The CCC & Health IT

Dr. Erwin Gianchandani
Director, Computing Community Consortium
Computing Research Association

National Institutes of Health
October 21, 2011

Objective

- Overview of the Computing Community Consortium (CCC)
- Our view of health information technology
- How can we be of help to you?

What is the CCC?

What is the CCC?

- Established in 2006 through a multi-year cooperative agreement between the National Science Foundation and the Computing Research Association (CRA)

- Provides **a voice for the national computing research community**

- Facilitates the development of a bold, multi-themed vision for the field – and communicates this vision to stakeholders

A broad-based Council

Leadership:
- Ed Lazowska, U of Washington (Chair)
- Susan Graham, UC-Berkeley (Vice-Chair)
- Erwin Gianchandani, CRA (Director)

Terms ending 2014:
- Deborah Crawford, Drexel
- Gregory Hager, Johns Hopkins
- John Mitchell, Stanford
- Bob Sproull, Oracle (ret.)
- Josep Torrellas, UIUC

Terms ending 2013:
- Randy Bryant, CMU
- Lance Fortnow, Northwestern
- Eric Horvitz, Microsoft Research
- Hank Korth, Lehigh
- Beth Mynatt, Georgia Tech
- Fred Schneider, Cornell
- Margo Seltzer, Harvard

Terms ending 2012:
- Stephanie Forrest, U of New Mexico
- Chris Johnson, U of Utah
- Anita Jones, U of Virginia
- Frans Kaashoek, MIT
- Ran Libeskind-Hadas, Harvey Mudd
- Robin Murphy, Texas A&M

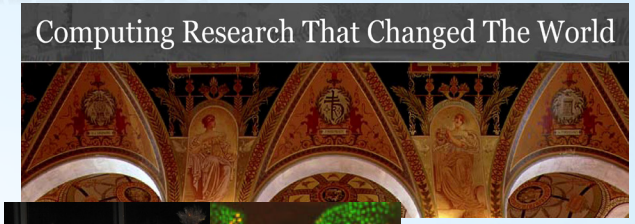
Rotated off:
- Greg Andrews, U of Arizona (ret.) (2009)
- Bill Feiereisen, Intel (2011)
- Dave Kaeli, Northeastern (2011)
- Dick Karp, UC-Berkeley (2010)
- John King, U of Michigan (2011)
- Peter Lee, Microsoft Research (2009)
- Andrew McCallum, U-Mass (2010)
- Karen Sutherland, Augsburg U (2009)
- Dave Waltz, Columbia (2010)

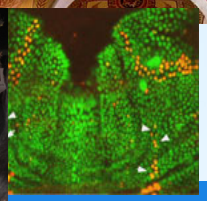
Meets three times a year, including an annual summer meeting in Washington, DC

A multitude of activities

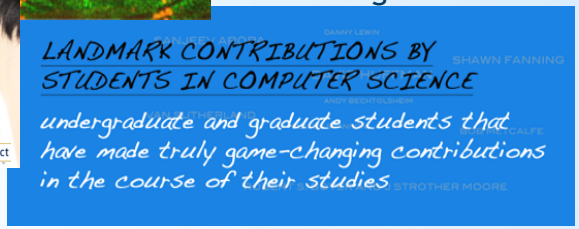
- **Community-initiated visioning:**
  - Workshops that bring researchers together to discuss the frontiers of computing
  - Challenges & Visions tracks at conferences

- **Outreach to the White House and Federal agencies:**
  - Outputs of visioning activities
  - Short reports to inform policy makers
  - Task Forces -- Health IT, Computational Sustainability, and Big Data

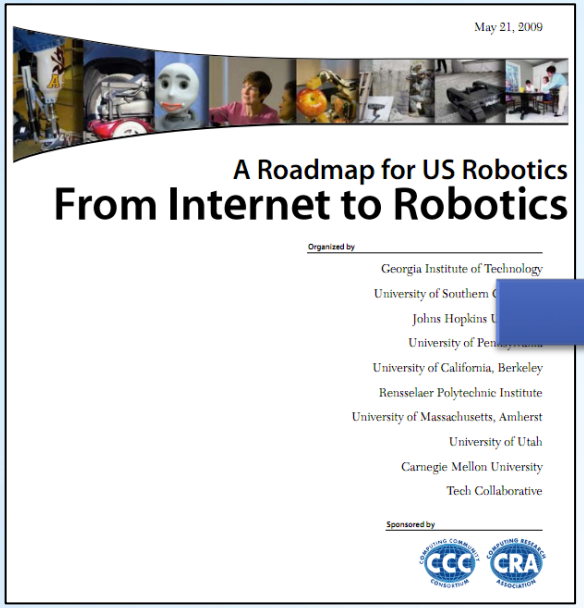




This Week's Highlight:
Fruit Fly Suggests New Solution to Computer Networking Problem



Visioning: Robotics success


May 21, 2009

A Roadmap for US Robotics

From Internet to Robotics

Organized by

Georgia Institute of Technology

University of Southern C

Johns Hopkins U

University of Pen

University of California, Berkeley

Rensselaer Polytechnic Institute

University of Massachusetts, Amherst

University of Utah

Carnegie Mellon University

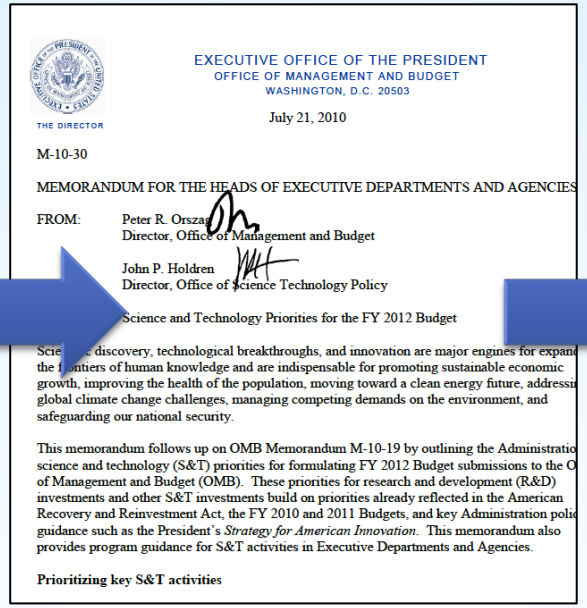
Tech Collaborative

Sponsored by

4 meetings during summer 2008

Roadmap published May 2009

Extensive discussions between visioning leaders & agencies


EXECUTIVE OFFICE OF THE PRESIDENT

OFFICE OF MANAGEMENT AND BUDGET

WASHINGTON, D.C. 20503

THE DIRECTOR

July 21, 2010

M-10-30

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Peter R. Orszag
Director, Office of Management and Budget

John P. Holdren
Director, Office of Science Technology Policy

Science and Technology Priorities for the FY 2012 Budget

Scie discovery, technological breakthroughs, and innovation are major engines for expand the f ntiers of human knowledge and are indispensable for promoting sustainable economic growth, improving the health of the population, moving toward a clean energy future, addressi global climate change challenges, managing competing demands on the environment, and safeguarding our national security.

