CCC INDUSTRY ROUNDTABLE

July 24, 2015

Greg Hager, JHU, CCC Chair
Beth Mynatt, GA Tech, CCC Vice Chair
Brent Hailpern, IBM, CRA Board
Limor Fix, Intel, CCC Council Member
Ann Drobnis, CCC Director

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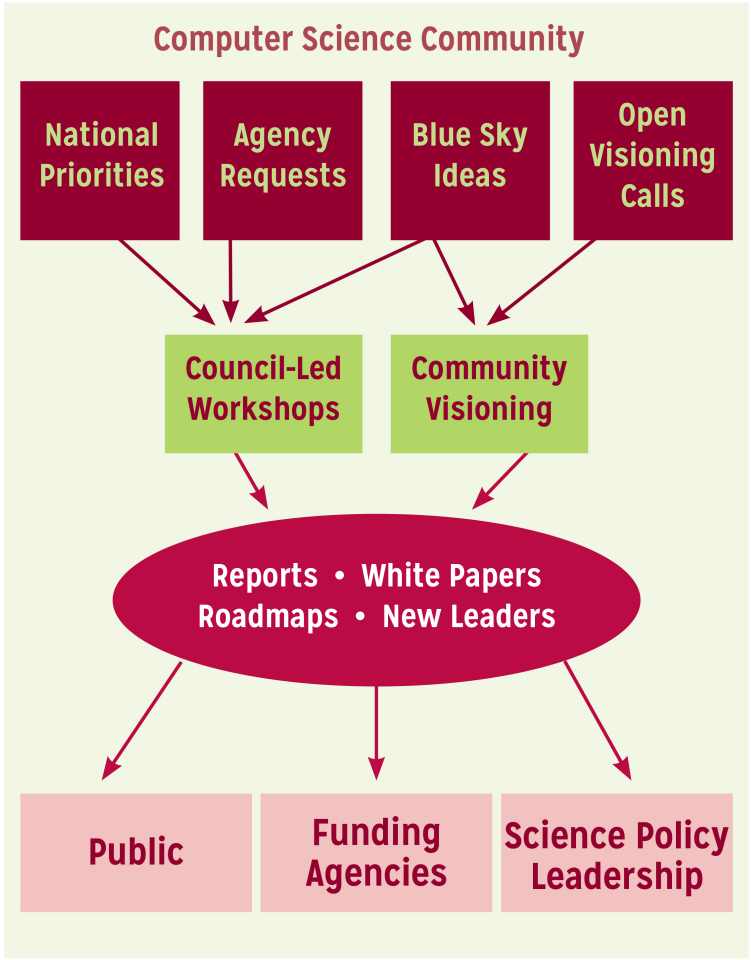
The **mission** of Computing Research Association's **Computing Community Consortium (CCC)** is to **catalyze** the computing research community and **enable** the pursuit of innovative, high-impact research.

- Audacious Thinking:
  - Community Initiated Visioning Workshops
  - Blue Sky Idea Tracks at Conferences
- Outreach to White House and Funding Agencies
- Communicating:
  - CCC Blog: http://cccblog.org
  - Great Innovative Ideas
  - Computing Research in Action Videos
- Nurturing the Next Generation of Leaders:
  - Computing Innovation Fellows
  - Leadership in Science Policy Institute
  - Postdoc Best Practices



