Making IT Better:

Expanding Information Technology Research to Meet Society's Needs

Presentation to the

President's Information Technology Advisory Committee

May 18, 2000

Computer Science and Telecommunications Board

The National Academies

Charge to the Committee

- Examine trends in IT research (funding and conduct): industry, university, government.
- Identify potential weaknesses in the current IT research program (e.g., levels of funding, scope).
- Determine the kinds of IT research investments needed for the 21st century.
- Suggest mechanisms for strengthening future IT research.

Committee Members

Samuel Fuller,
Analog Devices, Inc (Co-Chair)
David Messerschmitt
UC-Berkeley (Co-chair)
Paul Baran
Com21 Inc.
Linda Cohen
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John Copeland
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Albert Erisman
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Daniel Ling
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Sun Microsystems Labs
Mark Weiser
Xerox PARC (deceased)
Irving Wladawsky-Berger
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Increase Federal Funding for Fundamental IT Research

- Preserve/ensure diversity in the research base.
- Complement industry research, which is growing, but increasingly applied.
- Continue support for research on IT “components” while increasing support for research into large-scale systems and “social applications.”
- Proposed increases are probably the right order of magnitude ($100s of millions per year).

Improve Statistics on IT R&D

- Federal statistics on government and industrial investments in IT research are inconsistent.
  - Inadequate distinction between R and D
  - Classification of companies varies from year to year
  - Some "misclassification" of companies
  - Hard to capture IT research in non-IT companies
- Data problems will become worse as IT research becomes more distributed across the economy.
- Need for reliable data will become more important as nation transitions to information economy.
- Need to take action; cannot always be a footnote to studies of IT R&D.

Sustain Funding for IT "Components"

- "Components" broadly defined to include semiconductors, computers, communications devices, software, etc.
- Need to continue progress characterized by Moore's Law, capacity of fiber, etc.
  - Several limits to silicon/CMOS in sight.
  - Funding for research in EE appears to be down.
- Current mechanisms for funding and conducting research are reasonably effective.

Increase Support for Research on Large-Scale IT Systems

- **Characteristics**
  - Scale--large number of components and of users.
  - Complexity--deep interaction among components; hard to predict.
  - Heterogeneity--composed of different components.
- **Challenges**
  - Scalability--to accommodate more components/users.
  - Flexibility--how to upgrade, modify, evolve, add functionality.
  - Trustworthiness--security and reliability.
  - Distributed operation and administration.
- **Need both fundamental understanding (general) and research on specific cases.**
- **NSF and DARPA should lead bold, new research initiatives, and should involve other agencies.**

