Written Testimony of
Dr. Kathryn S. McKinley
Principal Researcher, Microsoft Research

Before the
Subcommittee on Research, Committee on Science, Space, and Technology
U.S. House of Representatives

Hearing on
"Applications for Information Technology Research and Development"

February 14, 2013

Chairman, Ranking Member, and Members of the Subcommittee, my name is Kathryn S. McKinley, and I am a Principal Researcher at Microsoft. Thank you for the opportunity to share perspectives on information technology research in the U.S., including in universities and at companies. I appreciate the time and attention the Committee has devoted to this topic, and I commend you for advancing the dialogue on innovation and competitiveness in information technology.

Microsoft deeply believes that investment in research and education lay the groundwork for advances that benefit society and enhance the competitiveness of U.S. companies, U.S. security, and the lives of individuals. In my testimony, I will describe

- Key elements of the information technology research and development (R&D) ecosystem.
- Microsoft Research and an illustration of how innovative new products build on a wide range of research activities.
- The two core pillars of NITRD – investment in discovery and investment in people – and examples of important research areas for NITRD going forward.

A brief summary of the key points covered in my testimony is provided at the end of this document.

My testimony today is informed by my experiences in academia and industry. I am a Principal Researcher at Microsoft Research and an Endowed Professor of Computer Science at the University of Texas at Austin, and previously was a Professor at the University of Massachusetts, Amherst. My research interests include programming language implementation, compilers, memory management, runtime systems, security, reliability, and computer architecture. I particularly focus on practical research that results in systems that substantially improve the performance, correctness, security, and, most recently, power of applications. The National Science Foundation (NSF), IBM, DARPA, Microsoft, Google, CISCO, and Intel all supported my research in academia.

Today, in addition to my work at Microsoft and on NSF, IBM, DARPA, Microsoft, Google, CISCO, and Intel research community activities, I am a member of the Board of the Computing Research Association (CRA), co-chair of the CRA's Committee on the Status of Women in Computing Research (CRA-W), and a member of the Defense Advanced Research Projects Agency's Information Science and Technology Study Group (ISAT).

The IT R&D Ecosystem

The commercial information technology (IT) industry is a well-known and appreciated success story of American innovation and leadership. American ingenuity turned advances in IT into an incredible driver for global competitiveness, military preparedness, and economic growth. Today, IT contributes about 5% to overall U.S. GDP, according to the Bureau of Economic Analysis. Yet the success was not solely the outcome of visionary and very hard-working people at companies across the U.S., such as Microsoft. Instead, the success and impact of IT is the result of a tightly interconnected ecosystem of people, ideas, projects, and resources from government, academia, and industry.

The nature of this complex partnership is illustrated in the 2012 report *Continuing Innovation in Information Technology*.[1] This report illustrates how fundamental research in IT, conducted in industry and universities over decades, and supported by Federal agencies, has and continues to lead to the introduction of entirely new product categories that ultimately have become the basis of new billion-dollar industries. In all these cases, there is a complex interweaving of fundamental research and focused development that subsequently create opportunities for new research, new products, and new markets. Innovations in academia continue to drive breakthroughs in industry, and vice versa, fertilized with ideas, technologies, and people transitioning among disciplines and institutions.

Without research agencies and universities to focus research on the ever-shifting frontiers of multiple computing sub-disciplines, to explore connections across disciplines, and to expose and train each generation of students to create the next set of innovations, companies will not have the reservoir of ideas and talent to maintain the U.S. lead in today's IT sector and to build the next set of multi-billion dollar job-creating industries.

Microsoft Research

Microsoft is a direct beneficiary of, and wholly committed to, its role in the innovation ecosystem described above. This commitment requires Microsoft to make significant investments in all elements of this ecosystem. Across the company, more than $9 billion a year is directed toward research and development (R&D) with the vast majority of those funds supporting development activities focused on specific products. A critical element, although small in relative terms, of our overall R&D investment is in more fundamental explorations at Microsoft Research (MSR). Founded in 1991, MSR is now the largest and highest quality industrial computing research organization in the world, with over 800 Ph.D.s working in more than 55 research areas. MSR is

[1] *Continuing Innovation in Information Technology*; Committee on Depicting Innovation in Information Technology; Computer Science and Telecommunications Board; Division on Engineering and Physical Sciences; National Research Council. http://sites.nationalacademies.org/CSTB/CurrentProjects/CSTB_045476.

dedicated to advancing the state of the art in computing, often in collaboration with academic researchers (graduate students, undergraduate students, and professors) and government agencies, and to creating new technologies for Microsoft's products and services. This organization and these people allow Microsoft to respond more rapidly to changing markets and emerging technologies and to provide a reservoir of technology, expertise, and people that can be quickly brought to bear to respond to and create new technologies, new business models, and new markets.