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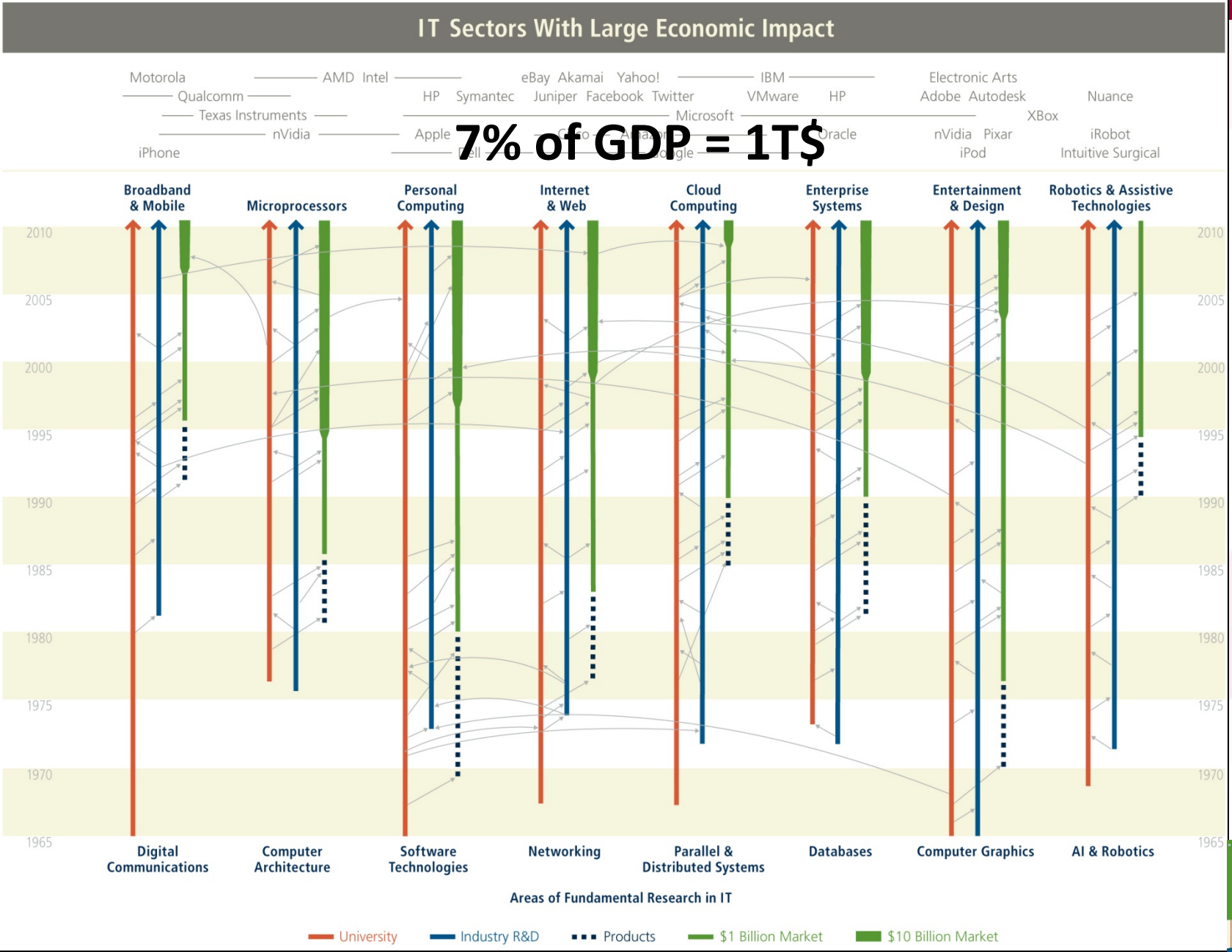
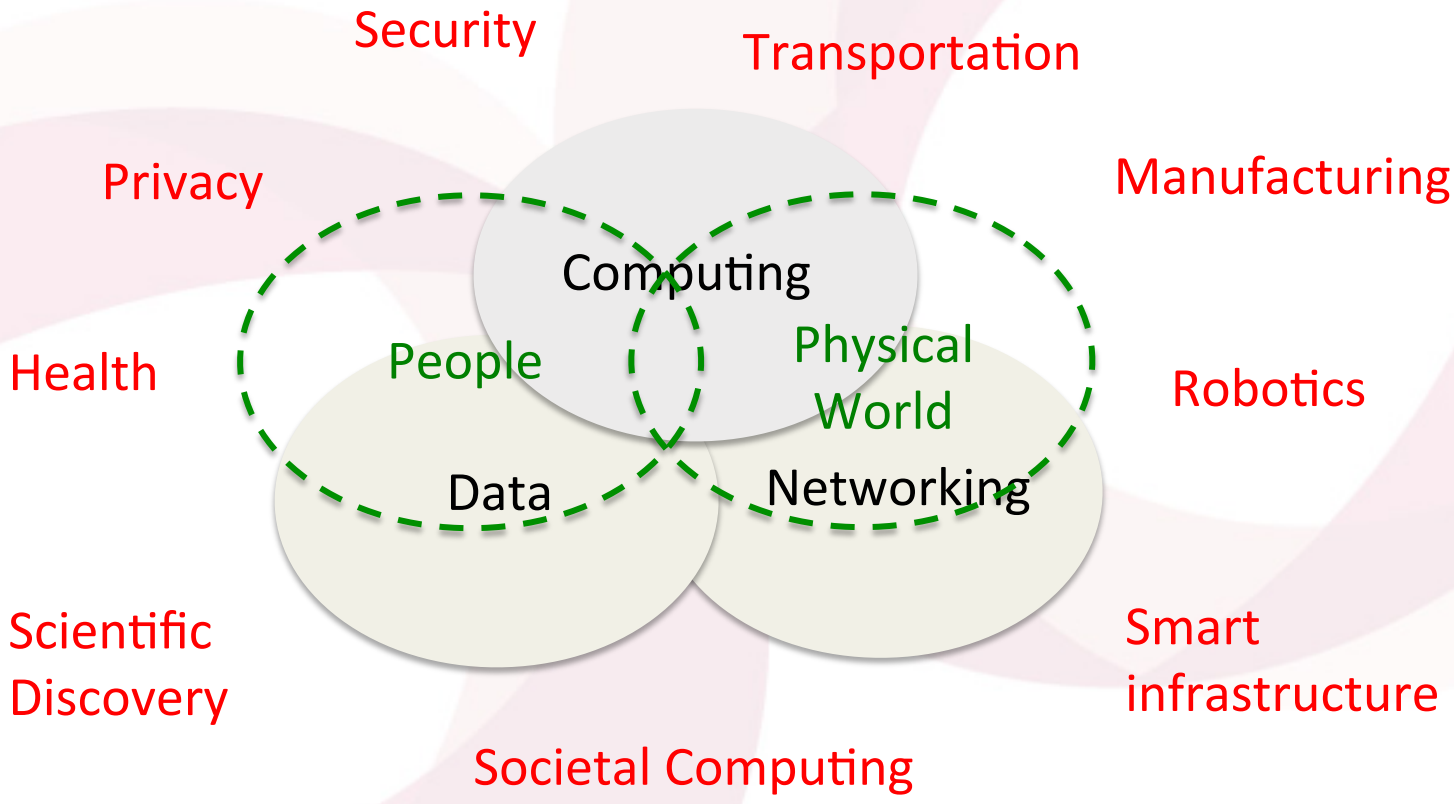

IT Sectors With Large Economic Impact
7% of GDP = 1T$
Motorola
Qualcomm
Texas Instruments
nVidia
iPhone
AMD
Intel
HP
Symantec
Apple
Dell
eBay
Akamai
Yahoo!
Juniper
Facebook
Twitter
IBM
VMware
HP
Microsoft
Oracle
Google
Electronic Arts
Adobe
Autodesk
XBox
nVidia
Pixar
iPod
Nuance
iRobot
Intuitive Surgical
Broadband & Mobile
Microprocessors
Personal Computing
Internet & Web
Cloud Computing
Enterprise Systems
Entertainment & Design
Robotics & Assistive Technologies
2010
2005
2000
1995
1990
1985
1980
1975
1970
1965
Digital Communications
Computer Architecture
Software Technologies
Networking
Parallel & Distributed Systems
Databases
Computer Graphics
AI & Robotics
Areas of Fundamental Research in IT
University
Industry R&D
Products
$1 Billion Market
$10 Billion Market


Continuing
Innovation
IN INFORMATION TECHNOLOGY

COMPUTING TODAY AND ITS ROLE IN SOCIETY



WHY STUDY INDUSTRY ACADEMIC INTERACTIONS?

There is a sense that the ecosystem is changing

- Growing number of areas of CS depend on strong industry/academic relationships in order to advance
- More companies are hiring PhDs and embedding them in R&D
- Whole research groups are being “bought out” by industry

This has implications for both communities

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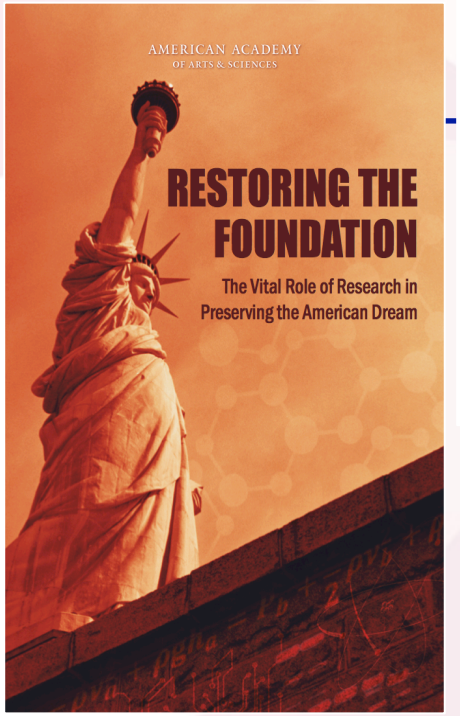
PARTNERSHIPS: MANY DIMENSIONS