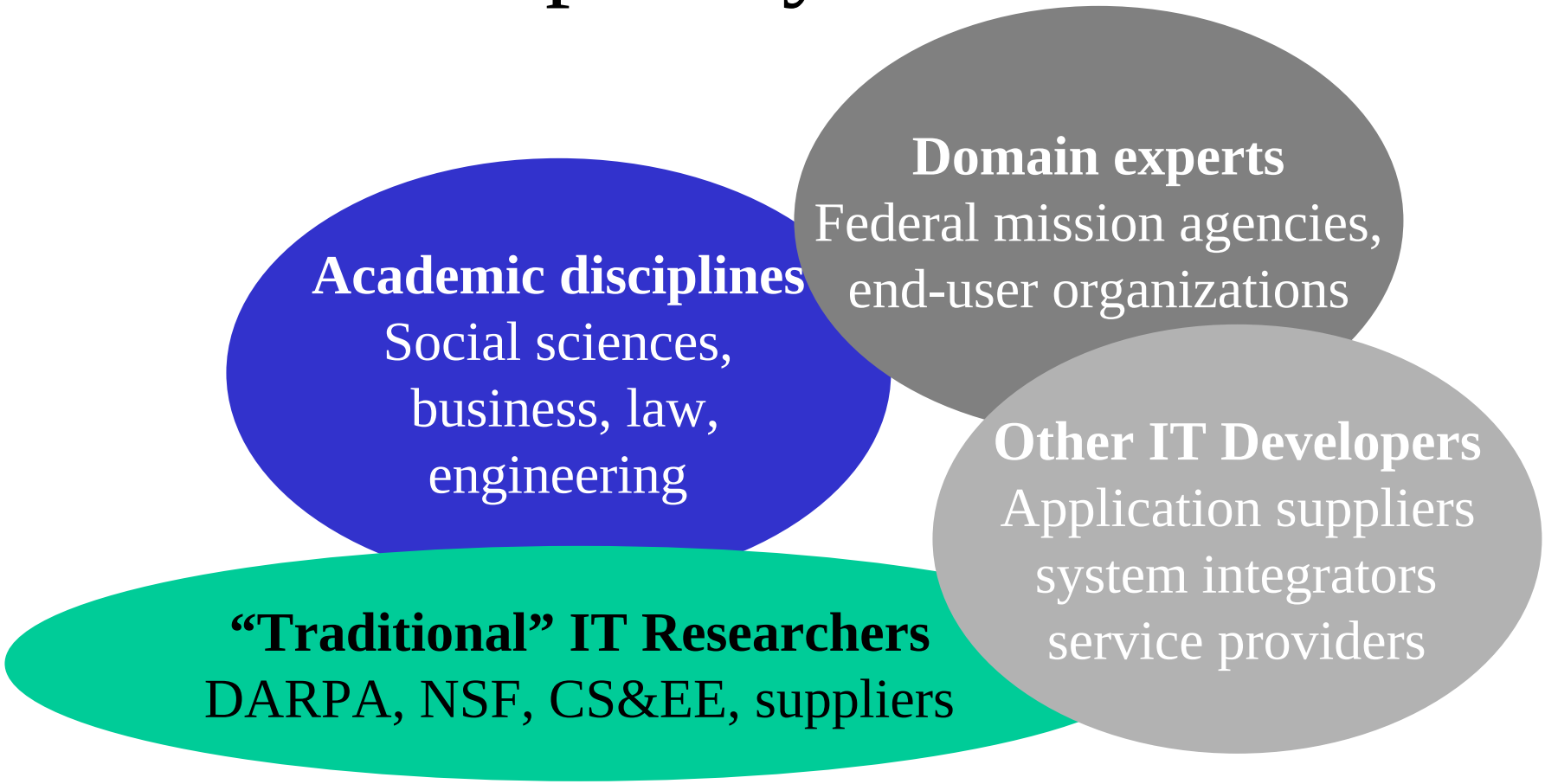
Social Applications of IT

- Characteristics
  - Serve groups of people in shared activities (e.g., collaboration, e-commerce, health care, education, manufacturing, legislative, battlefield, etc.).
  - Large-scale IT systems embedded in organizational/social systems ("sociotechnical" systems, organizational/IT interface).
- Types of research
  - Social and economic impacts of IT.
  - Better IT informed by needs.
  - Joint design of IT and organizational processes.
  - Interdisciplinary: IT, domain, social scientists, etc.
- More Federal support (NSF and DARPA taking the lead) and greater research community interest.

Mechanisms for Funding and Conducting IT Research

- Diversity of mechanisms: individual investigators, teams, centers, joint university/industry.
  - Research-specific objectives should dictate mechanisms (not other way around).
  - Case and fundamental research.
- Problem (not discipline) orientation.
- Access to end-users and operational and experimental systems.
- Broader participation.

Broaden participation in interdisciplinary IT Research



Summary of Recommendations

- **Recommendations to Government**
  1. Boost funding for fundamental IT research.
  2. NSF & DARPA should establish research programs in large-scale systems.
  3. Federal agencies should increase funding for interdisciplinary research on social applications, with NSF and DARPA as the lead.
  4. Census should work with NSF to improve data collection.
- **Recommendations to Universities**

  5.1 Ensure that hiring, review, and tenure processes are aligned with needs of interdisciplinary research.

  5.2 Encourage closer ties with industry for intellectual exchange.

  6. Senior faculty should take the lead in pioneer research on large-scale systems and social applications.
- **Recommendations to Industry**

  7. End-users should actively engage in IT research.

  8. IT companies should find ways to involve end-users more actively in research.

For More Information

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