Managing the Knowledge Workers: The New Management Challenge

EARMA Training Courses for Research & Innovation Managers and Administrators

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Outline

- Knowledge Workers: Background
- Management issues with Knowledge Workers
- Leadership strategies in Science and Engineering
- National Science Foundation's approach to managing Science and Engineering
- Leadership strategies in promoting equal opportunity

Concept of Knowledge Worker
(Peter Drucker)

Manual Worker

- Job optimization
- Needs management control
- Productivity issues
- ...
- One time learning
- Cost to an organization

Technologist

- ...
- Needs some supervision
- Quality and quantify issue
- Limited innovation
- Continuous learning
- Asset to an organization

Knowledge Worker

- Job definition
- Self-management
- Quality issue
- Continuous innovation
- Continuous learning
- Asset to an organization

Maslow's Hierarchy of Needs

High

- The need for self-actualization—developing powers and skills and having opportunities to use creativity
- The need for self-respect, self-esteem, the respect of one's fellows; status
- Social needs—to associate with other people and to have friendship and love
- The need for safety from danger, threat, and deprivation
- Physiological needs, the most important of which is the need for food and things necessary for survival

Low

Management Issues and Challenges with Knowledge Workers

- Must change basic management premises: knowledge workers need inspiration not supervision
- Must develop new infrastructure
  - regular education--intellectual talent with courage
  - continuous education programs
- Must develop strategies to attract and retain knowledge workers

Special Challenges in Science and Engineering

- Goals, tasks and quality are hard to define/evaluate (except in hindsight)
- ``Workers`` trained to be solo contributors while large efforts require collaboration
- Various eccentric personality types, frequently not willing/able to communicate well
- Each scientific field has a unique culture

People

Leadership
is creating environments that influence others to achieve group goals. People support a world they help create.

Communicating to Lead
Recognizing Human Potential
Building Cooperation
Making Decisions
Managing Conflict and Change

1. Self-direction
2. People skills
3. Process skills
4. Communication
5. Accountability

Coaching Process and Appraisal Systems
Delegation Process
Performance Process
Planning Process
Innovation Process

Management
is the creation and implementation of the process and the monitoring of results. People support a process that helps them succeed.

Process

Leadership Strategies in Science and Engineering

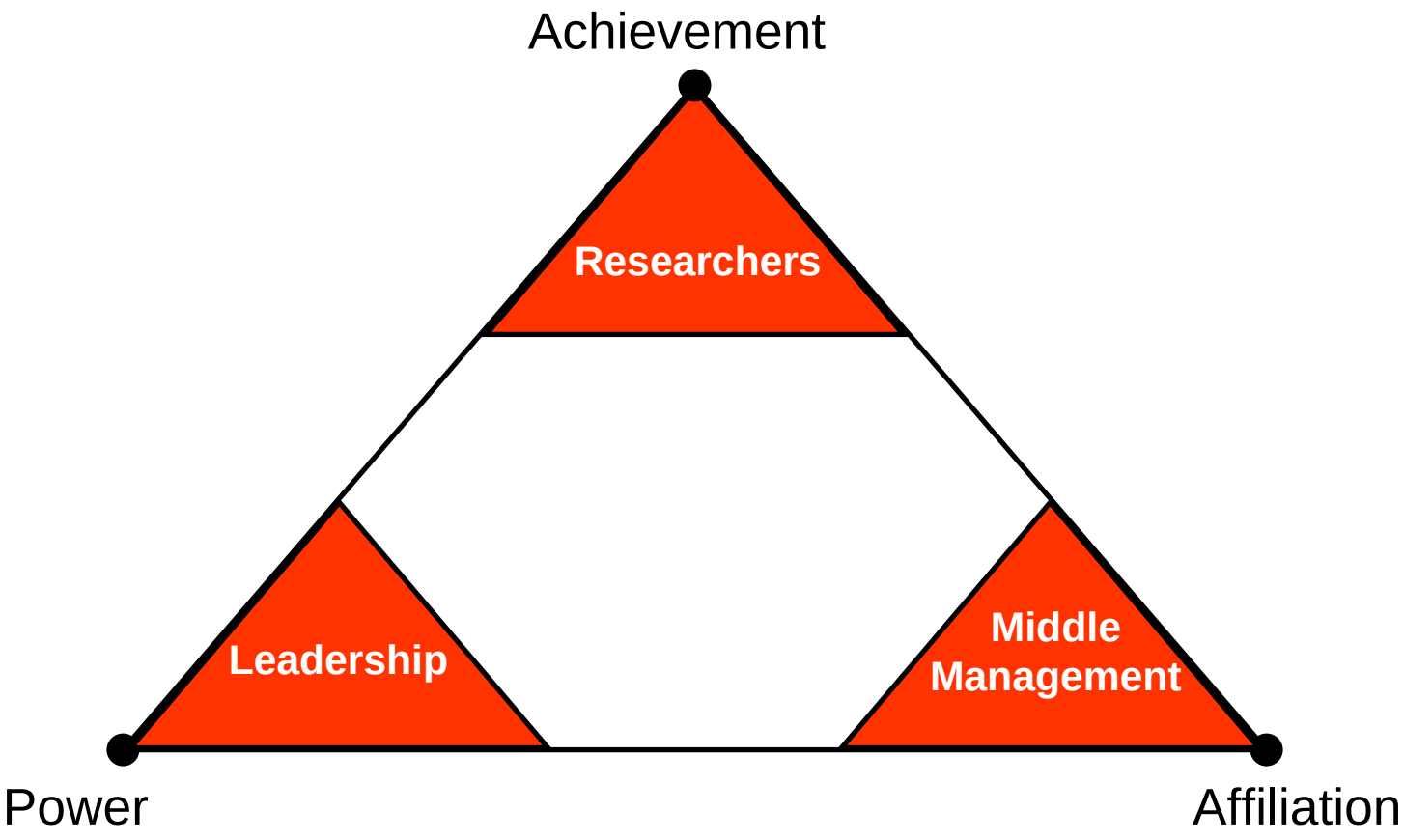
- Leading scientists and engineers as individuals—**human dimension**—requires
  - understanding creativity
  - understanding motivation