This memorandum follows up on OMB Memorandum M-10-19 by outlining the Administratio science and technology (S&T) priorities for formulating FY 2012 Budget submissions to the O of Management and Budget (OMB). These priorities for research and development (R&D) investments and other S&T investments build on priorities already reflected in the American Recovery and Reinvestment Act, the FY 2010 and 2011 Budgets, and key Administration polic guidance such as the President's *Strategy for American Innovation*. This memorandum also provides program guidance for S&T activities in Executive Departments and Agencies.

Prioritizing key S&T activities

OSTP issues directive to all agencies to include robotics in FY 12 budgets


Office of Science and Technology Po

About OSTP | OSTP Blog | Pressroom | Divisions | R&D Budgets | Res

Developing the Next Generation of Robots

Posted by Tom Kalil and Sridhar Kota on June 24, 2011 at 10:14 AM EDT

Tweet Share

ch at Carnegie Mellon University, President Obama is launching the Advanc esearch initiative that will promote a renaissance of American manufacturing.

One ex ting element of the President's Advanced Manufacturing Partnership is the National Robots are working for us every day, in countless ways. At home, at work, and on the battlefie increasingly lifting the burdens of tasks that are dull, dirty, or dangerous.

But they could do even more, and that's what the National Robotics Initiative is all about. So t (the National Science Foundation, the National Institutes of Health, NASA, and the United Sta Agriculture) are issuing a joint solicitation that will provide up to $70 million in research fundin generation robotics.

The focus of this initiative is on developing robots that work with or beside people to extend o capabilities, taking advantage of the different strengths of humans and robots. In addition to i technology needed for next-generation robotics, the initiative will support applications such a

National Robotics Initiative is announced

Henrik Chistensen
Georgia Tech

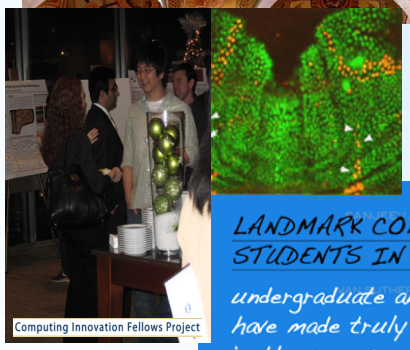
Visioning: Progress to date

Community visioning activities	Participants	Organizations
Networking science & engineering	109	44
Cyber-physical systems	100	47
Robotics	141	79
“Big Data” Computing	81	46
Theoretical computer science	39	26
Global development (ICT4D)	56	37
Learning technologies	55	30
Health information technology	121	102
Cross-layer reliability	121	45
Free & open source software	45	35
Advancing computer architecture	In progress	
Interactive technologies	In progress	
Sustainability & IT	In progress	

A multitude of activities

- **Community-initiated visioning:**
  - Workshops that bring researchers together to discuss the frontiers of computing
  - Challenges & Visions tracks at conferences

- **Outreach to the White House and Federal agencies:**
  - Outputs of visioning activities
  - Short reports to inform policy makers
  - Task Forces -- Health IT, Computational Sustainability, and Big Data



This Week's Highlight:
Fruit Fly Suggests New Solution to Computer Networking Problem

LANDMARK CONTRIBUTIONS BY STUDENTS IN COMPUTER SCIENCE

undergraduate and graduate students that have made truly game-changing contributions in the course of their studies

- **Public relations efforts:**
  - Library of Congress symposia
  - Research "Highlight of the Week"
  - CCC Blog [http://cccblog.org/]

Outreach: CCC Blog

The Computing Community Consortium Blog

A Service for the Computing Research Community

Home | Site Admin | Log out

Home | About the CCC | About this blog | Search

"Improving Brain-Computer Interfaces"

October 17th, 2011 by Erwin Gianchandani | Edit this entry — 0 Comments and 3 Reactions

A *Science Nation* story published today describes a public-private partnership funded in part by the National Science Foundation (NSF) that is attempting to link mind and machine to ultimately improve the living conditions of those with "locked-in syndrome" — a malady in which people with normal cognitive brain activity suffer severe paralysis, often from injuries or an illness such as Lou Gehrig's disease.

From the *Science Nation* article (see a video after the jump!):

» Read more: "Improving Brain-Computer Interfaces"

Posted in big science, research horizons, research news — 0 Comments and 3 Reactions

SUBSCRIBE VIA E-MAIL

Enter your email address: Go

SUBSCRIBE

to the CCC Blog Feed

LATEST TWEET

"Improving Brain-Computer Interfaces" http://t.co/SrgTEr8A

Follow CCC on twitter here.

RECENT POSTS

- "Improving Brain-Computer Interfaces"
- Administration Seeking Input on National Bioeconomy Blueprint
- First Person: "One of My Most Exciting Internship Experiences"
- Announcing the 2011 Computing Innovation Fellows
- Susan Graham to Receive Ken Kennedy Award

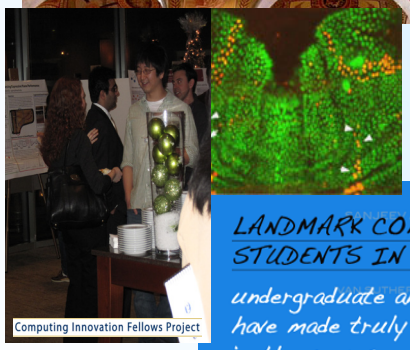
MOST READ POSTS

- "Improving Brain-Computer Interfaces" (22)
- Administration Seeking Input on National Bioeconomy Blueprint (15)
- Announcing the 2011 Computing Innovation Fellows (4)

A multitude of activities

- **Community-initiated visioning:**
  - Workshops that bring researchers together to discuss the frontiers of computing
  - Challenges & Visions tracks at conferences

- **Outreach to the White House and Federal agencies:**
  - Outputs of visioning activities
  - Short reports to inform policy makers
  - Task Forces -- Health IT, Computational Sustainability, and Big Data



This Week's Highlight:
Fruit Fly Suggests New Solution to Computer Networking Problem

LANDMARK CONTRIBUTIONS BY STUDENTS IN COMPUTER SCIENCE

undergraduate and graduate students that have made truly game-changing contributions in the course of their studies

- **Public relations efforts:**
  - Library of Congress symposia
  - Research "Highlight of the Week"
  - CCC Blog [http://cccblog.org/]

- **Nurturing the next generation of leaders:**
  - Computing Innovation Fellows Project
  - "Landmark Contributions by Students"
  - Leadership in Science Policy Institute

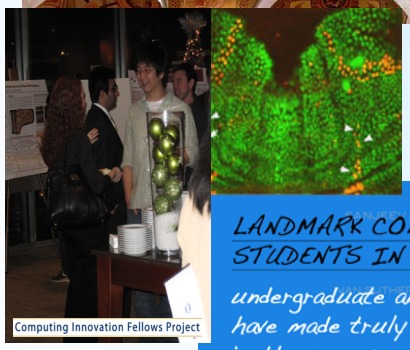
Next generation: CIFellows Project

- Established in 2009 with NSF/CISE funding
- Provides recent CS Ph.D.s one- to two-year postdoctoral positions
- Goal has been to retain new Ph.D.s in research & teaching during difficult economic times
- 60 CIFellows funded in 2009
  - 19 left the program after year I
  - 39 have now found tenure-track faculty or industrial research positions
- 47 funded in 2010
- 20 funded in 2011
- A research project in and of itself…