Partnerships **build capacity, leverage resources, increase the speed of translation** from discovery to innovation



Prescription 3: Regain America's Standing as an Innovation Leader by Establishing a More Robust National Government-University-Industry Research Partnership

AAAS 2014

Courtesy Jim Kurose

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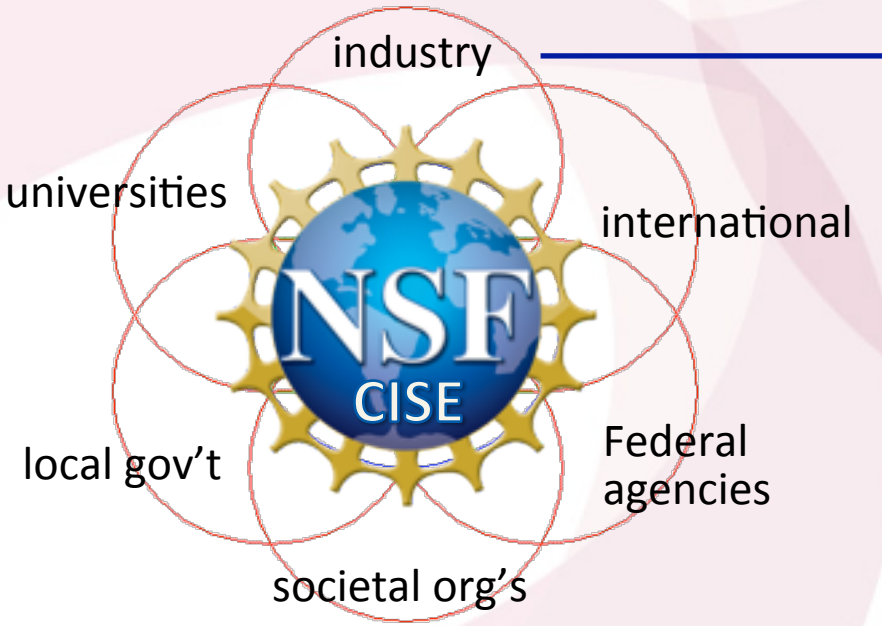
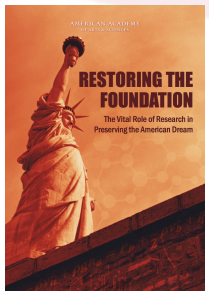


Courtesy Jim Kurose

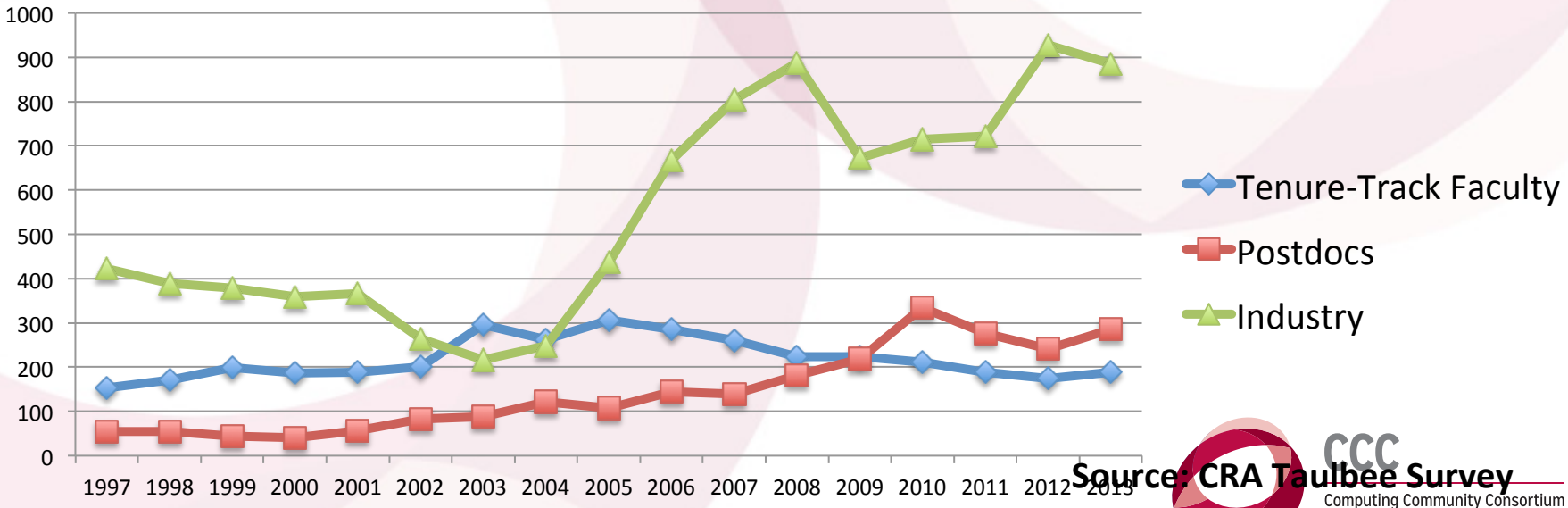
- NSF/SRC: SaTC STARRS
- NSF/Intel Partnerships (VEC, CPS)
- Innovation Transition (InTrans) DCL for Expeditions, Frontier projects



Prescription 3: Regain America's Standing as an Innovation Leader by Establishing a More Robust National Government-University-Industry Research Partnership

CHANGES FOR EDUCATION

- High leverage point – key connections and ideas can shape a career
- Other early career efforts largely focused on academics – CI fellows, Postdoc best practices
- Grad students and postdocs generally “do the work”



Source: CRA Taulbee Survey

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GOALS

- Initiate a conversation and understand mutual points of high value
- Discuss future needs and directions
- Understand barriers and limitations of existing models
- Create a framework for improving/amplifying/accelerating progress for both industry and academia

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AGENDA

- 9:00 – 9:30 Introduction
  - Greg Hager, Brent Hailpern – Welcome, Background, Goals
- 9:30 – 10:30 Future Vision for Computer Science
  - Beth Mynatt – 2025 Background / Moderator
  - Remarks: Nady Boules, GM; Chris Rossbach, VMWare
- 10:50 – 12:00 The impact of “academic research on industry” and “industry innovation on academic research”
  - Moderator: Limor Fix
  - Remarks: Stuart Feldman; Ben Zorn, MSR; Joel Emer, NVIDIA; Jia Li, Snapchat; Min Wang, Visa; Arnold Lund, GE
- 12:45 – 1:45 Infrastructure and Models for Collaboration
  - Ann Drobnis – Industry Survey Results
  - Moderator: Martial Hebert
  - Remarks: Laura Haas, IBM; Chris Re, Stanford
- 1:45 – 2:45 Open Discussion – Brent Hailpern
- 2:45 – 3:30 Next Steps -- Greg Hager

