Information Technology Business Advocacy Roundtable

The Woodrow Wilson Center
Washington, D.C.

June 19, 2008

Information technology (IT) underpins nearly all of the United States' critical economic sectors, from energy, finance, and medicine to entertainment, manufacturing, and retail. As a result, our IT infrastructure is growing so rapidly that government projections forecast IT will outpace nearly every industry in job growth over the next decade.[1]

The computing education pipeline that feeds the IT workforce in the United States, however, is showing stresses: lack of support for K-12 technology curricula and declining post-secondary enrollments may yield insufficient IT talent to meet demand. Further, gender equity in computing also has declined, compounding the potential talent shortage. If the United States wants to remain an economic leader in the twenty-first-century global economy, it must strengthen and diversify its IT workforce and the education pipeline that supports it.

On June 19, 2008, the Information Technology Business Advocacy Roundtable brought together over 50 representatives from government, business, and advocacy groups to discuss the serious challenges confronting the U.S. IT workforce. The roundtable assembled members of both the public and private sectors to advance ideas for developing a sustainable IT workforce in America – such as improving K-12 STEM education by focusing on computer science, and forming public-private partnerships crucial to IT innovation and competitiveness.
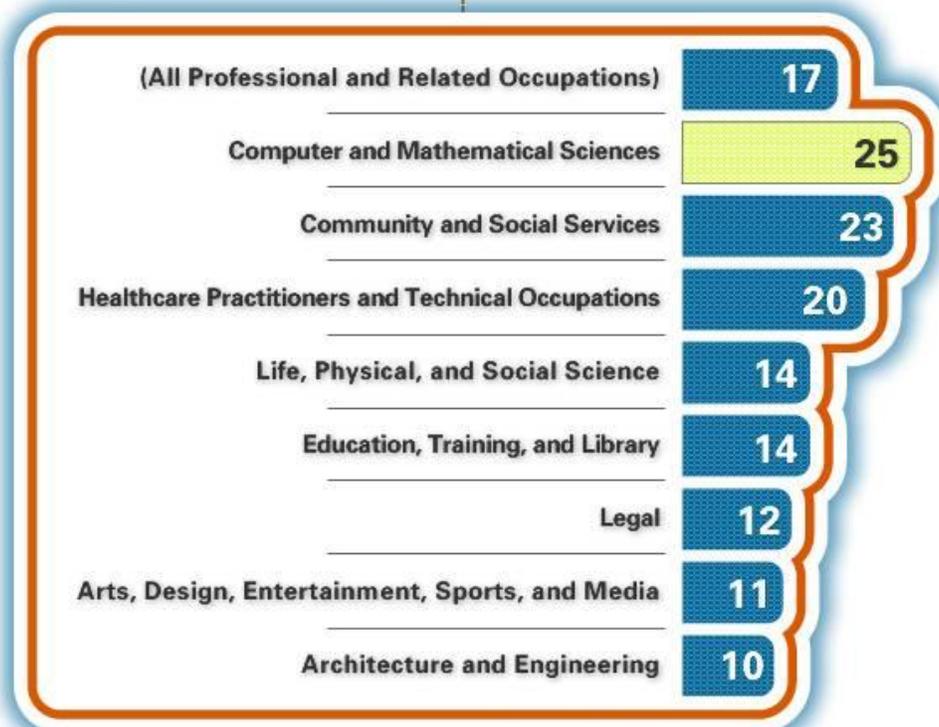
Leading the discussion were Lucy Sanders, CEO and Co-Founder of National Center of Women & Information Technology (NCWIT); Peter Harsha, Director of Government Affairs of the Computing Research Association (CRA); and Cameron Wilson, Director of Public Policy at the Association for Computing Machinery (ACM). Kent Hughes, Director of Science, Technology, America, and the Global Economy at The Woodrow Wilson Center in Washington, D.C., hosted and moderated the event. Corporations participating through their government affairs, diversity,

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[1] *"Occupational employment projections to 2016," Department of Labor Monthly Labor Review, November 2007.*

and philanthropy offices included Microsoft, Avaya, Cisco, IBM, Avon, Intel, Texas Instruments, Bechtel, Halliburton, Symantec, and others. Also present were members of the U.S. Navy and the U.S. Postal Service. Trade associations, think-tanks, and not-for-profits included the Alliance for Science and Technology Research in America (ASTRA), Information Technology and Innovation Foundation (ITIF), Society of Women Engineers (SWE), and the Anita Borg Institute for Women and Technology (ABI).