A multitude of activities

- **Community-initiated visioning:**
  - Workshops that bring researchers together to discuss the frontiers of computing
  - Challenges & Visions tracks at conferences

- **Outreach to the White House and Federal agencies:**
  - Outputs of visioning activities
  - Short reports to inform policy makers
  - Task Forces -- Health IT, Computational Sustainability, and Big Data



This Week's Highlight:
Fruit Fly Suggests New Solution to Computer Networking Problem

LANDMARK CONTRIBUTIONS BY STUDENTS IN COMPUTER SCIENCE

undergraduate and graduate students that have made truly game-changing contributions in the course of their studies

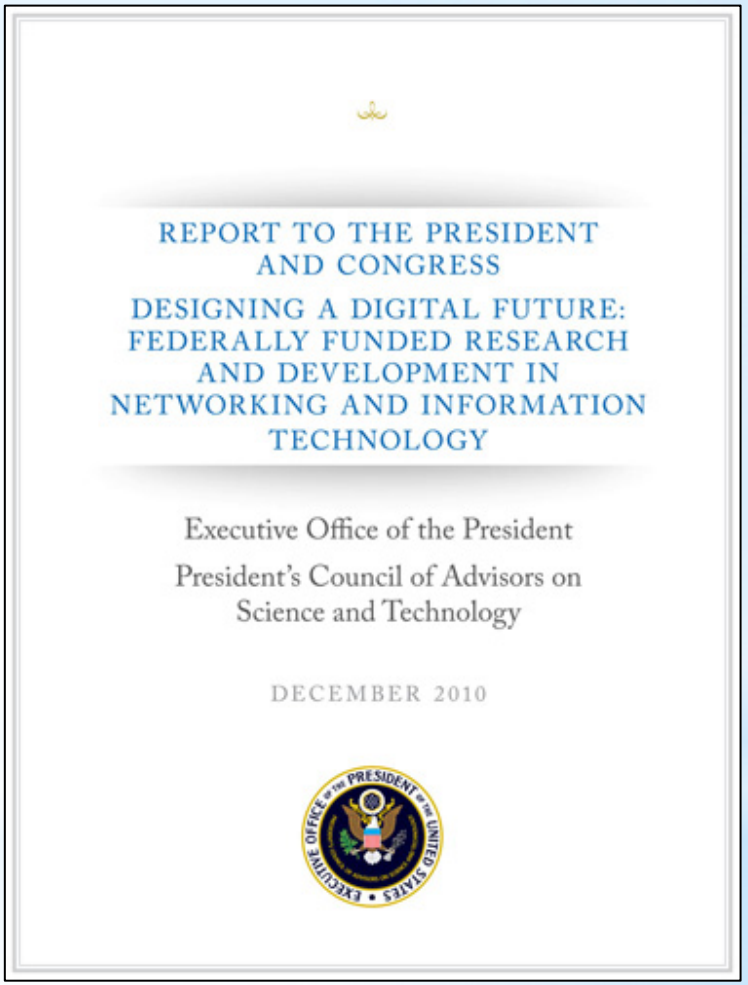
- **Public relations efforts:**
  - Library of Congress symposia
  - Research "Highlight of the Week"
  - CCC Blog [http://cccblog.org/]

- **Nurturing the next generation of leaders:**
  - Computing Innovation Fellows Project
  - "Landmark Contributions by Students"
  - Leadership in Science Policy Institute

Our view of health IT

The PCAST report

- "Go well beyond the current national program to adopt electronic health records"
- "Make possible comprehensive lifelong multi-source health records for individuals"
- "Enable both professionals and the public to obtain and act on health knowledge from diverse and varied sources as part of an interoperable health IT ecosystem"
- "Provide appropriate information, tools, and assistive technologies that empower individuals to take charge of their own health and reduce costs."


REPORT TO THE PRESIDENT AND CONGRESS

DESIGNING A DIGITAL FUTURE: FEDERALLY FUNDED RESEARCH AND DEVELOPMENT IN NETWORKING AND INFORMATION TECHNOLOGY

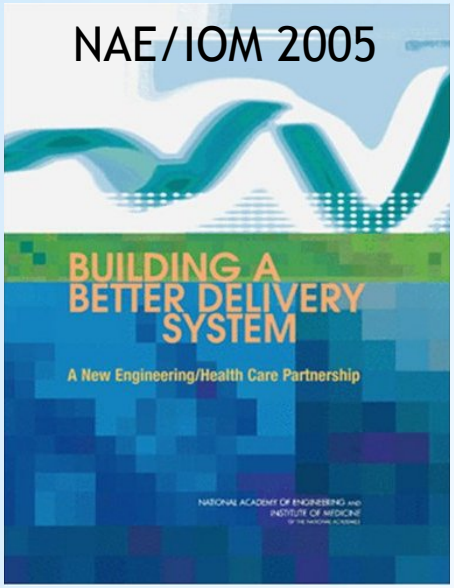
Executive Office of the President

President's Council of Advisors on Science and Technology

DECEMBER 2010

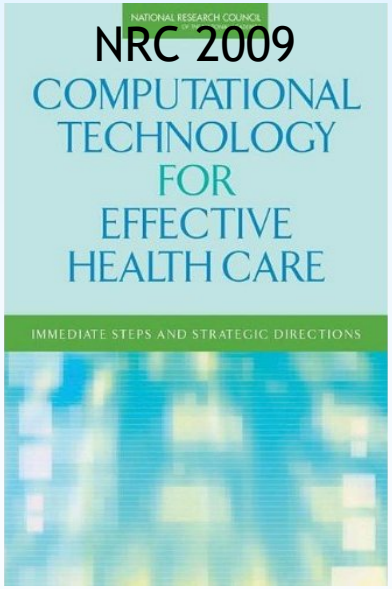
Various NRC reports

NAE/IOM 2005



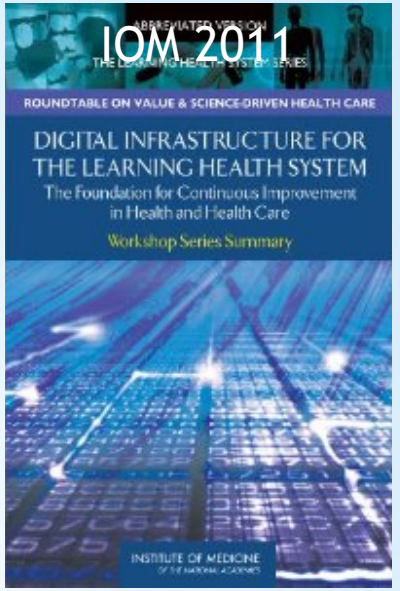
"Although information collection, processing, communication, and management are at the heart of health care delivery, and considerable evidence links the use of clinical information/communications technologies to improvements in the quality, safety, and patient-centeredness of care, the health care sector remains woefully underinvested in these technologies…"

NRC 2009



Computer science as a discipline does not subsume health/biomedical informatics, although computer scientists can and do make major contributions to that field. Health/biomedical informatics is more than medical computer science… In the context of this report, specialists in health/biomedical informatics can serve a bridging function between the computer science community and the world of biomedicine…

IOM 2011



The **Learning Healthcare System** is… one in which progress in science, informatics, and care culture align to generate new knowledge as an ongoing, natural by-product of the care experience, and seamlessly refine and deliver best practices for continuous improvement in health and health care.