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SESSION 1: FUTURE VISION FOR COMPUTER SCIENCE

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COMPUTING RESEARCH HORIZONS

There is a sense in many different parts of the community that we are on the cusp of transformational changes that make looking out a decade from now very different than such exercises in the past

- Not just technological change, but societal change and individual change
- Need to get beyond our disciplinary and sub-disciplinary silos to grasp it fully

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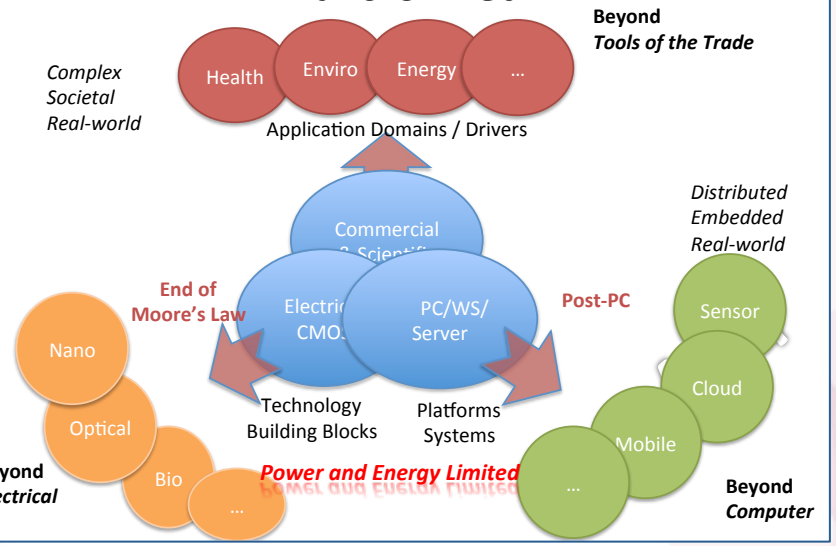
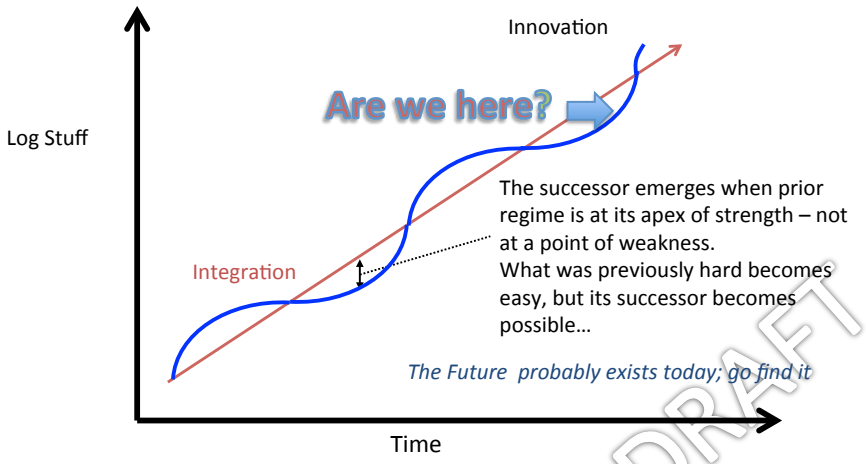
CISE AC WORKING GROUP DISCUSSION

The Three Legs of CISE "sweetspot" Transformed



Tides of Innovation



DRAFT

A New **Renaissance**

- The Information Age has transformed the world as we know it. (is transforming?)
- Now that digital technologies are fundamentally integrated in virtually every aspect of modern life, what does the "new" Renaissance circa 2025 promise?

Renaissance

… cultural movement sandwiched between the dark ages and the industrial revolution giving rise to modern science, culture and politics…

Enabled by the invention of movable type - sped the dissemination of ideas…

DRAFT

Three Cross-cutting Thrusts

- Indy Manufacturing
  - Pervasive innovation, mass customization, creation of goods and services by individuals with wide distribution, possibly highly specialized, open source copy-paste & edit *things* like SW is today
- Post mobile
  - Programmable intelligence all around us, within us, and between us
- Massively connected society
  - Expansion of the social contract, cyber-enabled organizations, democratization of education and research

DRAFT

INTELLIGENT ASSISTANTS

We expect computing to dramatically improve the way it assist humans in three fundamental dimensions:

Cognitive, Physical, Social

A vast variety of Networked Intelligent Assistants will be created

NIAs will help humans to overcome challenges in education, health, elder-care, population growth, work, sustainability, and more

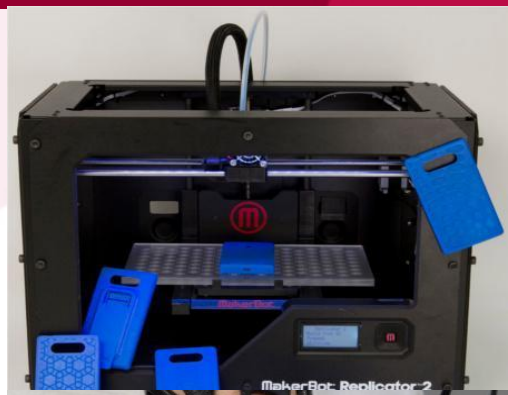
PROGRAMMABLE MATTER

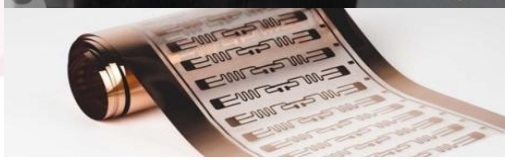
This new renaissance, underpinned by "maker movement", may change the way that most items are designed, manufactured, and delivered.

Confluence of 3 major trends:

- Cheap and fast creation of matter in new forms (e.g., 3D printing)
- On-demand electronics
- Programmable intelligence in every object

The creativity & change unleashed could change how society operates: return to craftsmanship with precision and the ability to mass customize/produce.