Moderator and host Kent Hughes opened the discussion by reminding the audience of the strong tie between education and innovation. Lucy Sanders' subsequent presentation starkly demonstrated that America's IT workforce supply does not meet expected demand, today or for the future.
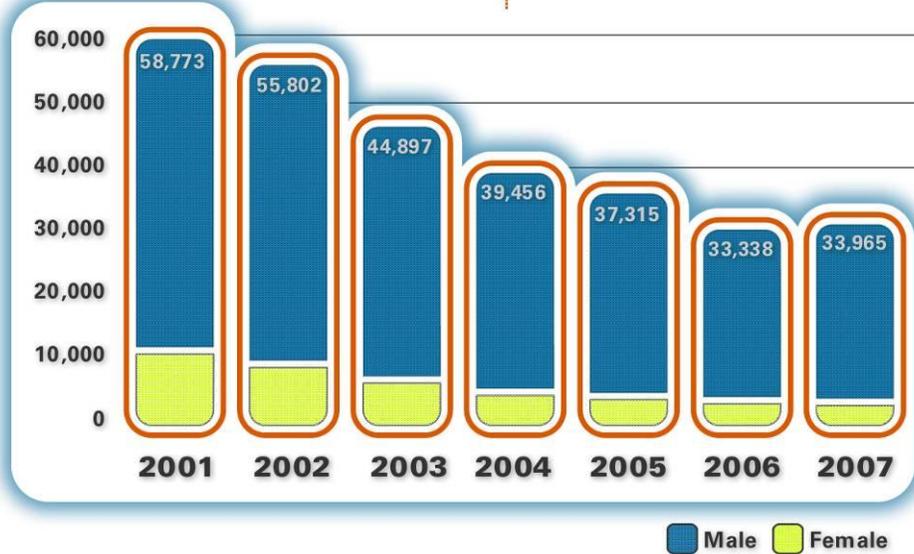

Eight Fastest-Growing Occupational Groups by Projected Percent Change, 2006-2016

(All Professional and Related Occupations)	17
Computer and Mathematical Sciences	25
Community and Social Services	23
Healthcare Practitioners and Technical Occupations	20
Life, Physical, and Social Science	14
Education, Training, and Library	14
Legal	12
Arts, Design, Entertainment, Sports, and Media	11
Architecture and Engineering	10

Source: Bureau of Labor Statistics, Monthly Labor Review, November 2007

She displayed projections for growing demand for IT professionals coupled with indicators of decreasing interest and participation in American schools.
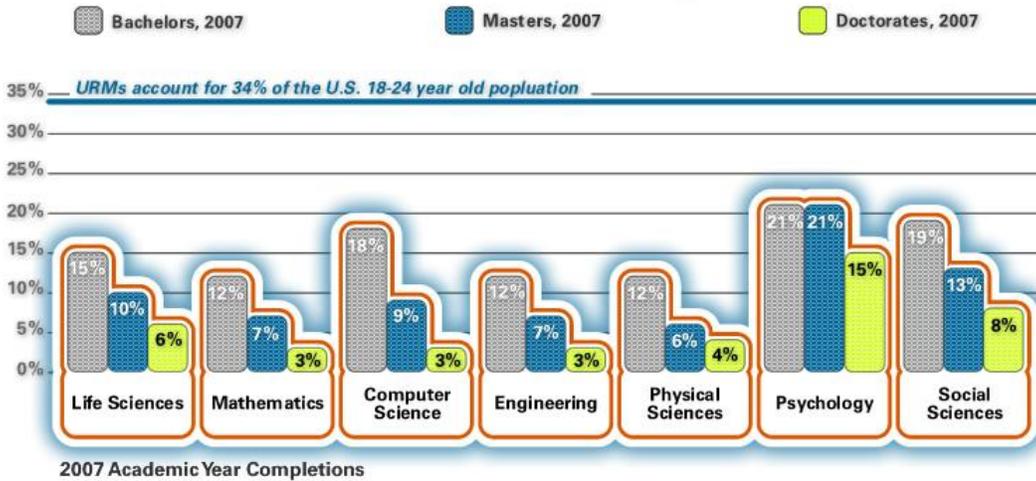
Students Indicating Computing and Information Sciences as Intended Major on SAT

Year	Male	Female
2001	58,773	
2002	55,802	
2003	44,897	
2004	39,456	
2005	37,315	
2006	33,338	
2007	33,965	

Source: College Board, "2007 college bound seniors: total group profile report", 2007.