While MSR activities are distinct from the short-term development activities conducted at Microsoft and other companies, distinctions such as "basic" versus "applied" do not really apply to computing research. In fact, computing research is an evolving blend of invention, discovery, and engineering. MSR researchers collaborate with leading academic, government, and industry colleagues and often move in and out of universities and Microsoft business groups as their activities shift in focus between research, applications of that research, and technology transfer and implementation.

A recent example of how research comes to fruition in Microsoft is Microsoft's Kinect product, which links to an Xbox system and allows you to control your Xbox games and other functions with your body and voice. The most innovative achievements of Kinect are the creation of a system that recognizes people and their voices in a variety of environments; that tracks and responds to their body motions in real time; and that this system can be produced in bulk. The technology builds on decades of blue-sky and disruptive research, conducted both in academia and in MSR, in a range of areas, including machine learning, image processing, audio processing, and natural language processing. Furthermore, this technology is now inspiring new directions in cross-disciplinary research on virtual and augmented reality, secure video presence, health monitoring, and education.

The impact of Kinect is just one example of the connections and synergies between industry and academia that are discussed in the *Continuing Innovation in Information Technology* report and that illustrates how information technology shifts and evolves from research to products back to research. By providing a flexible and affordable system by which visual and voice feeds can be processed and used by a computer, Kinect is already transforming a variety of academic research projects and applications in robotics, human-computer interaction, online education, and more. In addition, the advances originally targeted at the gaming and entertainment business are having multiplier effects outside the IT sector as the technology is investigated for deployment in retail (virtual car tours)[2] and for healthcare applications (such as autism or post-stroke physical therapy).[3]

NITRD

As a nation, we can be proud of the achievements and innovations due to the IT R&D ecosystem to date, including those spurred by the Federal government under NITRD, but U.S. global leadership, the future health of the economy and national security depend on government investment in research to accelerate technological innovation, address societal challenges, and

[2] More information about how the Kinect is being used in other commercial sectors is available at http://www.microsoft.com/en-us/kinectforwindows/.
[3] More information about how the Kinect is being used in healthcare, education, the arts, and other applications is available at http://www.xbox.com/en-US/Kinect/Kinect-Effect.

train a globally competitive workforce. The activities and investments of the past lay the groundwork on which we can build going forward. Support, oversight, and reauthorization of NITRD is a critical step toward providing Federal research agencies with the resources and guidance they need to stimulate our innovation ecosystem.

Investing in Research

The potential results and impact of research are often unknown when the research is started. The value and payoff of a sustained and healthy investment in research is often realized well after the initial investment and research. Today, the U.S. is reaping the benefits in our quality of life, the global competitiveness of our companies, and our national security that build on past investments, as is highlighted in the *Continuing Innovation in Information Technology* report.

Looking ahead, NITRD investments to advance computing capabilities are required in a range of areas to generate the next generation of technological innovations, as has been discussed in reports and past testimony[4]:

- ***Data volumes are growing exponentially****.* Health, cameras, video, motion, and other sensors can produce and stream an enormous volume of electronic information. "Big data" and "streaming data" pose great challenges, including how to collect, manage, access, search, analyze, and act on this data efficiently in bulk and in real time. Solutions require substantial innovations in software, networking, and hardware (from embedded to mobile to cloud), and have the potential to revolutionize society with applications ranging from personalized education, continuous health monitoring, personal assistants, enhanced social networks, robotics, smart buildings, and efficient transportation.
- ***Computing systems must be trustworthy and privacy preserving****.* As more of government, the economy, and individuals depend on information technology, we must create and combine technical, social science, and policy solutions to meet the wide range of risk and trust environments.
- ***Technologies driving computer hardware capabilities are reaching fundamental limits.*** Over the past three decades, we have enjoyed exponential improvements in computing hardware performance due to substantial innovations in materials, hardware, and software, and because the hardware/software interfaces did not change much, the improvements created a virtuous cycle of innovation on both sides of the interface. However, today, on the hardware side, the physical constraints on power, wire delay, and feature sizes are forcing single-processor performance to plateau. These constraints require substantial research and