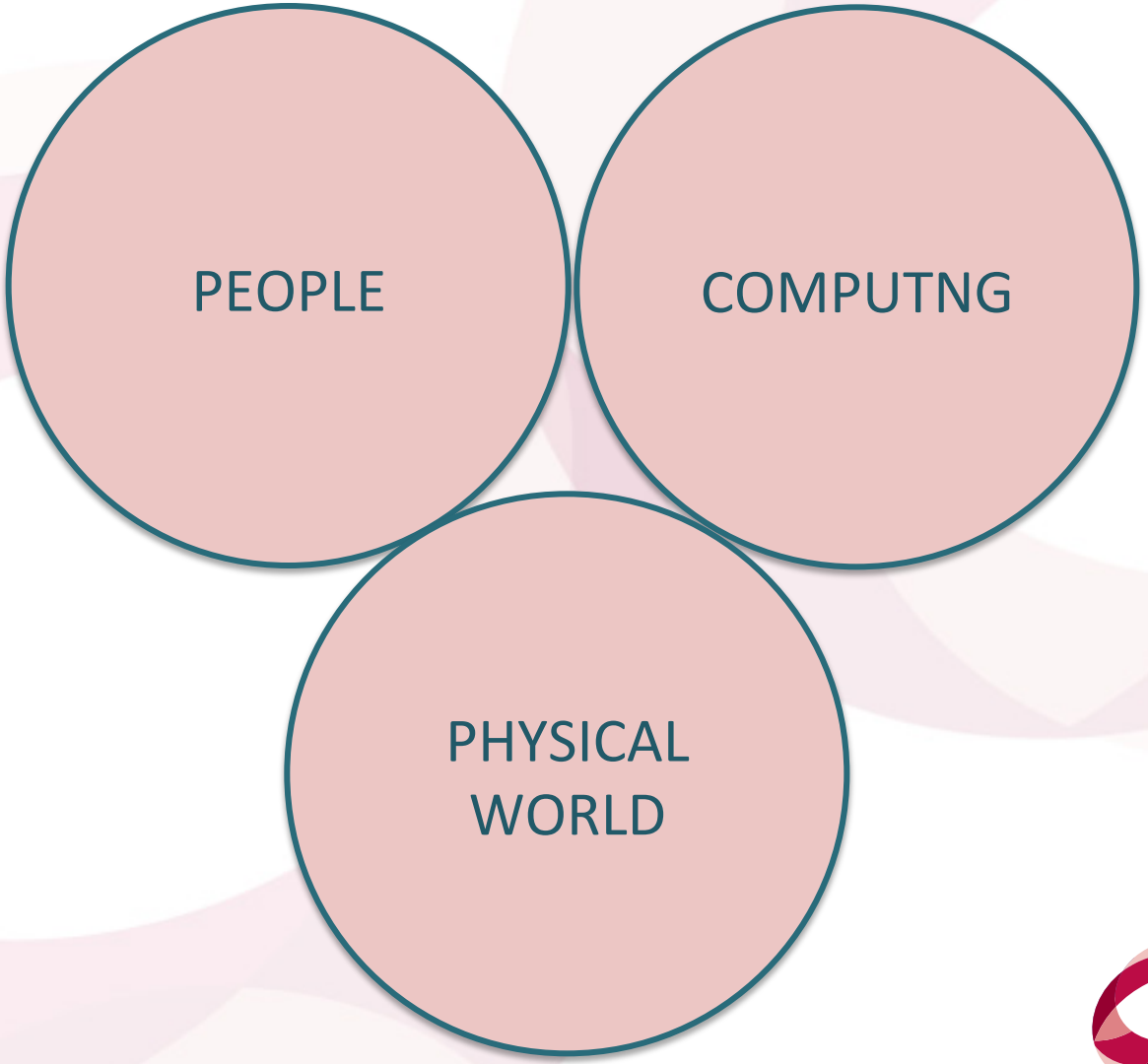


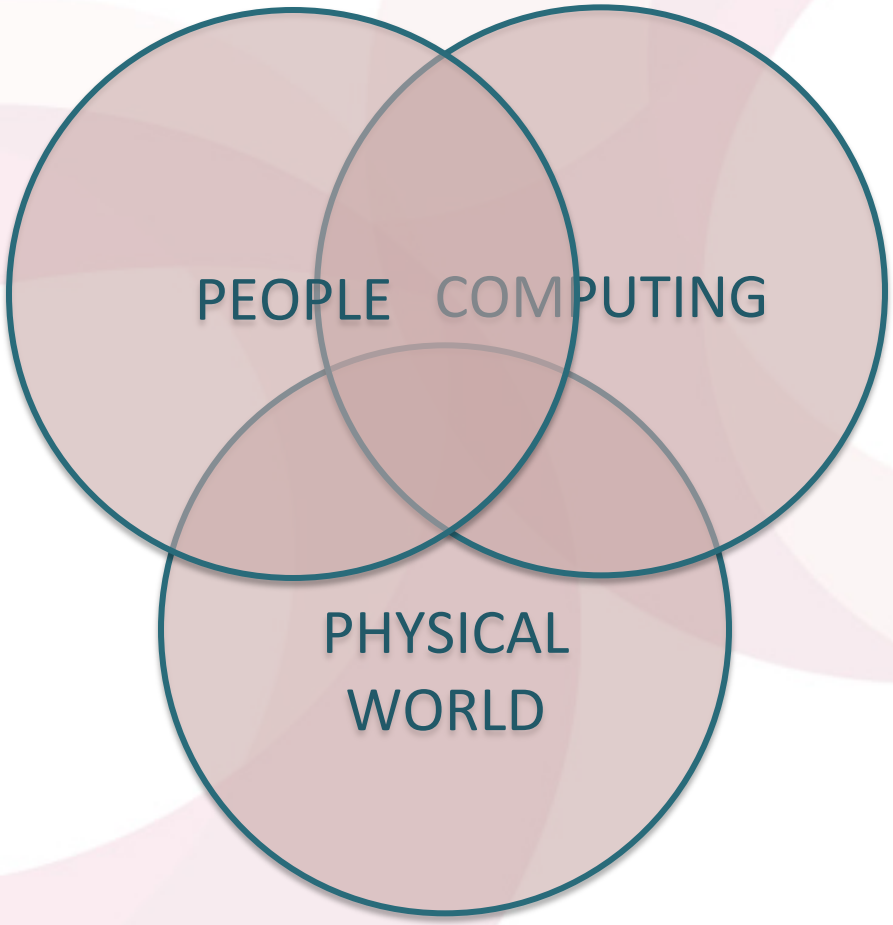


PERSONALIZED X

- "Wide" data analytics to create personalized models that support our needs, X = healthcare, X = education, X = transportation, X = social, X = home management, ….
- Eg. X = healthcare: Smart home technologies to enable comprehensive home health monitoring (e.g. aging population)
- Fundamental challenges in sensor fusion, data uncertainty, distributed systems, HCI, collaborative computing, and privacy and security