The challenge of healthcare

Exhibit ES-1. Overall Ranking

Country Rankings
1.00–2.33
2.34–4.66
4.67–7.00

	AUS	CAN	GER	NETH	NZ	UK	US
OVERALL RANKING (2010)	3	6	4	1	5	2	7
Quality Care	4	7	5	2	1	3	6
Effective Care	2	7	6	3	5	1	4
Safe Care	6	5	3	1	4	2	7
Coordinated Care	4	5	7	2	1	3	6
Patient-Centered Care	2	5	3	6	1	7	4
Access	6.5	5	3	1	4	2	6.5
Cost-Related Problem	6	3.5	3.5	2	5	1	7
Timeliness of Care	6	7	2	1	3	4	5
Efficiency	2	6	5	3	4	1	7
Equity	4	5	3	1	6	2	7
Long, Healthy, Productive Lives	1	2	3	4	5	6	7
Health Expenditures/Capita, 2007	$3,357	$3,895	$3,588	$3,837*	$2,454	$2,992	$7,290

Note: * Estimate. Expenditures shown in $US PPP (purchasing power parity).
Source: Calculated by The Commonwealth Fund based on 2007 International Health Policy Survey; 2008 International Health Policy Survey of Sicker Adults; 2009 International Health Policy Survey of Primary Care Physicians; Commonwealth Fund Commission on a High Performance Health System National Scorecard; and Organization for Economic Cooperation and Development, OECD Health Data, 2009 (Paris: OECD, Nov. 2009).

Source: The Commonwealth Fund.

The challenge of healthcare II

- Between $600 million and $850 million in waste and fraud in the U.S.
- Over two million patients harmed each year by hospital-acquired infections
  - Over 100,000 of these individuals die
- Over one million patients suffer disabling complications during surgery
  - 100,000 of these are fatal
  - Half are thought to be avoidable

"Discovery & Innovation in HIT"

- Multi-agency workshop with 100+ computer scientists, systems engineers, social scientists, care practitioners
- Oct. 2009 in San Francisco
- Produced a report summarizing key research questions, directions
- NSF/CISE initiated Smart Health & Wellbeing in FY 2011

- From data to knowledge to action -- enabling evidence-based healthcare
- Empowering people -- providers and consumers -- improves healthcare quality
- Computer-based augmentation of human learning, reasoning, decision-making, and physical motion significantly enhances human capabilities
- Healthcare is a complex, large-scale, adaptive distributed evolving system
- The Importance of Collaborative Government Investment

Healthcare is changing

- Acute to chronic care
  - 75% of healthcare expenditures due to chronic disease
  - Top 50% of patients account for 97% of total cost

Continuous treatment of chronic conditions

- Disease-centered to patient-centered
  - Patients become active participants in their care

Individuals **manage** their own health

- Hospitals to homes

More healthcare at home, in communities; family members act as caregivers

- Treatment to wellness
  - Behaviors impact over 50% of one's health status – but only 4% of healthcare expenses are spent on managing one's activities
  - Medical services impact 10% of health status – but total 88% of expenses
  - Among heart disease patients, 75% claimed healthy behaviors – but 30% were honest

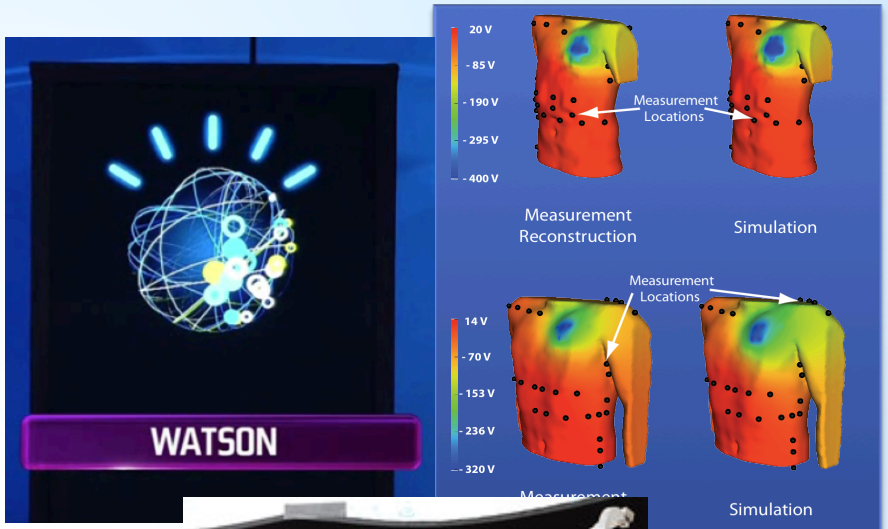
Individuals take **responsibility** of their health

- Quantity to quality

Business of healthcare delivery is increasingly complex

Powerful technologies emerging…

- Sophisticated imaging, sensing, monitoring and communication technologies
- Massive amounts of multi-media electronic data about individuals, disease, treatments
- Increasingly powerful data analysis methods
- Robust robotic and speech technologies
- Advancing understanding of human behavior, cognition, and incentives



...But healthcare is different

- Multi-modal data, e.g., quantitative metrics, continuous readings, human reports
- Data are incomplete and may be contradictory
- Poorly defined noise models
  - Sampling bias towards the sick
  - Poorly characterized individual and population variations
- Complex social dynamics
- Leads to **integration** and **specialization**

Integration is essential

- Information over long periods of time must be uniformly accessible
- Must combine data from multiple sources, multiple scales, and multiple representations
- Need common understanding of terminology and actions

Specialization is important

- Access to information must be contextual and use-driven
  - Privacy in context
  - Use-driven relevance
- Ease and clarity of understanding
- Skills of caregiver and patient matter

The research opportunities

- "Data to Knowledge to Action" (Decisions)
  - Data availability, summarization, and visualization
  - Information discovery, predictive modeling, and decision-making
- Smart sensing, telemetry, and actuation for patient monitoring and care
- Deployment systems

Research opportunities:

Big Data

- Patient records
  - Automated abstraction
  - Interactive contextual views
  - Automated documentation and communication
  - Person's own record

- Care-giving tools for non-specialists
  - Online personalized recommendations
  - Social networking for questions and concerns
  - Mobile interactive tools for community health workers

Research opportunities:

Information Extraction

- Machine learning for clinical care
  - Use large patient data sets to develop recommendations, alerts, and warnings for diagnosis, drugs, disease management, etc.
  - Analyze genomic, epidemiologic, and clinical data to create wellness plans and therapies
- Predictive models
  - Assess the effects of a new therapy on outcomes and costs
  - Identify drug-related adverse effects and to whom
  - Model relationships among biologic, environmental, and behavioral processes at multiple scales
- Cognitive assistance
  - For decision making under uncertainty and time pressure
  - Self-documenting environments, e.g. for care
  - Automated fault detection

Research opportunities:

Monitoring and care

- Closed loop
  - Sensing and dosing for fine-grained drug delivery
  - Non-invasive monitoring of physiological phenomena
  - Implanted devices to monitor internal structure and function
  - Robotic home care assistance
- Diagnosis and surgery
  - Machine vision for histological and radiological imaging
  - Distributed surgical teams and collaborations
  - Robotic surgical assistance
  - Automated vision-guided precision microsurgery
- Patient-in-the-loop
  - Telemetric and remote social monitoring and assistance for the chronically ill
  - Assistive software agents for independent living for the cognitively impaired
  - Devices and behavioral models to persuade and coach healthier living
  - Privacy-preserving architectures for selective sharing of personal health data

Research opportunities:

Deployment platforms

- Patient-centered – model information processes from hospital to home
- Disease-centered – diabetes from childhood to adult, Alzheimer's progression and evaluation
- Tool-centered – robotics
- Modeling and simulation
- A hospital, a home, or an individual as a testbed
- *Competitions for solutions*

An interdisciplinary approach

- Problem solutions require diverse disciplinary components
- Experts in one domain are novices in others
  - CS experts understand human-computer interfaces, data collection and analysis, assistive technologies, etc.
  - Healthcare experts understand disease, interventions, a variety of healthcare processes, etc.
- Many computer scientists are eager to do health-related research
  - Opportunity to ground their research in important applications
  - Socially relevant problems
  - New intellectually interesting challenges unique to healthcare
  - 150 applications to NSF's FY 2011 Smart Health & Wellbeing solicitation
- Systems engineers, social and behavioral scientists, economists
- *Some hesitate to apply to NSF, others hesitate to apply to NIH, etc.*

How can we help?

How can we help?

- Based in downtown DC
- Committee of 20 leading computing researchers can tap into the field
- Workshops? White papers?
- Other offices at NIH?

Please contact me:
erwin@cra.org or 202-266-2936
http://cra.org/ccc or http://cccblog.org/

Computing Research Association

Arizona State University - CSE
Auburn University - CSSE
Ball State University - CS
Boston College - CS
Boston University - CS
Bowdoin College - CS
Bowling Green State University - CS
Bradley University - CS
Brandeis University - CS
Brigham Young University - CS
Brown University - CS
Bryn Mawr College - MCS
Bucknell University - CS
California Institute of Technology - CS
California Polytechnic State University - CS
California State University, Chico - CS
Carnegie Mellon University - CS
Case Western Reserve University - EECS
City University of New York, Graduate Center - CS
Clemson University - CS
Colgate University - CS
College of William & Mary - CS
Colorado School of Mines - MCS
Colorado State University - CS
Columbia University - CS
Cornell University - CS
Cornell University - ECE
Dalhousie University - CS
Dartmouth College - CS
DePaul University - CS
Drexel University - CS
Drexel University - IST
Duke University - CS
Emory University - MCS
Florida Atlantic University - CSE
Florida Institute of Technology - CS
Florida International University - CS
Florida State University - CS
Florida State University - IS
George Mason University - CS
George Washington University - CS
Georgia Institute of Technology - CSE
Georgia Southern University - IT
Georgia State University - CIS
Georgia State University - CS
Grinnell College - MCS
Harvard University - CS
Harvey Mudd College - CS
Hofstra Universyt - CS
Illinois Institute of Technology - CS
Illinois State University - ACS
Indiana University - CS
Indiana University - I
Iowa State University - CS
Iowa State University - ECE
Johns Hopkins University - CS
Johns Hopkins University - SI
Juniata College - IT & CS
Kansas State University - CIS
Kent State University - CS
Lafayette College - CS
Lehigh University - CSE
Long Island University - ICS
Louisiana State University - CS
Loyola University, Chicago - CS
Massachusetts Institute of Technology - EECS
Miami University - CS
McMaster University - CE&S
Michigan State University - CSE
Michigan Technological University - CS
Mississippi State University - CS
Montana State University - CS
Montclair State University - CS
National University of Singapore - CS/IS
Naval Postgraduate School - CS
New Jersey Institute of Technology - CCS
New Mexico State University - CS
New York University - CS
North Carolina State University - CS
Northeastern University - CIS
Northwestern University - ECE
Nova Southeasern University - CS
Oakland University - CSE
Ohio State University - CSE
Ohio University - EECS
Oklahoma State University - CS
Old Dominion University - CS
Oregon Health & Science University - CSE
Oregon State University - EECS
Pace University - CSIS
Pennsylvania State University - CSE
Pennsylvania State University - IST
Polytechnic University - CIS
Pomona College - MCS
Portland State University - CS
Princeton University - CS
Purdue University - CS
Purdue University - ECE
Rensselaer Polytechnic Institute - CS
Rice University - CS
Rochester Institute of Technology - CS
Roosevelt University - CS&T
Rutgers University, Busch Campus - CS
Saint Louis University - MCS
Santa Clara University - CE
Simon Fraser University - CS
Singapore Management University - IS
Southern Illinois University, Carbondale - CS
Southern Methodist University - CSE
Southern Polytechnic State University - CSE
Stanford University - CS
State University of New York, Albany - CS
State University of New York, Binghamton - CS
State University of New York, Stony Brook - CS
Stevens Institute of Technology - CS
Swarthmore College - CS
Syracuse University - IS
Temple University - CIS
Texas A&M University - CS
Texas State University - CS
Toyota Technological Institute at Chicago - CS
Tufts University - CS
Tulane University - EECS
Union College - CS
University at Buffalo - CSE
University at Buffalo - IS
University of Alabama, Birmingham - CIS
University of Alabama, Tuscaloosa - CS
University of Alberta - CS
University of Arizona - CS
University of Arkansas - CSCE
University of Arkansas at Little Rock - I
University of Calgary - CS
University of California, Berkeley - EECS
University of California, Berkeley - IMS
University of California, Davis - CS
University of California, Irvine - ICS
University of California, Los Angeles - CS
University of California, Riverside - CSE
University of California, San Diego - CSE
University of California, Santa Barbara - CS
University of California, Santa Cruz - CE
University of California, Santa Cruz - CS
University of Central Florida - CS
University of Chicago - CS
University of Cincinnati - ECECS
University of Colorado, Boulder - CS
University of Delaware - CIS
University of Denver - CS
University of Florida - CISE
University of Georgia - CS
University of Hawaii - ICS
University of Houston - CS
University of Houston - ECE
University of Idaho - CS
University of Illinois, Chicago - CS
University of Illinois, Urbana Champaign - CS
University of Illinois, Urbana Champaign - ECE
University of Iowa - CS
University of Kansas - EECS
University of Kentucky - CS
University of Louisiana at Lafayette - CACS
University of Louisville - CECS
University of Maine - CS
University of Maryland - CS
University of Maryland, Baltimore Co - CSEE
University of Maryland, Baltimore Co - IS
University of Massachusetts, Amherst - CS
University of Massachusetts, Boston - CS
University of Michigan - EECS
University of Michigan - I
University of Michigan, Dearborn - CIS
University of Minnesota - CSE
University of Minnesota, Duluth - CS
University of Mississippi - CIS
University of Missouri, Columbia - CS
University of Missouri, Rolla - CS
University of Montana - CS
University of Montreal - CS
University of Nebraska at Omaha - CS/IST
University of Nebraska, Lincoln - CSE
University of Nevada, Las Vegas - CS
University of Nevada, Reno - CSE
University of New Brunswick - CS
University of New Hampshire - CS
University of New Mexico - CS
University of New Mexico - ECE
University of North Carolina at Chapel Hill - CS
University of North Carolina at Chapel Hill - SILS
University of North Carolina, Charlotte - IT
University of North Dakota - CS
University of North Texas - CS
University of Notre Dame - CSE
University of Oklahoma - CS
University of Oregon - CIS
University of Pennsylvania - CIS
University of Pittsburgh - CS
University of Pittsburgh - IS
University of Puget Sound - MCS
University of Rochester - CS
University of South Alabama - CIS
University of South Carolina - CSE
University of South Florida - CSE
University of Southern California - CS
University of Southern California - EES
University of Tennessee, Knoxville - CS
University of Texas, Arlington - CSE
University of Texas, Austin - CS
University of Texas, Dallas - CS
University of Texas, El Paso - CS
University of Toronto - CS
University of Tulsa - MCS
University of Utah - CS
University of Virginia - CS
University of Washington - CSE
University of Washington - I
University of Washington, Bothell - CS
University of Washington, Tacoma - CSS
University of Waterloo - CS
University of Wisconsin, Madison - CS
University of Wisconsin, Milwaukee - EECS
University of Wyoming - CS
Utah State University - CS
Vanderbilt University - EECS
Virginia Commonwealth University - CS
Virginia Tech - CS
Wake Forest University - CS
Washington State University - EECS
Washington University in St. Louis - CS
Wayne State University - CS
West Virginia University - CSEE
Western Michigan University - CS
Williams College - CS
Worcester Polytechnic Institute - CS
Wright State University - CSE
Yale University - CS
York University - CS