She shared statistics showing that the representation of women and minorities in the profession fails to reflect their proportion of the population.

Percent URM by Field and Degree Level, 2007 Degree Conferrals

Bachelors, 2007   Masters, 2007   Doctorates, 2007

URMs account for 34% of the U.S. 18-24 year old population

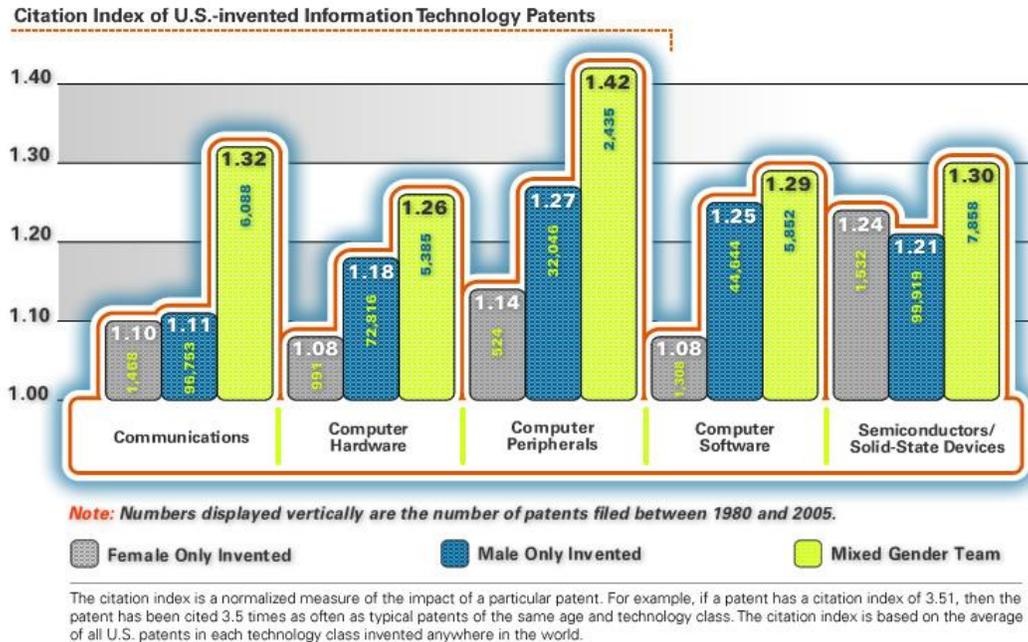| Field	Bachelors	Masters	Doctorates
Life Sciences	15%	10%	6%
Mathematics	12%	7%	3%
Computer Science	18%	9%	3%
Engineering	12%	7%	3%
Physical Sciences	12%	6%	4%
Psychology	21%	21%	15%
Social Sciences	19%	13%	8%

2007 Academic Year Completions

URM: Underrepresented Minorities. Includes African Americans, American Indians, Alaska Natives, and Latinos/as.

NCWIT Analysis from NCES IPEDS Data; Lecia Barker

She reported research findings that diverse and mixed gender teams have more highly cited IT patents than those invented by all men or all women[2], an important IT innovation metric.

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[2] *"Who Invents IT? An Analysis of Women's Participation in Information Technology Patenting", NCWIT, 2007.*

Citation Index of U.S.-invented Information Technology Patents

Note: Numbers displayed vertically are the number of patents filed between 1980 and 2005.

Female Only Invented — Male Only Invented — Mixed Gender Team

The citation index is a normalized measure of the impact of a particular patent. For example, if a patent has a citation index of 3.51, then the patent has been cited 3.5 times as often as typical patents of the same age and technology class. The citation index is based on the average of all U.S. patents in each technology class invented anywhere in the world.

Her presentation provided compelling evidence that the solution to the IT workforce crisis involves promoting women and minorities in IT, and cultivating a diverse and versatile pipeline by encouraging K-12 curricula in computer science.