[4] Relevant reports and testimony include:

- *The Future of Computing Performance: Game Over or Next Level?*, Samuel H. Fuller and Lynette I. Millett, Editors, National Research Council Committee on Sustaining Growth in Computing Performance, National Academies Press, 2010. http://www.nap.edu/catalog.php?record_id=12980
- Two reports entitled *Designing a Digital Future: Federally Funded Research and Development Networking and Information Technology*, President's Council of Advisors on Science and Technology, 2010 and 2013. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-nitrd-report-2010.pdf and http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-nitrd2013.pdf
- Testimony by Dr. Peter Lee, Microsoft Research, before the Senate Committee on Commerce, Science and Transportation on September, 2012.

innovations up and down the hardware/software stack to provide continued growth in computing capabilities.

As examples of how computing research will connect with national and business priorities going forward, I will discuss at greater length two key research areas: (1) increasing hardware capabilities as traditional hardware reaches its limits, and (2) managing the energy usage of information technology in a wide range of settings.

In the first area, the National Academies recently completed a study on *The New Global Ecosystem in Advanced Computing: Implications for U.S. Competitiveness and National Security*[5] that addresses these research needs and consequences if they go unaddressed. (I am an author of this report.) Over the past 35 years, the IT industry and all those who use IT products, have benefitted greatly from the steady and dramatic (exponential) increases in microprocessor performance.

Every two years until about 2005, performance of computers doubled, which underpinned and drove rapid, dramatic, and systemic increases in the speed of software and increases in new software capabilities. However since 2005, the advances in performance have plateaued due to fundamental limits of physics and silicon materials. No new technology is waiting to replace this technology. One current solution industry is pursuing is parallel computing (more processors, rather than faster processors), but this solution presents substantial hardware and software challenges, since, in particular, most software is not parallel. There are many research ideas on how to continue the scaling of computing performance, but more than ever before this research depends on achieving greater levels of hardware/software integration, innovation, and co-design than ever before. This incredibly challenging, exciting, and important problem is one that is arguably underfunded today.

However, if the performance engine of the virtuous cycle of hardware and software capabilities goes dry, the gap between our nation's capabilities and other nations' will narrow substantially. Significant investment in hardware and coordinating programming software system capabilities are needed by government, academia, and industry to establish a new virtuous cycle of hardware/software innovation in the post-Moore's Law era.

Global competition is compounding the technical challenges. Whereas until recently, the vast majority of computing research was centered in the U.S, substantial investments in Asia and Europe are spurring global IT innovation. For example, studies of papers published, patents, and collaborations occurring internationally show that in four key computing fields – semiconductor devices and circuits, architecture, applications, and programming systems – the distribution of research and innovation is shifting. For example, Figure 1 shows the international collaboration network on scientific publications at the most prestigious and influential scholarly publication venues in these areas, reproduced from *The New Global Ecosystem in Advanced Computing*.[5] The U.S. is still the leader in these areas, but it is no longer the sole locus and driver of innovation, countries such as China, Japan, Korea, Taiwan, Great Britain, and Germany have increased both

[5] *The New Global Ecosystem in Advanced Computing: Implications for U.S. Competitiveness and National Security*; Committee on Global Approaches to Advanced Computing; Board on Global Science and Technology; Policy and Global Affairs; National Research Council. http://www.nap.edu/catalog.php?record_id=13472.

their contributions to the research ecosystem and their ability to convert research into technological advancements. While the U.S. enjoys an edge, the gap is narrowing.