Sun Microsystems (Sponsoring Member)
Microsoft Corporation (Sustaining Member)
IBM Research (Supporting Member)

Accenture Technology Labs
Argonne National Laboratory
Avaya
CA Labs
Computer Science Research Institute,
Sandia National Labs
Fraunhofer Center for
Experimental Software Engineering
Fujitsu Laboratories of America
Google
Hewlett-Packard Company
IDA Center for Computing Sciences
Intel Corporation
Lawrence Berkeley National Laboratory
Los Alamos National Laboratory
Lucent Technologies, Bell Labs
McAfee Research
Mitsubishi Electric Research Labs
National Center for Atmospheric Research
NCSA
NEC Laboratories America
NTT DoCoMo USA Labs
Pacific Northwest National Laboratory
Panasonic Information &
Networking Technologies Lab
Ricoh Innovations
San Diego Supercomputer Center
SAP Labs
SRI International
Telcordia Technologies

Mission and activities

- Strengthen research and education in the computing fields
  - Working to influence **policy** that impacts computing research
  - Encouraging the development of **human resources**
  - Contributing to the cohesiveness of the professional **community**
- Collect and disseminate **information** about the importance and state of computing research

Gov't. Affairs

CRA-W & CDC

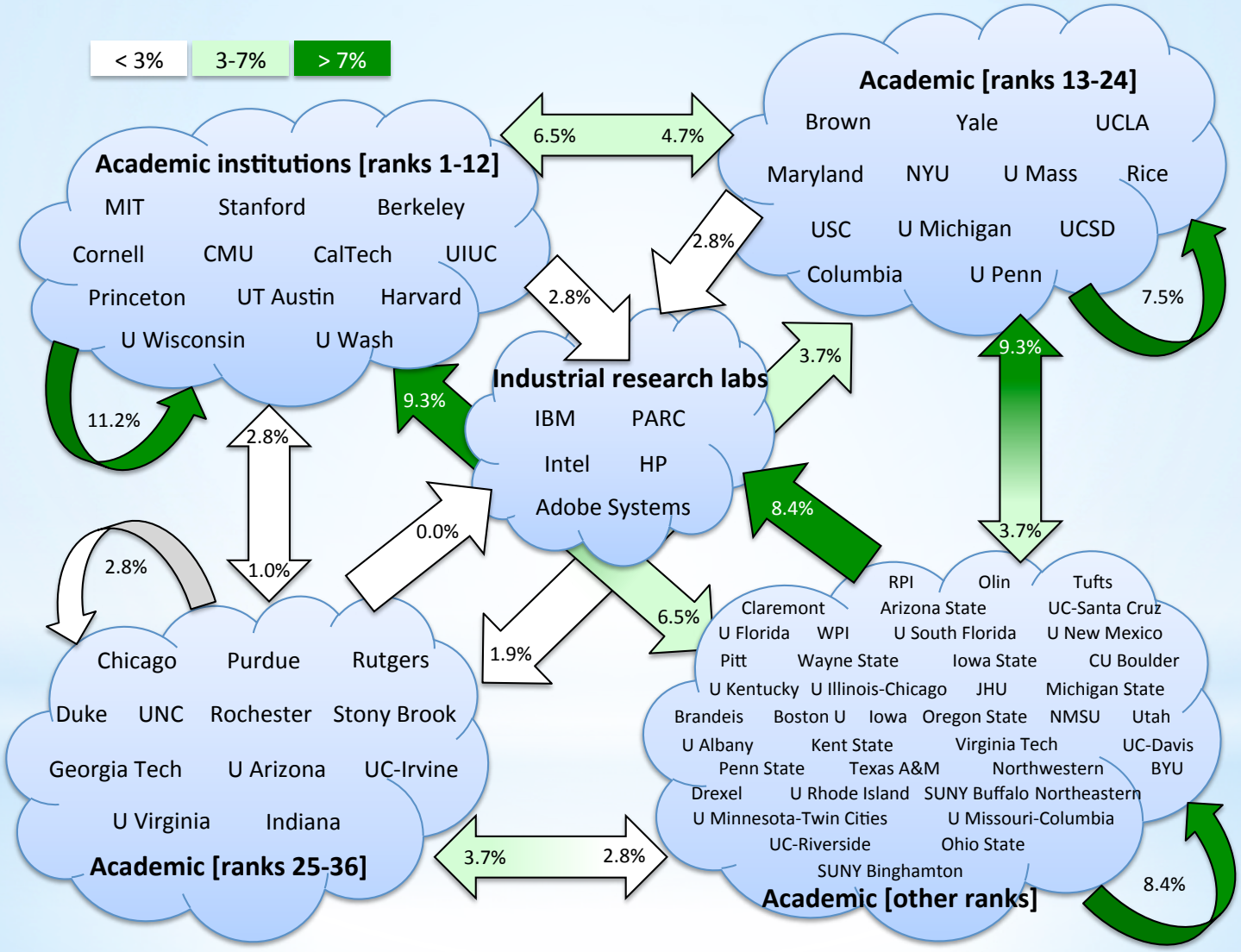
Taulbee Survey

Table 1. PhD Production by Type of Department and Rank				
Department, Rank	PhDs	Avg. per Dept.	PhDs Next Year	Avg. per Dept.
US CS 1-12	[illegible]	[illegible]	288	26.2
US CS 13-24	215	17.9	241	20.1
US CS 25-36	[illegible]	[illegible]	205	17.1
US CS Other	[illegible]	[illegible]	962	8.4
US CS Total	1,501	10.0	1,696	11.3