- Managing research environment—**organizational factors**—requires
  - understanding impact of organizational structure
  - understanding impact of formal systems

Creativity

- Common characteristics of creative people
  - tolerance to ambiguity
  - curiosity
  - ability to perceive juxtaposition of seemingly disparate elements
  - self-confidence
  - persistence
- Creative people do NOT respond to extrinsic motivators such as
  - management pressure
  - project evaluations
  - competition for reward
- Organizational factors are more important than personal factors in inhibiting creativity

Motivation: Work Related Needs
(David McClelland)



Organizational Factors Important in Enhancing Creativity

- Organizational structure
  - hierarchical vs. lateral
  - organization size
- Sharing of information among people with complementary skills
- Protection of discovery phase

Conditions for Creative Organizations

- → Willingness to take risks
- → Collaboration
- → Candid communications
- → Intellectual challenge

The criteria are incompatible with large organization (>200 people). The criteria require focus on people involved and require development of good organizational relationships.

Creative Organizations and Formal Systems

The change from traditional organization to a creative organization requires changing formal systems.

- Recruitment—concentrate on “competent eccentrics” and provide them with encouragement
- Performance appraisals and rewards—account for risks, failures and collaboration
- Decision making and approvals—allow as much as possible decision making by individuals
- Information systems—employ the latest technology

Small Scientific Projects vs. Large Scientific Projects Characteristics and Drivers