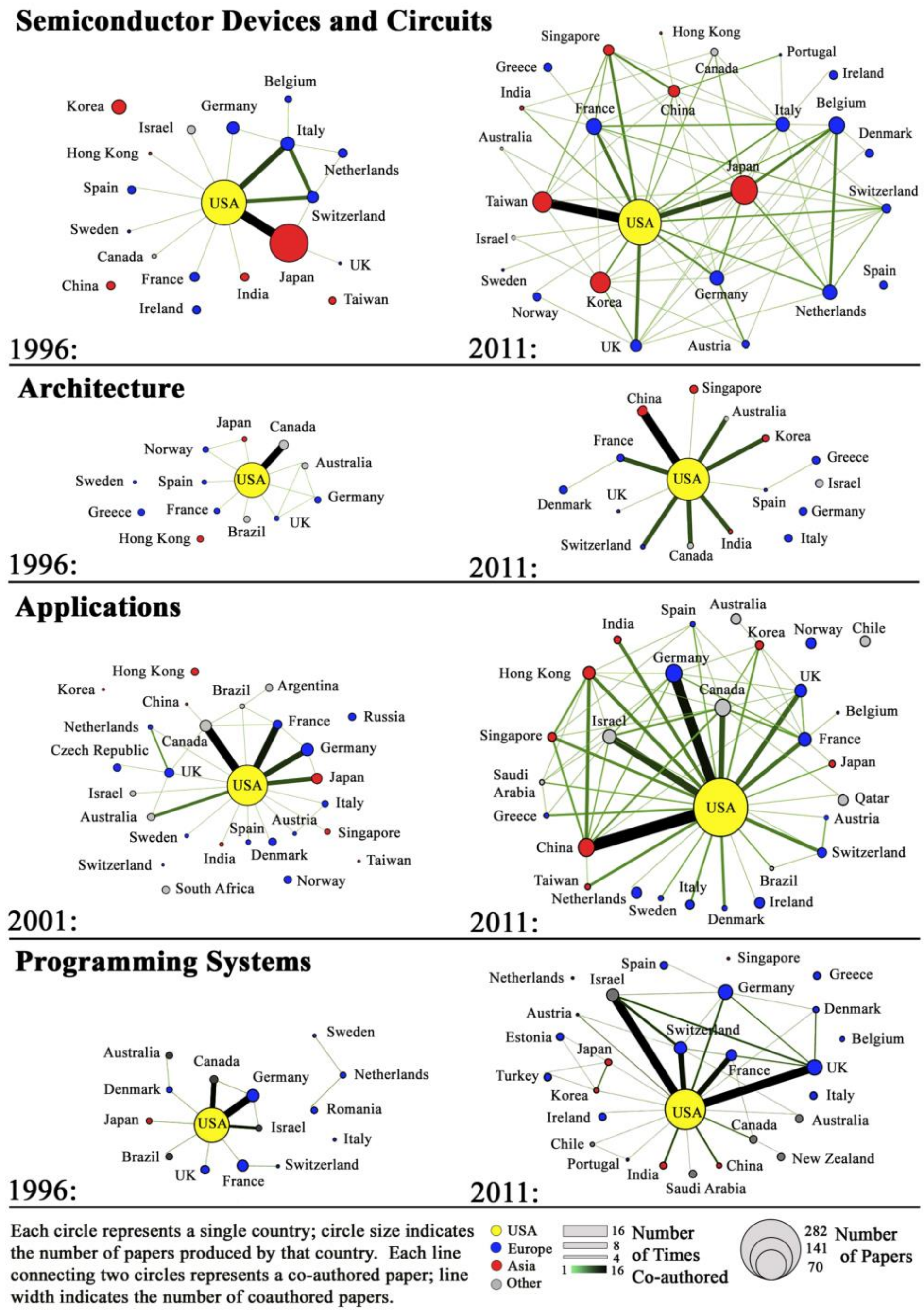


FIGURE 2-1 International conference collaboration networks. Data compiled from the following conferences: ASPLOS, HPCA, ISCA and MICRO (architecture); ECOOP, OOPSLA, PLDI, POPL, and PPoPP (programming systems); SC, SIGGRAPH, VLDB, and WWW (applications); and IEDM and ISSCC (semiconductor devices and circuits). Collaboration maps were generated using the Science of Science (Sci2) Tool available at http://sci2.cns.iu.edu.

Figure 1. From *The New Global Ecosystem in Advanced Computing: Implications for U.S. Competitiveness and National Security*; Committee on Global Approaches to Advanced Computing; Board on Global Science and Technology; Policy and Global Affairs; National Research Council. http://www.nap.edu/catalog.php?record_id=13472.