Peter Harsha discussed the importance of IT research in driving the innovation that enables so much of what has made the United States a world leader – including securing the national defense, improving health care delivery, powering the sciences, and fueling the new economy. He made the case for federal support of IT research by walking through an explanation of a National Academy of Sciences chart, showing the origin and development of 19 different multi-billion dollar subsectors of the IT economy, each one bearing the clear stamp of federal support in their development. He explained how the chart illustrated the Academy's conclusion that a dominant position in IT for the United States is owed in part to *"an extraordinarily productive interplay of federally funded university research, federally and privately funded industrial research, and entrepreneurial companies founded and staffed by people who moved back and forth between universities and industry."*

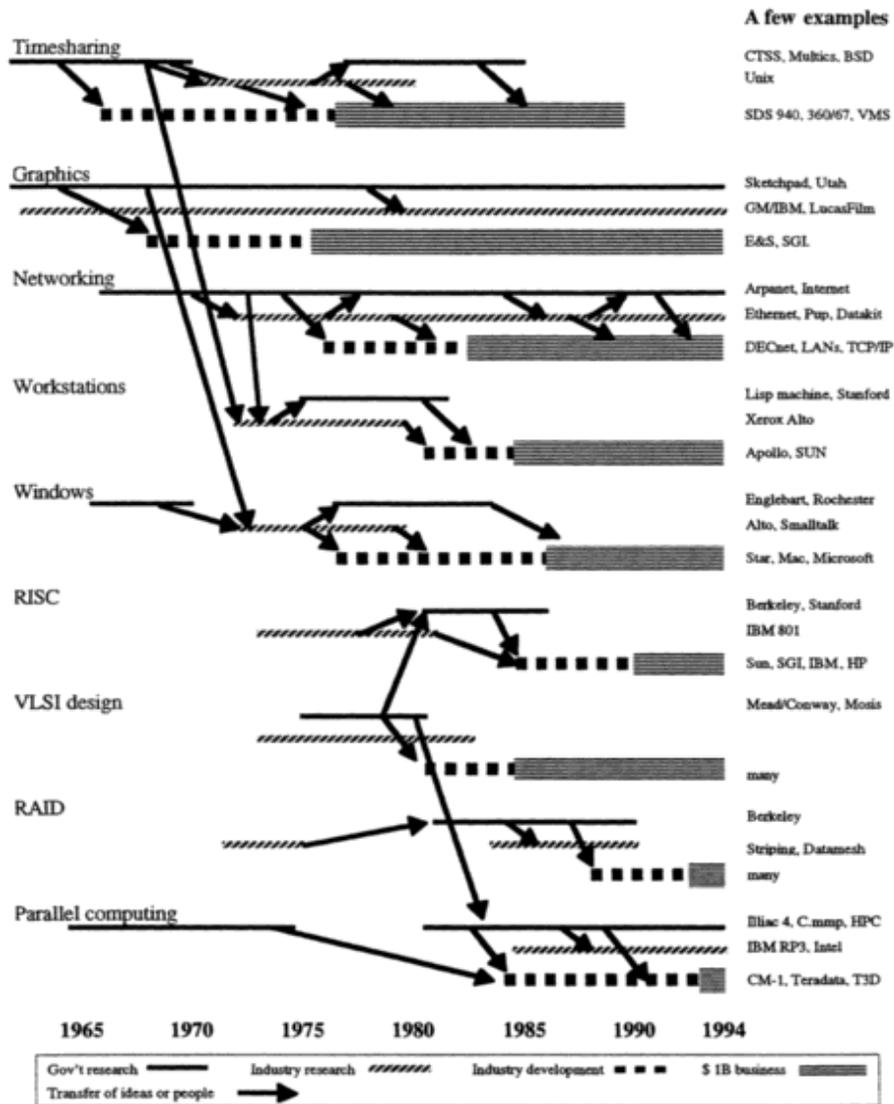**How Government-sponsored Computing R&D Stimulates Ideas and Industries**