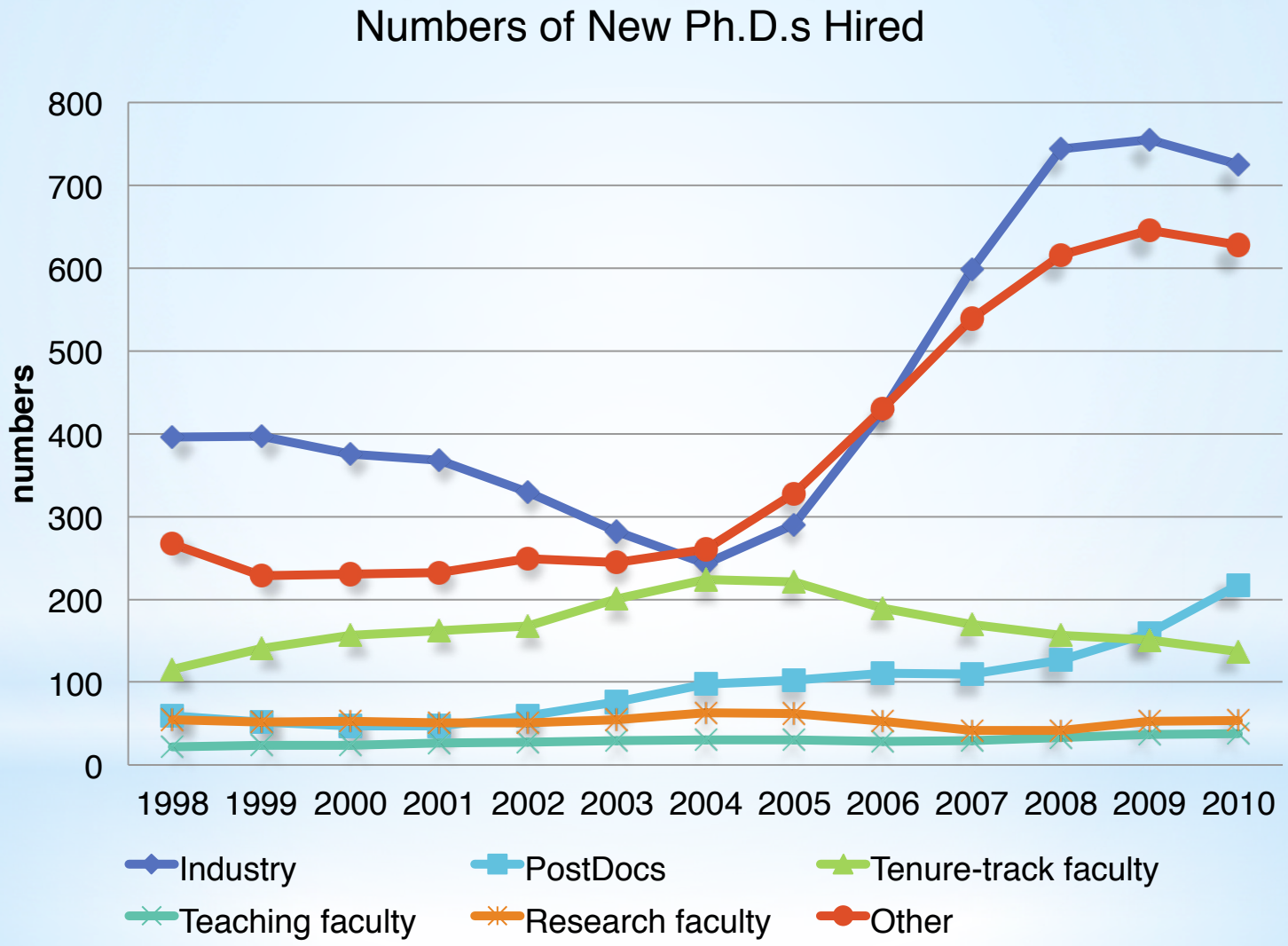
"Transition Team" white papers

- Sensed and seized an opportunity to influence Federal science policy through the Presidential transition team
- 19 papers produced in late 2008 & early 2009
  - 30 separate authors
- Many highly influential:
  - Re-envisioning DARPA – Peter Lee, Randy Katz
  - Infrastructure for eScience & eLearning/Unleashing Waves of Innovation – Ed Lazowska, Peter Lee, Chip Elliott, and Lary Smarr
  - Security is Not a Commodity – Stefan Savage, Fred Schneider
  - Synthetic Biology – Drew Endy
  - Big Data Computing – Randy Bryant, Randy Katz, Ed Lazowska
  - The Ocean Observatories Initiative – John Delaney, John Orcutt, Robert Weller
  - Cyber-Physical Systems – Janos Sztipanovits, Jack Stankovic