This change in circumstances has implications for the U.S both in its internationally-leading IT sector and its national defense strategies. Both our companies and our defense technologies have benefitted from having first access to steadily improving overall IT functionality, but as the innovation networks and supply chains become more global, the U.S. must prepare and adapt. In particular, if the rate of innovation slows, closing the gap becomes easier and the U.S. will lose its competitive advantage. From a research perspective, as the report notes, "major innovations in semiconductor processes, computer architecture, and parallel programming tools and techniques are all needed if we are to continue to deliver ever-greater application performance." This research will build on sustained past investment in these areas supported by NITRD and requires intellectual and practical contributions from universities, government, and companies.

In the second area, the expanding deployment of computing devices at all sizes and scales (from mobile devices in every pocket to massive data centers that require their own power plants) has highlighted the challenge of efficiently powering microprocessors to perform a vast array of different tasks. Also, the technological shifts described above mean that IT designers face tradeoffs between performance and power in everything from checking a phone's location via GPS to running searches on thousands of servers in data centers. Research on power and performance tradeoffs will have implications for hardware, architecture, and application design going forward with a first order effect on mobile user experiences and the economics of cloud services. Furthermore, advances in both have direct effects on enhancing the safety and effectiveness of the military, ranging from improving military intelligence and planning, to helping soldiers during combat.

The above list and examples are not meant to imply that NITRD is not working on these and other important areas. To the contrary in the past several years, we have seen significant interagency collaboration on research targeted at major challenges and opportunities. Two recent examples are the initiatives in robotics and big data. Similar to the examples described above, they are simultaneously areas for cutting-edge fundamental research on hard problems that will occur at universities, industry, and government laboratories, and also the focus of development and deployment activities at corporations and agencies.

Investing in People: *The Nation's computing workforce demands are outpacing its supply.*

To create the next generation of highly skilled IT workers requires improving the nation's K-12 education in computing to feed our universities and requires broadening the IT talent pool to include the missing 70%, women and under-represented minorities.

As information technology permeates more aspects of our day-to-day lives and becomes a critical element of sectors from manufacturing to healthcare, from retail to education, U.S. industry and government will be searching for people with the core knowledge and creativity to reinvent how we do business and keep American companies at the forefront of the global economy. Careers in technology, engineering, science, and mathematics will be growing, especially those in computing. Based on Bureau of Labor Statistics data, jobs in computing occupations are expected to account for 62 percent of the projected annual growth of newly created science, technology, engineering, and mathematics (STEM) job openings from 2010 to 2020.

At Microsoft, we are very aware of this issue today. The success of Microsoft is strongly dependent on the capabilities of our employees. We aggressively seek out talented people who will help build our company into one that is successful in improving our current products and creating new ones as we participate in the rapid change that characterizes our innovation-based economy. Yet in January 2013, Microsoft had more than 3,400 unfilled research and engineering positions in the United States, a 35 percent increase in our number of unfilled positions for these types of positions compared to a year ago. Microsoft has proposed a "National Talent Strategy" that couples responding to our short-term workforce challenges with long-term investments in improving our STEM education system, including computing education in high school, and we are working with other companies, organizations, and governments on these challenges.[6]

Ensuring that students have the opportunity to explore careers in computing and the support to succeed in those careers requires contributions from the government, industry, and education communities and improvements at all levels of the educational pipeline. For example, the National Science Foundation's Computing Education for the 21st Century (CE21)[7] program has helped create innovative new courses for high school students to inform and inspire more participation in computing. Unfortunately, in 2009 only 5% of high schools offered the AP Computer Science class (2,100 out of 42,000). Furthermore, only nine states allow computer science courses to count toward "core" math and science high school graduation requirements. More information about the opportunities and policy challenges is available from the Computing in the Core coalition (http://www.computinginthecore.org/), of which Microsoft is a founding member.

A particular element of the challenge relates to the relatively limited participation of women and Hispanic and Black minorities in computing. The failure to capitalize on the creativity of these groups is a huge opportunity cost to our nation's leadership in technical innovation. The business case for a diverse work force is compelling. A 2007 study from the National Center for Woment in IT shows that IT patents issued to mixed gender teams are cited 26% to 42% more than similar IT patents by all men or all women teams.[8] In 2009, Herring found that companies with the highest levels of racial diversity had 15 times more sales revenues than those with lower diversity.[9]

In 2011, white men were 31% of the U.S. population and yet received 61% of the bachelor degrees in computer science (see Figure 2). Looking specifically at the research workforce in 2011, out of 1782 Ph.D.s in 2011, women earned only 345 Ph.D.s, less than 20%.