A few examples

Timesharing — CTSS, Multics, BSD Unix / SDS 940, 360/67, VMS

Graphics — Sketchpad, Utah / GM/IBM, LucasFilm / E&S, SGI

Networking — Arpanet, Internet / Ethernet, Pup, Datakit / DECnet, LANs, TCP/IP

Workstations — Lisp machine, Stanford / Xerox Alto / Apollo, SUN

Windows — Englebart, Rochester / Alto, Smalltalk / Star, Mac, Microsoft

RISC — Berkeley, Stanford / IBM 801 / Sun, SGI, IBM, HP

VLSI design — Mead/Conway, Mosis / many

RAID — Berkeley / Striping, Datamesh / many

Parallel computing — Illiac 4, C.mmp, HPC / IBM RP3, Intel / CM-1, Teradata, T3D

1965   1970   1975   1980   1985   1990   1994

Gov't research ▬▬▬   Industry research ⁄⁄⁄⁄⁄⁄   Industry development ■ ■ ■ $ 1B business ▬▬▬▬
Transfer of ideas or people ➝

FIGURE 1.2 Government-sponsored computing research and development stimulates creation of innovative ideas and industries. Dates apply to horizontal bars, but not to arrows showing transfer of ideas and people. Table 1.1 is a companion to this figure.

But Harsha expressed concerns that the IT research and development ecosystem that has proven to be so successful in the past is undergoing changes that could threaten its future effectiveness. He cited recent changes in emphasis at the Defense Advanced Research Projects Agency (DARPA) that have sharply reduced the number of university researchers who can participate in DARPA-led computing research efforts, effectively reducing the mindshare focused on defense problems and placing additional burdens on the only remaining federal agency supporting fundamental computer science research: the National Science Foundation

(NSF). NSF, he noted, is feeling the strain, evident in reduced success rates for solicitations and a large number of good ideas going unfunded. Without other federal mission agencies stepping in to fill the gap left by DARPA – and without increases in funding for NSF – the vibrant ecosystem that enabled America's global leadership might be at risk. This is a conclusion, he noted, that was shared by the members of the President's Council of Advisors for Science and Technology in a report last year.

Cameron Wilson discussed the importance and difficulties of bringing computer science into K-12 education. Computer science involves understanding how computers work, based on knowledge of algorithmic thinking, creative design, and problem-solving. Curriculum of this sort fosters critical-thinking skills that are vital in many fields of science, not just computer science. Exposure to quality computer science in high school also gives students a better perspective on the breath of computer science and the role it can play in other fields as well. However, particularly at the K-12 level, educators often replace computer science curriculum with basic technical skills needed to operate computer programs, such as proficiency with word processing or spreadsheet programs. Further, computer science is seen as a non-core elective in many states, starving it for resources as schools focus on subjects such as reading and math that are tested under the No Child Left Behind Act.

These factors have contributed to declines in computer science participation in high school. Between 2002 and 2004, while the number of AP exam-takers in other disciplines rose overall by 19 percent, the number of students taking the Computer Science A exam dropped by 8 percent and the number of students taking the Computer Science AB exam decreased by nearly 20 percent.[3] In early 2008 the College Board announced it was discontinuing the Computer

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[3] *The College Board, 2007.*

Science AB exam. To develop a response to the twenty-first century global IT development race, Wilson said, the United States must address computer science in K-12 education.

The Future Workforce -- The High School Pipeline:
AP Mathematics and Science Exams 1997-2007
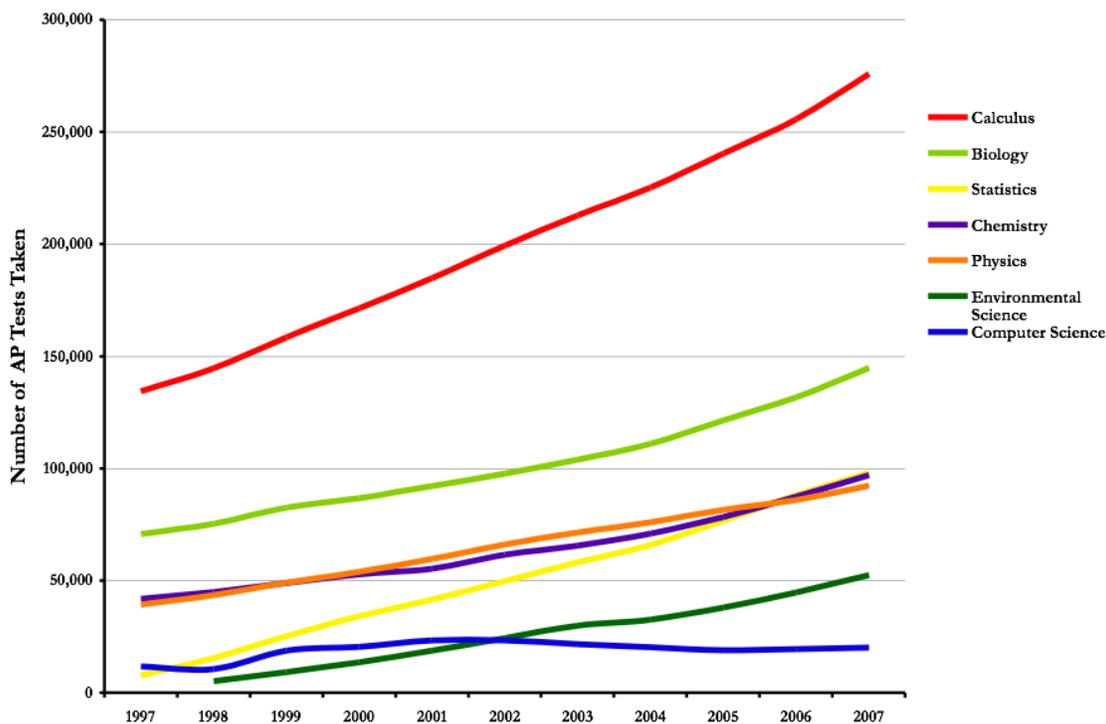
Source: College Board Exam Volume Data