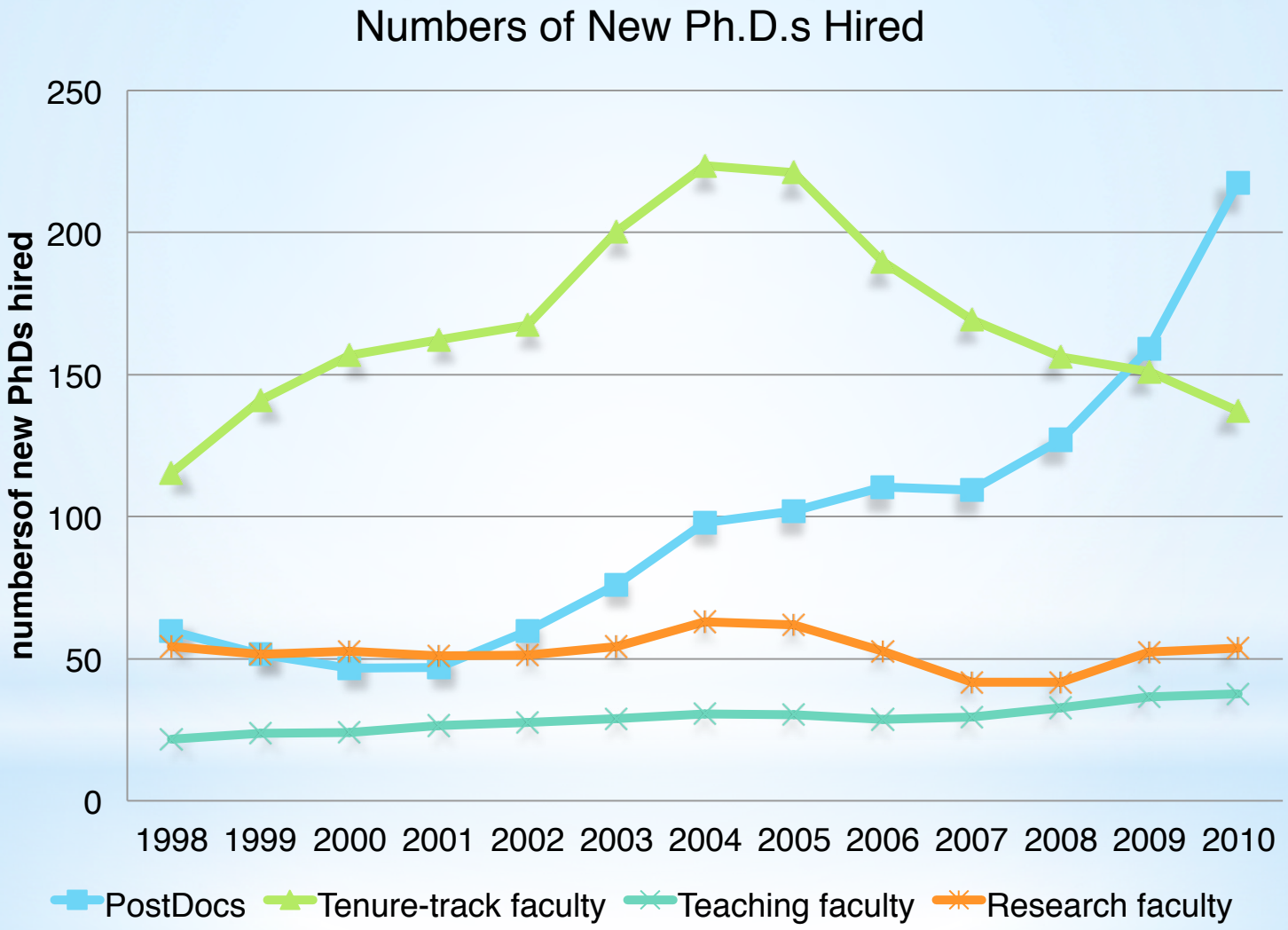
Next generation: CIF "cross-flow"



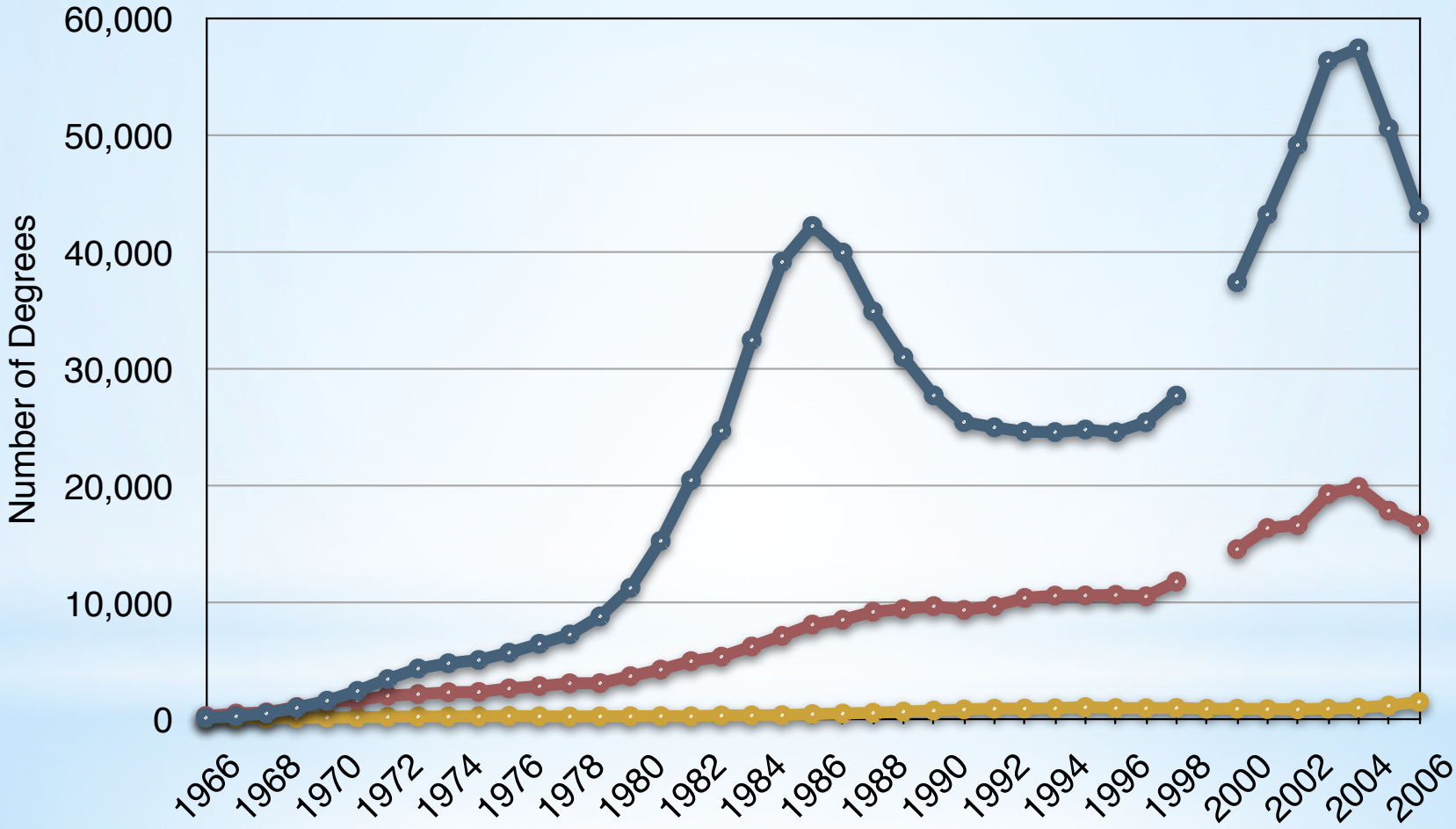
Next generation: Postdocs in CS



Next generation: Postdocs in CS II



Total CS degrees granted



Key drivers: information

* Just about every field is becoming an information field

* "NIT is arguably unique among all fields of science and engineering in the breadth of its impact … Recent technological and societal trends place the further advancement and application of NIT squarely at the center of our Nation's ability to achieve essentially all of our priorities and to address essentially all of our challenges … All indicators – all historical data, and all projections – argue that NIT is the dominant factor in America's science and technology employment.

-- *PCAST report, December 2010*

The shift toward interdisciplinary