2025 IN 4 SLIDES





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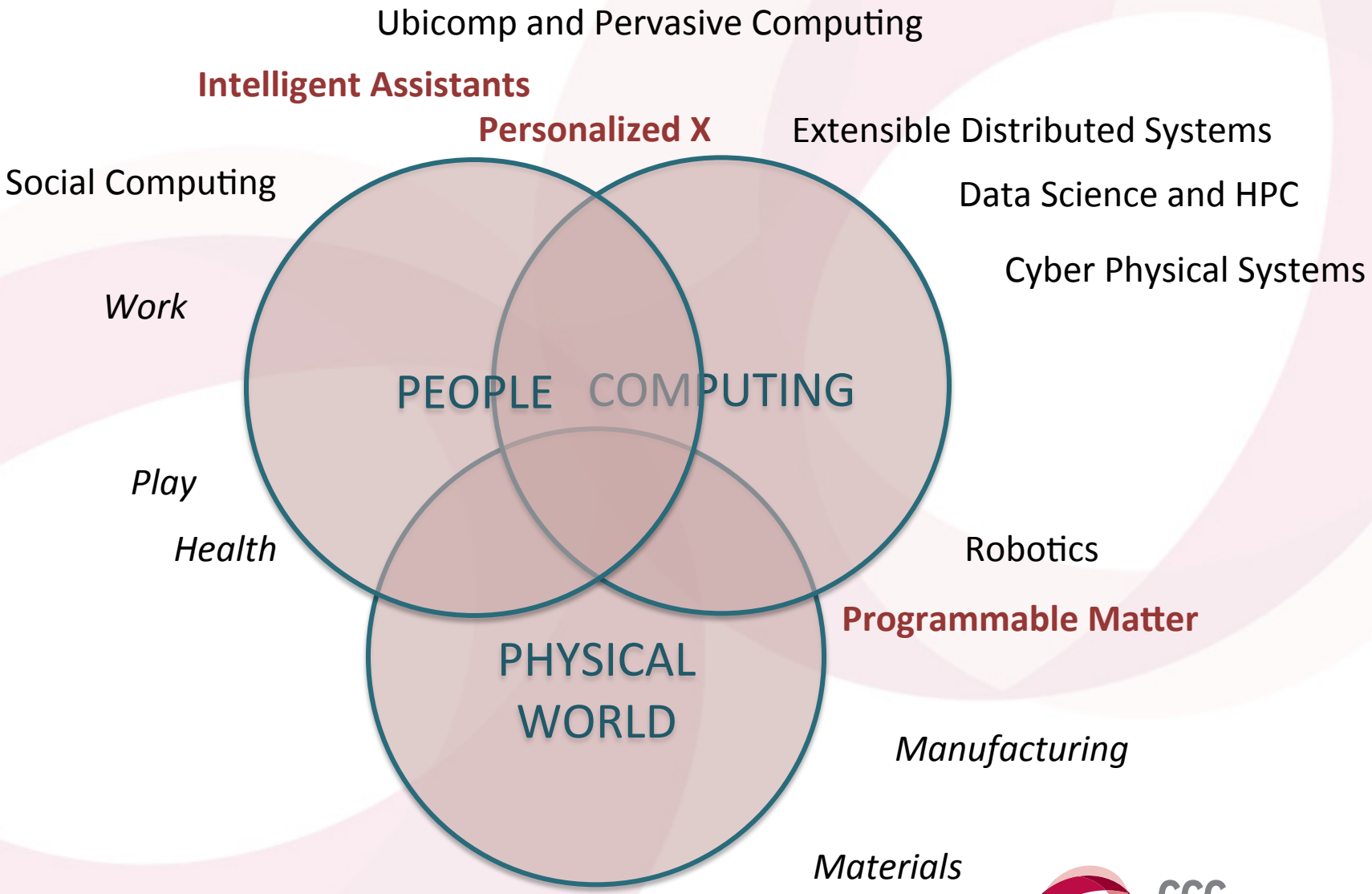
Ubicomp and Pervasive Computing
Intelligent Assistants
Personalized X
Extensible Distributed Systems
Social Computing
Data Science and HPC
Cyber Physical Systems
Work
PEOPLE
COMPUTING
Play
Health
Robotics
Programmable Matter
PHYSICAL
WORLD
Manufacturing
Materials

SHARING ECONOMY

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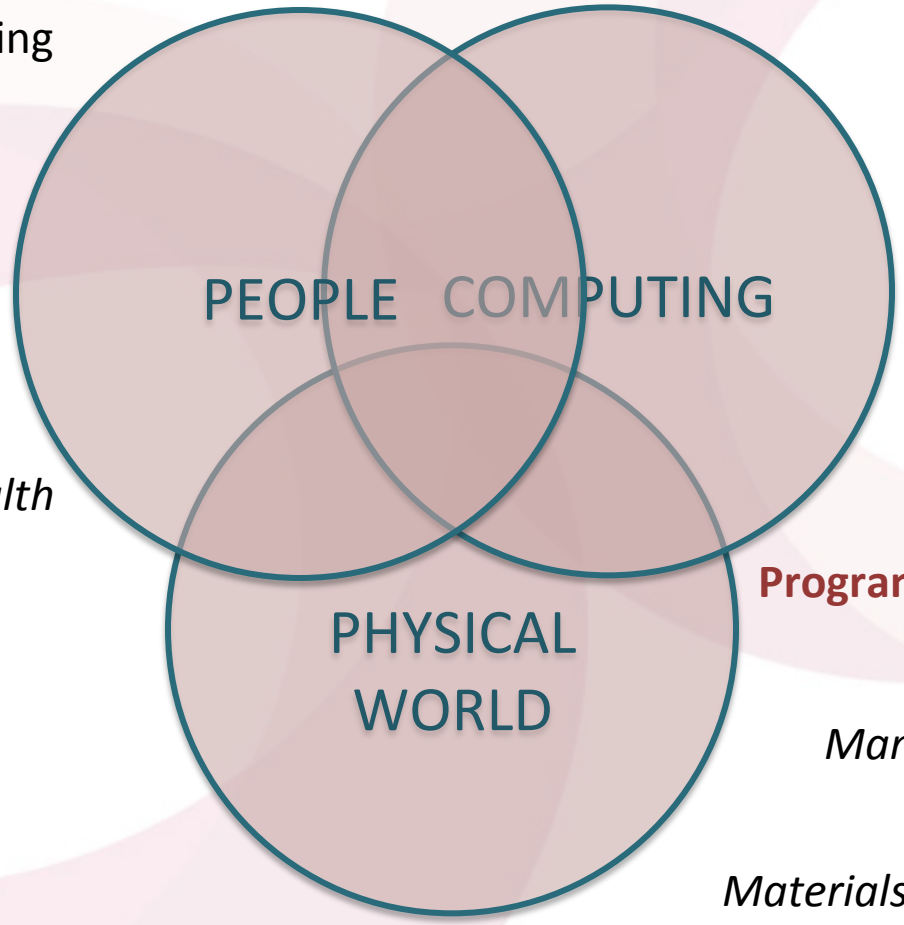
PRIVACY