During the subsequent discussion period participants spoke about the difficulties that confront the IT field, the obstacles to getting more people involved at a young age, and the importance of gender equity and ethnic diversity. Participants offered both personal and corporate perspectives on ways to shape a common understanding of how IT weaves through the social fabric crisscrossing businesses and government. Preparing for America's future, they concluded, must start in grade schools and continue through the workforce, leadership, and cutting-edge research and development.

Participants generated a wide variety of ideas, suggestions, analyses, and pragmatic solutions. For instance, the emphasis of corporate efforts in Washington, D.C. to reform education has broadly included all the so-called STEM categories: science, technology, engineering, and

math. The roundtable discussion addressed the potential of narrowing the focus to concentrate on the impact of IT and computer science education.

It was also mentioned that the "America Competes" legislation has stipulations in it related to broad STEM issues, such as teacher training. As innovation bills such as this one reach the agencies for implementation, it is important that those of us who care about computing reach out to the agencies and ensure that IT attracts its share of the funding. Many roundtable participants voiced the belief that computing is a "stealth discipline" – that policy-makers and agency implementers often don't think of computing as a science, since they were not exposed to it during their educational years.

A spirited discussion ensued over whether to require computing education in K-12 schools. How can we make the study of computing relevant to today's students? They are surrounded by technology, and yet the study of HOW the technology is made does not seem interesting to them. How might we remedy the discipline's seeming image problem?

The group also focused on the need for a common understanding of what curriculum the community should rally around at the K-12 level. Cameron Wilson noted that the ACM and the Computer Science Teachers Association have produced a model curriculum that has been vetted by many experts in computing education. Further, groups such as NCWIT are producing innovative new curriculum following the ACM model to attract a more diverse population to computing.

With regard to how computing education is impacting our future IT workforce, a warning bell was sounded. Over the years, U.S. corporations have been willing to move overseas to reduce labor costs. If our public policy fails to confront the skills and education gap through programs

that address workforce needs, U.S. corporations will be forced to fill their workforce needs abroad.

As the dialogue continued, the group focused on the following questions:

- » Should we try to tackle computing workforce issues from a policy perspective?
- » If so, what should we do together?
- » How should we do it?

The Information Technology Business Advocacy Roundtable successfully raised awareness about how interventions to promote diversity and gender equity in IT can help to promote the competitiveness of the American workforce, now and for years to come.

The group recognized that reform to advance education in computer science must be concentrated at the state and local government level, which traditionally shapes American curriculum. Reformed curriculum should be attractive to both boys and girls, and is best designed when computer science is well-integrated with other disciplines. The group agreed to seek the support of other groups working nationally, but at the state level, when addressing issues of computing education. We also agreed on the importance of working with federal agencies as they implement any competitiveness legislation, such as teacher training; and agreed on the necessity of paying attention to the reauthorization of No Child Left Behind.

Finally, it was acknowledged that programs that help to integrate former members of the military (and their spouses) could provide much-needed IT talent through re-entry and re-education efforts. Pilot programs already have been launched and a sub-set of meeting attendees agreed to continue to push these efforts forward.