---

[6] The Microsoft National Talent Strategy is available at http://www.microsoft.com/en-us/news/download/presskits/citizenship/MSNTS.pdf.

[7] The National Science Foundation's Computing Education for the 21st Century (CE21) program focuses on generating knowledge and activities related to computing education with the goal of building a robust computing research community, a computationally competent 21st century workforce, and a computationally empowered citizenry. The program is described at http://nsf.gov/funding/pgm_summ.jsp?pims_id=503582.

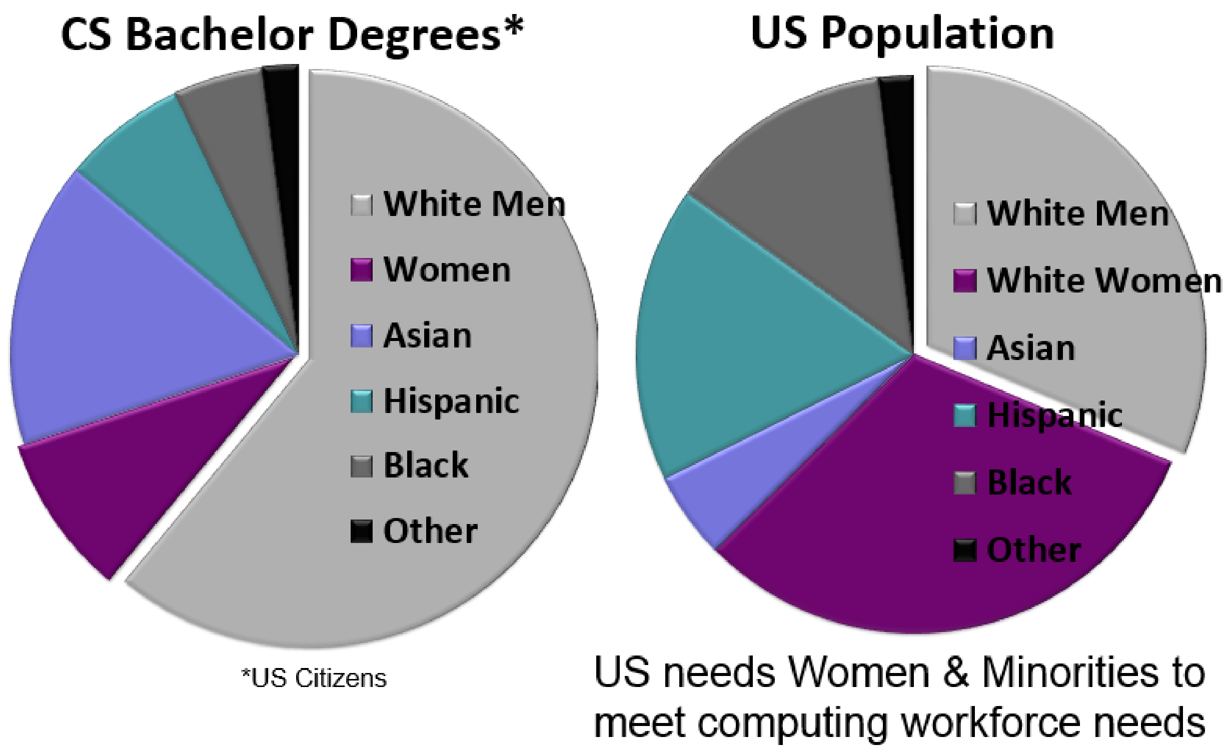
[8] *Who invents IT? An Analysis of Women's Participation in Information Technology Patenting*, C. Ashcraft and A. Breitzman, Technical report, NCWIT, March 2007.

[9] *Does Diversity Pay? Race, Gender and the Business Case for Diversity*, C. Herring, American Sociological Review, 74(2):208–224, 2009.

The U.S. simply cannot afford to stand by while 70% of its population does not participate in the computing ecosystem of the "knowledge economy" and remain globally competitive.

After I joined Microsoft Research in 2011 and with the enthusiastic support of Microsoft, I became the co-chair of the Computing Research Association (CRA) Committee on the Status of Women in Computing Research (CRA-W), which is working to fill the computing workforce needs with programs that accelerate innovation by improving the participation and success of undergraduates, graduate students, and Ph.D. women and minorities in computing research. Furthermore, CRA-W recently helped establish the CRA Center for Evaluation of the Computing Research Pipeline (CERP) to evaluate how well intervention programs work and what leads students to pursue computing research careers.