INTELLECTUAL PROPERTY

Play

Health

Robotics

Programmable Matter

Manufacturing

Materials

HUMAN AUGMENTATION

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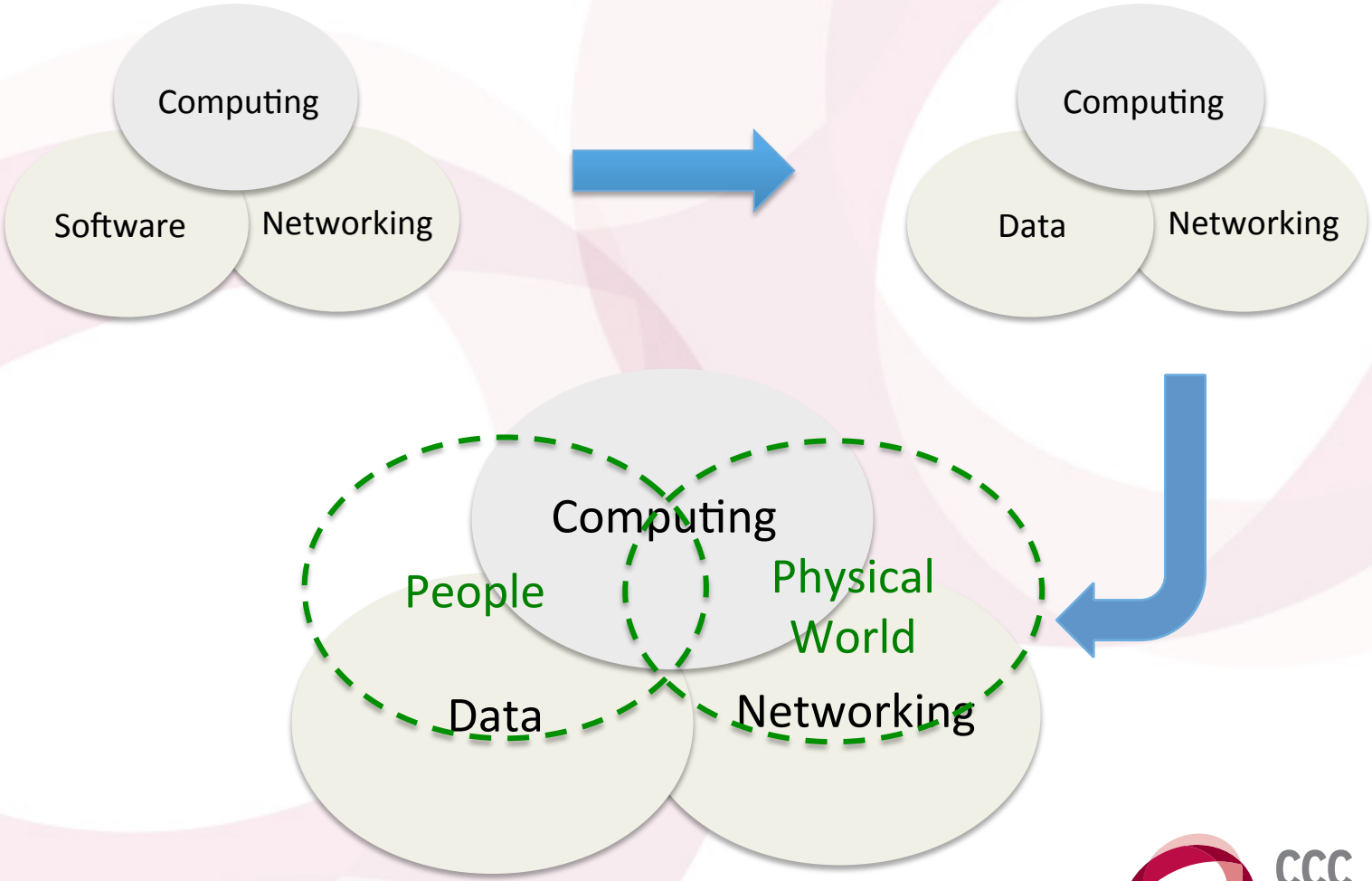
EVOLUTION OF NIT 1991-2015



