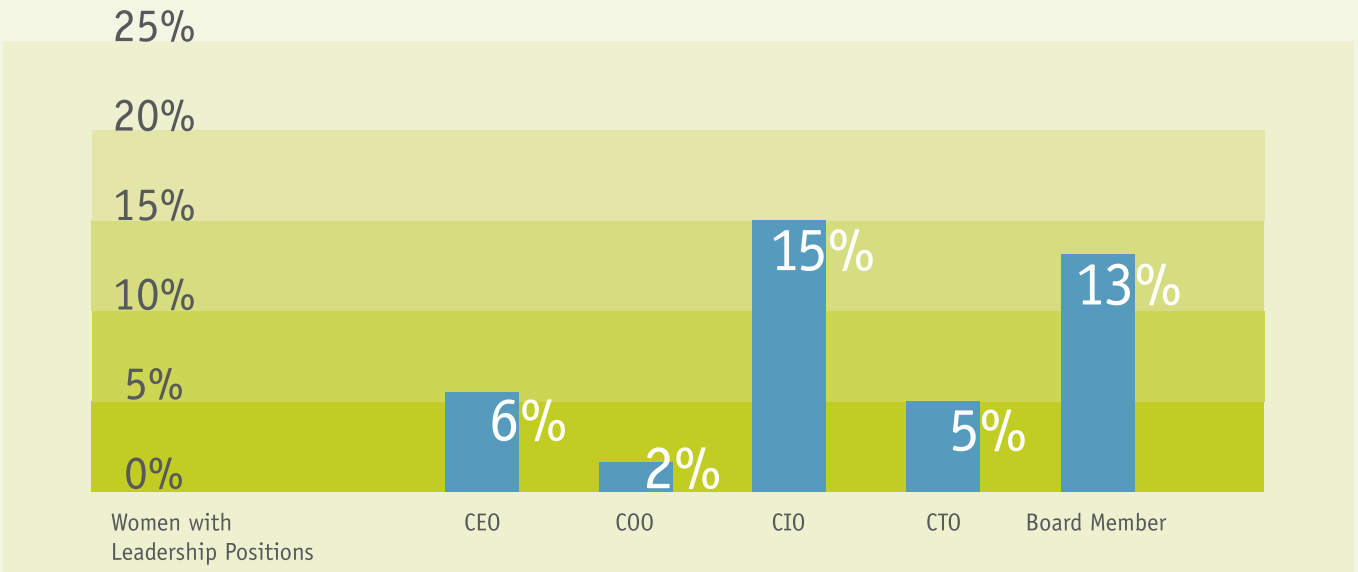


Commission on Professionals in Science and Technology, 2006.

Women in IT Executive Leadership Positions

Women's participation in computer-related occupations is low overall, and it decreases as women climb the corporate ladder. Women in leadership positions within IT are a scarce commodity, comprising 15 percent or fewer of board members and executive officers at the top 100 Fortune 500 IT companies.*

Top Fortune 500 IT Companies: Female Leadership



*Based on survey of top 100 Fortune 500 companies classified by Hoover's as IT-related companies.

Female Percentage of Computer Science Faculty

	Newly Hired, Tenure-Track	Current Faculty- Professorships		
		Assistant	Associate	Full
1994/95	17%	18%	9%	5%
1995/96	18%	20%	10%	5%
1996/97	15%	19%	10%	6%
1997/98	17%	20%	10%	6%
1998/99	13%	16%	12%	8%
1999/00	13%	16%	12%	8%
2000/01	12%	14%	13%	8%
2001/02	15%	14%	14%	8%
2002/03	17%	15%	13%	8%
2003/04	18%	16%	12%	9%
2004/05	18%	16%	12%	10%

CRA Taulbee Survey, 2006

Women in professional academic positions fare just as poorly. As women make their way up the ladder in educational leadership roles, their ranks thin.

Case Study | *How Organizations Can Develop Women Leaders*

How effectively an organization develops its women as leaders depends on the climate of the organization and how being a woman fits with the styles and behaviors subordinates expect from leaders in that climate.

The least congenial climate for women's leadership development is characterized by rigid hierarchy and vertical communication through the chain-of-command, by emphasis on leaders' power and resources, and by singular attention to task performance. In these climates, women leaders can be seduced into adopting leadership strategies associated with power, dominance, and masculinity — such as aggressiveness, being autocratic and directive, and promoting one's self. For women, these strategies often bring unintended negative consequences because they violate others' expectations or stereotypes of how women should behave, and they can bias performance appraisals.