Figure 1: Computing Demographics: The Missing 70% [10]



[10] Sources for figure: Computing Research Association, Taulbee Survey 2010-2011, available at http://www.cra.org/resources/taulbee/ (providing voluntary responses from Ph.D.-granting universities on new enrollments and degrees awarded in their undergraduate CS/CE programs. U.S. Census Data 2011, available at http://quickfacts.census.gov/qfd/states/00000.html

Below are two examples of ongoing CRA-W programs that expand the research workforce, as shown by comparisons of program participants with the national pool of computing students.

- *Support for Women in Graduate School*: The CRA-W Grad Cohort is a two day mentoring workshop that brings computing graduate students together with successful senior women researchers, who serve as role models, give practical advice and information on navigating graduate school, and provide personal insights on the challenges and rewards of their own careers. The workshop provides group and individual mentoring, networking, and peer support for women master's and Ph.D. students—this experience is something their home institutions, most with very few women, do not provide. Between 2004 and 2012, 2089 graduate students participated in a Grad Cohort and 245 attended in 2012, impacting an enormous fraction of the women who subsequently go on to earn Ph.D.s. Surveys comparing Grad Cohort participants with nonparticipants in a national survey, showed participants were twice as likely to publish and over three times more likely to be a first author on a research publication. Ph.D. students who have a broader technical network and publish are more competitive in the job market.

- *Undergraduates and Research Experiences*: Each year, CRA-W and the CRA Coalition to Diversify Computing (CDC) match between 50 and 100 women and minority undergraduate students with faculty across the U.S. based on mutual research interests. Students, many whose home institutions are without computing research programs, spend an intense 10 weeks working closely with a faculty researcher, typically at another university. Faculty serve as role models and research mentors. The student and faculty agree on a research project, report on their progress monthly, publish a web page, and issue a final research report. Some of these reports turn into peer-reviewed research publications. These programs inform and encourage women and minorities to pursue computing research careers, and enhance and expand their experiences beyond the classroom. Undergraduate program participants are significantly more likely to apply (51% vs. 23%) and enroll (39% to 19%) in graduate school in computing than nonparticipants, and, if at graduate school, to enroll in a Ph.D. program (81% vs. 18%).

These activities are a community effort, supported by the National Science Foundation, by Microsoft, by other companies, by universities, and by volunteer participants throughout the community. They are complemented by other activities targeted at women, at minorities, and at the student population in general. For example, at Microsoft, we bring over 1,800 student interns to Redmond each year, with over 300 in Microsoft Research. The MSR interns participate in cutting-edge research and learn about how advances fit into the context of a company that must continuously provide innovative products to thrive. This experience helps prepare students for a variety of career paths – as professors, as entrepreneurs, as industry researchers, and some as Microsoft employees.

Improving students' opportunities to explore and succeed in computing careers and research careers, including the participation of women and minorities, is critical to assuring our nation's security and building an innovative and growing economy. Federal agencies should continue to support efforts to strengthen computing education at all levels. In addition, general Federal STEM programs must recognize that computer science is a critical component of their purview due to its largest predicted workforce gap, and thus articulate its particular needs for curriculum reform and clearly support its inclusion through their solicitations, outreach, and review criteria.

Conclusion

In conclusion, I want to emphasize that the U.S. has a strong and effective innovation system in information technology in which Federal agencies, companies, and universities all play major roles. This ecosystem ensures new knowledge is created and deployed for the sake of the nation's economic competitiveness, national security, and society's well-being, and that our education system produces the next generation of computing workers and leaders that are required to sustain and accelerate innovation in the information technology ecosystem.

Finally, let me thank you for this committee's longstanding support for IT research, discovery, and innovation. I would be pleased to answer any questions you might have.

Summary of Testimony

- Past investment in computing research has spawned multiple new billion-dollar information technology (IT) industries that have significant positive impact on the U.S. economy as well as enabling innovation in multiple sectors, such as manufacturing, healthcare, energy, entertainment, education, and retail.