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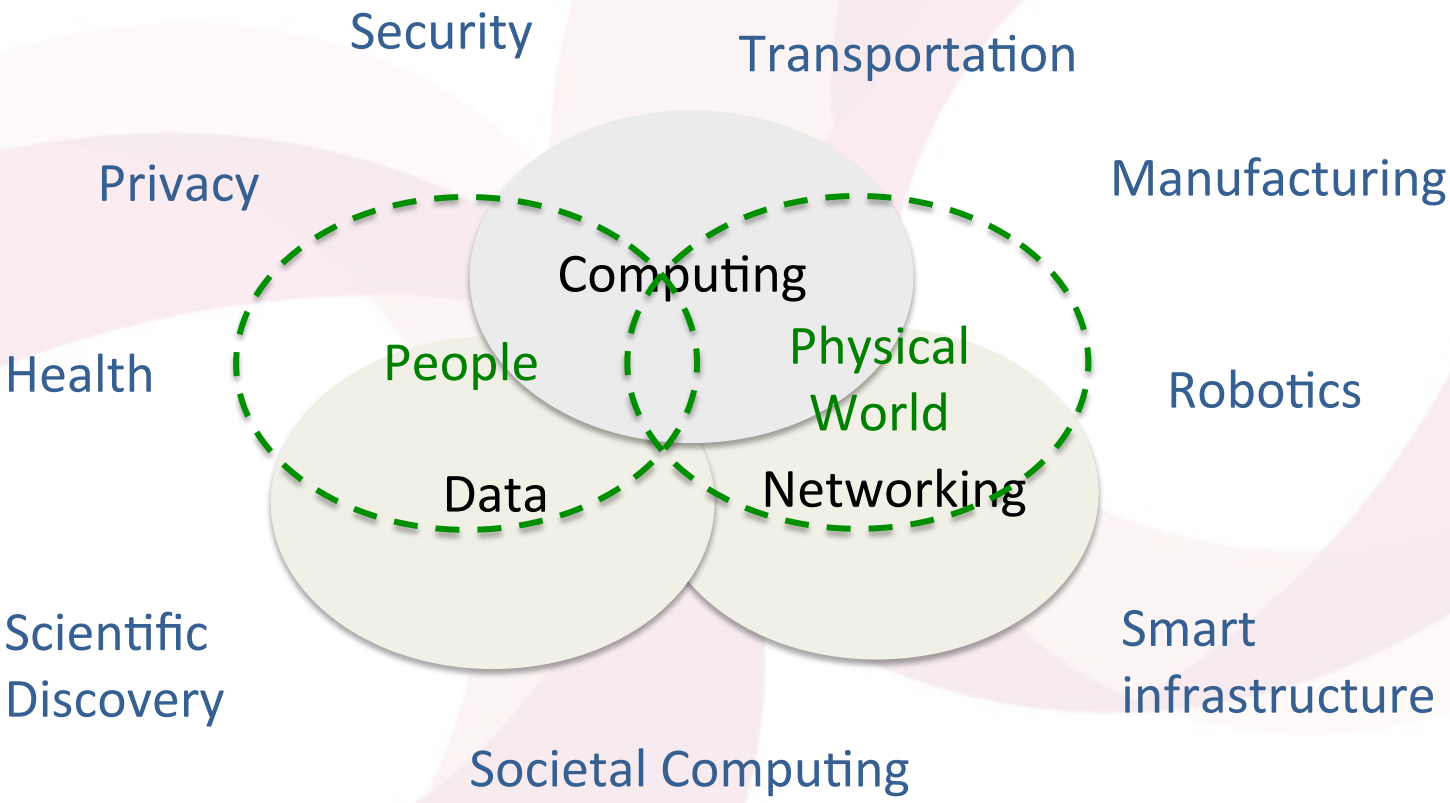

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An expanding vision of computing

Human-centered computing

Assistive technologies, affective computing, social informatics, mind/machine interface, brain

Science, societal applications

Science, engineering, humanities health, security, environment. energy, transport, commerce, education

Nano, molecular, optical, quantum

Smart vehicles & buildings, cyber-physical systems, swarms, mobile/cloud

Changing "physicalness" of computing

computing embedded around us

A NEW ERA OF COMPUTING

Hyper-connectivity

- Data intensive computing

Computing and the Physical World

- Robotics, Smart and Programmable Matter

Societal and Human Implications

- Up and down the stack
- Major societal impact

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QUESTIONS SESSION 1

- What do you see as the biggest technology challenge that the combination of industry and academia in our community can impact in the next 5-10 years?
- As the vision of computer science expands into new domains (human-centered computing, science and societal applications, the changing “phyiscalness” of computing, and computing embedded around us) are there new concepts we need to be exploring, but aren’t?

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SESSION 2: THE IMPACT OF “ACADEMIC RESEARCH ON INDUSTRY” AND “INDUSTRY INNOVATION ON ACADEMIC RESEARCH”

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QUESTIONS SESSION 2

- What is the value of academic research for industry? What is the value of industrial research for academia?
- Where do you see the most value in collaborating / working across the academia/industry border? where are the biggest problems working together?
- To what degree does academic research impact your industrial organization's strategic directions? To what degree does industrial research change the directions of your academic department?

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SURVEY OF THE FIELD

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SURVEY OF THE FIELD

Administered in March and May to CRA Members and Contacts of CCC Council in Industry

Industry – 64 responses

Academia – 60 responses

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QUESTIONS

- What are types of interactions you have with (opposite)?
- Goals for engaging (opposite)?
- Barriers to working together?
- Opportunities to improve connections?
- Challenges in hiring PhD graduates?
- Value in hiring PhD vs. Master's?

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WHAT ARE TYPES OF INTERACTIONS YOU HAVE WITH (OPPOSITE)?

Academia

- Industry hires students and hosts interns

Industry

- Host graduate Student Interns
- Hire PhDs as permanent staff
- Work on collaborative projects funded by organization

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GOALS FOR ENGAGING (OPPOSITE)?

Academia

- Didn't ask

Industry

- Getting to know students / future employees
- Creating large network for collaboration
- Access to particular expertise

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BARRIERS TO WORKING TOGETHER?

Academia

- IP
- Finding Contact Person

Industry

- IP / NDA's
- International Students

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OPPORTUNITIES TO IMPROVE CONNECTIONS?

Academia

- Better methods for interaction / exchange of personnel

Industry

- Industry based training
- Better methods for interaction / exchange of personnel

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CHALLENGES IN HIRING PHD GRADUATES? – ASKED OF INDUSTRY

- Losing potential employees to startups
- Losing people to competition

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VALUE IN HIRING PHD VS. MASTER'S? – ASKED OF INDUSTRY

- " A fresh PhD understands what it takes to carry out a significant research effort, independently and imaginatively."
- "Both have value."
- "In my field, I believe a master's degree with some years of experience is more valuable than a fresh PhD student."
- "In my research organization, it is critical for people to have research experience and a research mindset. A PhD is not required, but a typical Master's degree holder who has been working in a product group tends to be focused on near-term tactical issues, as opposed to longer term fundamental issues"
- "PhDs tend to have better analytic skills, and often better skills at clearly and concisely explaining things. However, traditional PhD programs (IMHO) still do not do a good enough job at training students to get better at writing clearly and presenting clearly -- it seems to me that the ones who go in with good skills are the ones who leave with them, but relatively few programs try to teach these skills to students who lack them. Working effectively in our company (probably, any large company) means working beyond the boundary of the small team that you see on a daily basis -- so you need to be able to explain things well to others."

SESSION 3: INFRASTRUCTURE AND MODELS FOR COLLABORATION

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QUESTIONS SESSION 3

- What sort of organizational structures might improve communication / collaboration between academia and industry? For example, project clearing houses, published best practices, a “dating” site?
- As innovation is happening at rates unheard of, how do we create testbeds for researchers that are accessible, adaptable, and cross-disciplinary?
- Classical academic and industrial research depend on a long term view and investment in researchers and new ideas. With the economic shift to startups as drivers of technology innovation, how must industrial and academic researchers adapt?
- How does the centrality of big data to new CS+X research change the way industry and academia cooperate?
- The US government has announced a commitment to open/public access to research results - this will affect how researchers publish and possibly what experimental data must be included. How will industry and industry / academia research efforts deal with the new IP issues?

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