The most congenial climates are those that develop in less hierarchical structures, with open lines of communication; emphasize empowerment over power; and value outcomes beyond task performance. In these contexts, the kinds of leadership styles and behaviors shown to be effective include being an inspirational role model by building on followers' trust and confidence, stressing team building and collaboration, valuing creativity and innovation, and serving as a mentor who actively seeks to empower followers.

In a controlled experiment, researchers established a climate that was purposively inhospitable to women's leadership. They formed groups of 4-6 men, gave each group a task to do together that was highly masculine-stereotyped, and appointed a solo woman to lead them. Then they simply let the group do the task and scored the group's performance as the baseline measure of task performance.

In two other experiments, the researchers enacted the same conditions but brought the woman leader into the lab in advance of the group. She completed the task alone, was given the answers, and then was re-tested, scoring higher after training. Half these women went on to lead groups unaware of her training, and they fared no better than the baseline experiment. The other half also led groups, but the groups were told beforehand that the woman had been trained and knew a lot about the task. These groups outscored the baseline.

Study Conclusion:

Skill is not enough to make a woman an effective leader in challenging contexts. Having the organization validate her credentials makes her input credible and effective. To level the playing field for women leaders, women need to have rewards to distribute and to be regarded by their subordinates as legitimate. Organizations can facilitate both of these outcomes by empowering women leaders with resources and by publicly recognizing their qualifications and skills. Additionally, organizations should foster a climate that values change and innovation, that rewards performance as well as social cooperation and social complexity, and that encourages the sharing of power and information. Across all climates, paying attention to the proportions of women in upper and lower echelons of the organization can serve as a marker of the organization's success in promoting women's leadership.

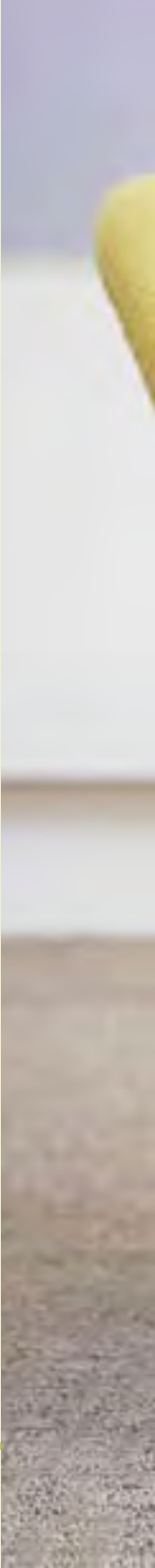
Yoder, J.D., Schleicher, T.L., & McDonald, T.W. (1998). Empowering token women leaders: The importance of organizationally legitimated credibility. Psychology of Women Quarterly, 22, 209-222.

Trend | *Offshoring, the Future of IT, and the Implications for Women*

Offshoring of software work to countries offering large numbers of trained IT people and low wages is likely to grow for some years.

Even so, IT is a good career choice in the United States. There continues to be tremendous growth potential for the application of information technology to many domains of business and government. This growth potential is demonstrated by the fact that there are now more IT jobs in the United States than there were at the height of the dot-com boom; and the fact that the U.S. government forecasts that some IT jobs will be the fastest-growing over the coming decade.

There are a number of things that people wanting to pursue a career in IT should do to prepare themselves for a fulfilling, life-long career. These include having a strong foundational knowledge of computing that includes familiarity with large applications, knowledge of the principal platforms, and tools used in the offshoring of software work; good communication, teamwork, and leadership skills; familiarity with application domains (particularly ones where it is likely there is great potential for IT providing strong value over the coming years, such as health care, construction, or defense); familiarity with foreign languages and cultures so that they can operate effectively in a global environment; and an expectation for the need to engage in life-long learning in a field that is rapidly changing.[16]



[16] *Aspray, William. Adapted from "Globalization and Offshoring of Software: A Report of the ACM Job Migration Task Force," by William Aspray, Frank Mayadas, Moshe Y. Vardi, Editors, 2006.*

Conclusion | *The Road to Progress*

We live in an age of innovation, communication, and globalization. One U.S. senator has asserted that creating information technology without the input of women is akin to having "one hand tied behind our backs." In an age such as ours, we cannot afford to be so handicapped.

It is our hope that the Scorecard encourages an awareness of women's participation in IT, and in so doing, contributes to women's increasing participation. As we continue to publish the Scorecard and benchmark women's progress in IT, we look forward to finding successes, defining needed improvements, and highlighting the possible causes and consequences along the way.

We welcome your input and feedback. Please contact us at **info@ncwit.org**.

We are grateful to Microsoft for its support in this inaugural NCWIT Scorecard.

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