- Government, universities, and industry each play a critical role in advancing IT innovation and discovery. In particular, Federal investment, through the NITRD program is vital in providing sustained support of research in existing and emerging computing areas and in enabling the training and flow of people and ideas throughout the IT R&D ecosystem.

- Research at Microsoft is a critical investment for the company and contributes to the creation of new products, such as Kinect, that build on, accelerate, and inspire advancements in multiple areas of computing. Furthermore, Microsoft Research thrives within the larger computing research community, which provides ideas and a pool of talented researchers that Microsoft hires and with whom Microsoft researchers collaborate.

- Looking ahead, there are a number of key investments to be made in computing research, and NITRD in particular. Areas with economic, societal, and security impacts include fundamental multi-disciplinary computing challenges in areas such as big data and robotics, as well as the computing advances needed to tackle national challenges in energy, education, health, and defense.
    - In particular, a major research challenge and opportunity is due to the plateauing of single-processor performance and shifts in global innovation networks with implications for the U.S. economy and defense.

- The 21st century will be a technology-infused world, where our innovators, employees, and citizens will need computing knowledge and skills. We must continue to strengthen students' ability to access rigorous and engaging computing education at all levels (K-12, undergraduate, and graduate) and include computer science in broader science, technology, engineering, and mathematics education efforts.
    - In particular, work must continue on ensuring that the full range of our population, including women and under-represented minorities, have the opportunity to explore and succeed in computing and computing research careers.

- Support, oversight, and reauthorization of NITRD is an important step toward providing Federal research agencies with the resources and guidance they need to contribute to our innovation ecosystem.

Witness Biography

KATHRYN S. MCKINLEY, MICROSOFT

Kathryn S. McKinley is a Principal Researcher at Microsoft and an Endowed Professor of Computer Science at the University of Texas at Austin. She previously was a Professor at the University of Massachusetts, Amherst.

Dr. McKinley's research interests include programming language implementation, compilers, memory management, runtime systems, security, architecture with a focus on programmability, performance, and power efficiency. Her research group has produced numerous tools, algorithms, and methodologies that are in wide research and industrial use, such as the DaCapo Java Benchmarks, the TRIPS Compiler, the Hoard memory manager, the Memory Management Toolkit (MMTk), and the Immix mark-region garbage collector. For example, the Apple operating system uses the Hoard memory management algorithm; the TRIPS compiler was the first demonstration of a compiling general-purpose programming language to execute on a dataflow architecture; the Jikes Research Java Virtual Machine (VM) uses MMTk and is the most widely used open-source VM; and the DaCapo Benchmarks are the most widely used Java benchmarks for performance and verification in both research and testing. NSF, IBM, DARPA, Microsoft, Google, CISCO, and Intel have supported her research.

McKinley was named an ACM Fellow (2008) for contributions to compilers and memory management and an IEEE Fellow (2011) for contributions to compiler technologies. She was awarded the 2012 ACM SIGPLAN Programming Languages Software Award for Jikes RVM and the 2011 ACM SIGPLAN Distinguished Service Award. Other research awards include The Most Influential OOPSLA Paper Award from 2002 (awarded 2012), two CACM Research Highlights Invited Papers (2012, 2008), IEEE MICRO Top Picks (2012), Best Paper at ASPLOS (2009), David Bruton Jr. Centennial Fellowship (2005-2006), six IBM Faculty Fellow Awards (2003-2008), and an NSF CAREER Award (1996-2000).

She served as a committee member on the National Academies Committee report "The New Global Ecosystem in Advanced Computing: Implications for U.S. Competitiveness and National Security," 2011-2012, and The National Academies Committee report "The Future of Computing Performance: Game Over or Next Level?" 2007-2011. She has served as the Technical Program Chair for ASPLOS, PACT, PLDI, ISMM, and CGO (ACM and IEEE conferences). She was co-Editor-in-Chief of ACM Transactions on Programming Language Systems (TOPLAS) (2007-2010). She was Secretary & Treasurer of the ACM Special Interest Group on Programming Languages (SIGPLAN), 1999-2001. She was a CRA-W board member (2009-2011) and is currently serving as the co-Chair of CRA-W (2011-present). CRA-W seeks to improve the participation of women in computing research nationwide. She currently serves on the DARPA ISAT Committee (2012--present) and the CRA Board (2011--present).

McKinley has graduated seventeen PhD students. She is married with three sons. She received a BA, MS, and Ph.D. from Rice University.