Small Projects

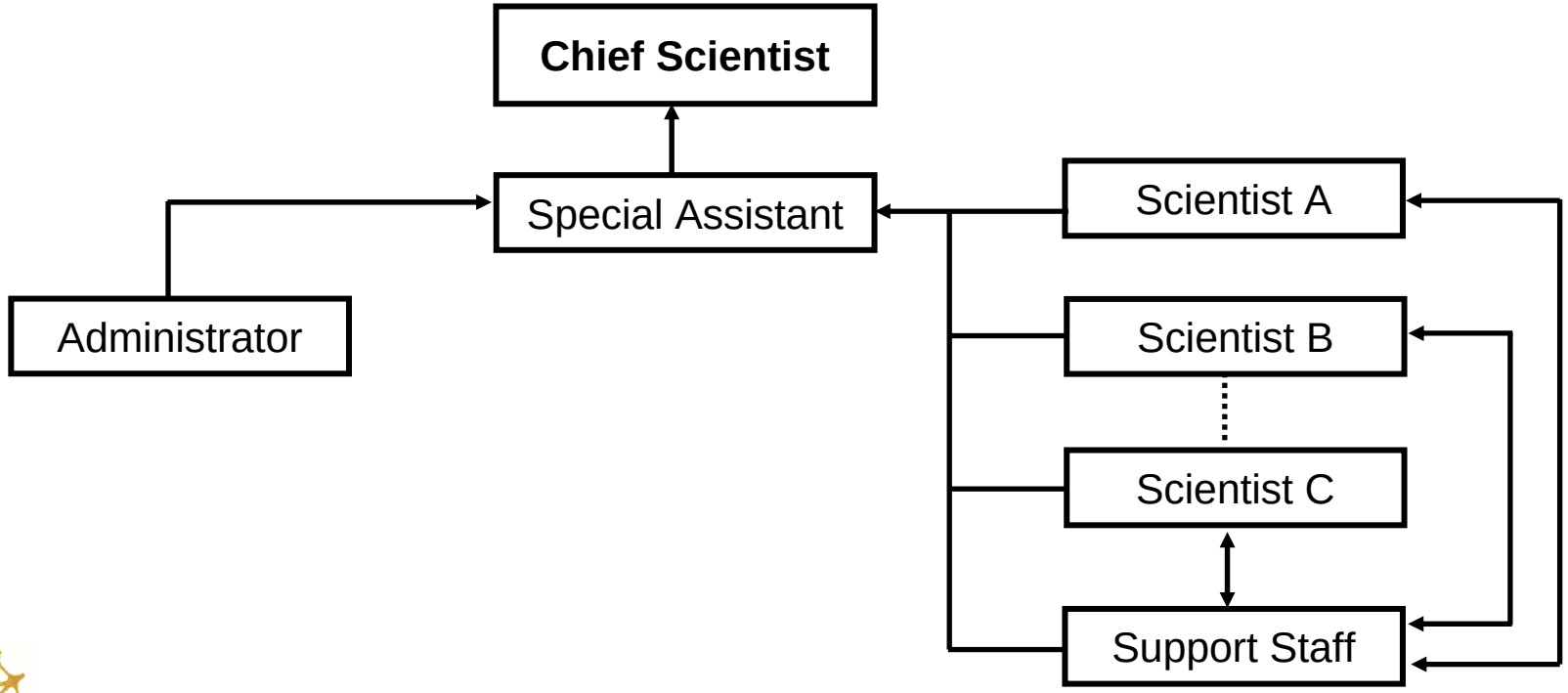
- Controlled by individual scientists
- Homogeneous team
- Relatively low visibility

Large Projects

- Controlled by managers and external forces
- Heterogeneous team
- High visibility
- Tight schedules

Some Models of Science Management and Administration—Direct Involvement in a Project

- Orchestra conductor analogy
- Adaptive management strategy (ecology)—partnership approach
- Surgical model—administrator as a facilitator



From Pure Science to Manhattan Project

(From unmanaged science to managed scientific development)

Partial Chronology

Pure Science

1905 — Einstein formulates photon theory of light and Special Theory of Relativity
1908 — Perrin calculates the size of an atom
1911 — Rutherford's scattering experiments lead to his theory of atomic structure
1913 — Bohr Theory of the atom
1914 — Rutherford suggests that H nucleus is fundamental "proton"
1915 — Einstein formulates the General Theory of Relativity
1919 — Rutherford discovers nuclear reactions
1921 — Stern and Gerlach discover spin
1926 — Fermi links spin with statistics
1931 — Fermi theorizes the neutrino
1932 — Anderson discovers the positron
————Chadwick discovers the neutron
1934 — Fermi theorizes weak interactions
1939 — Hahn and Strassman observe fission

Not Managed

Predominantly Development

1939 — Early US government support**
1942 (September) — Leslie Groves appointed to head the effort
1942 (end) — complete government support
1943 — Los Alamos, Openheimer heading the new laboratory
1945 — tests and deployment

Managed

** Detailed Chronology in The Manhattan Project: Making the Atomic Bomb, published by the DOE History Division 1999.

From War Years to NSF

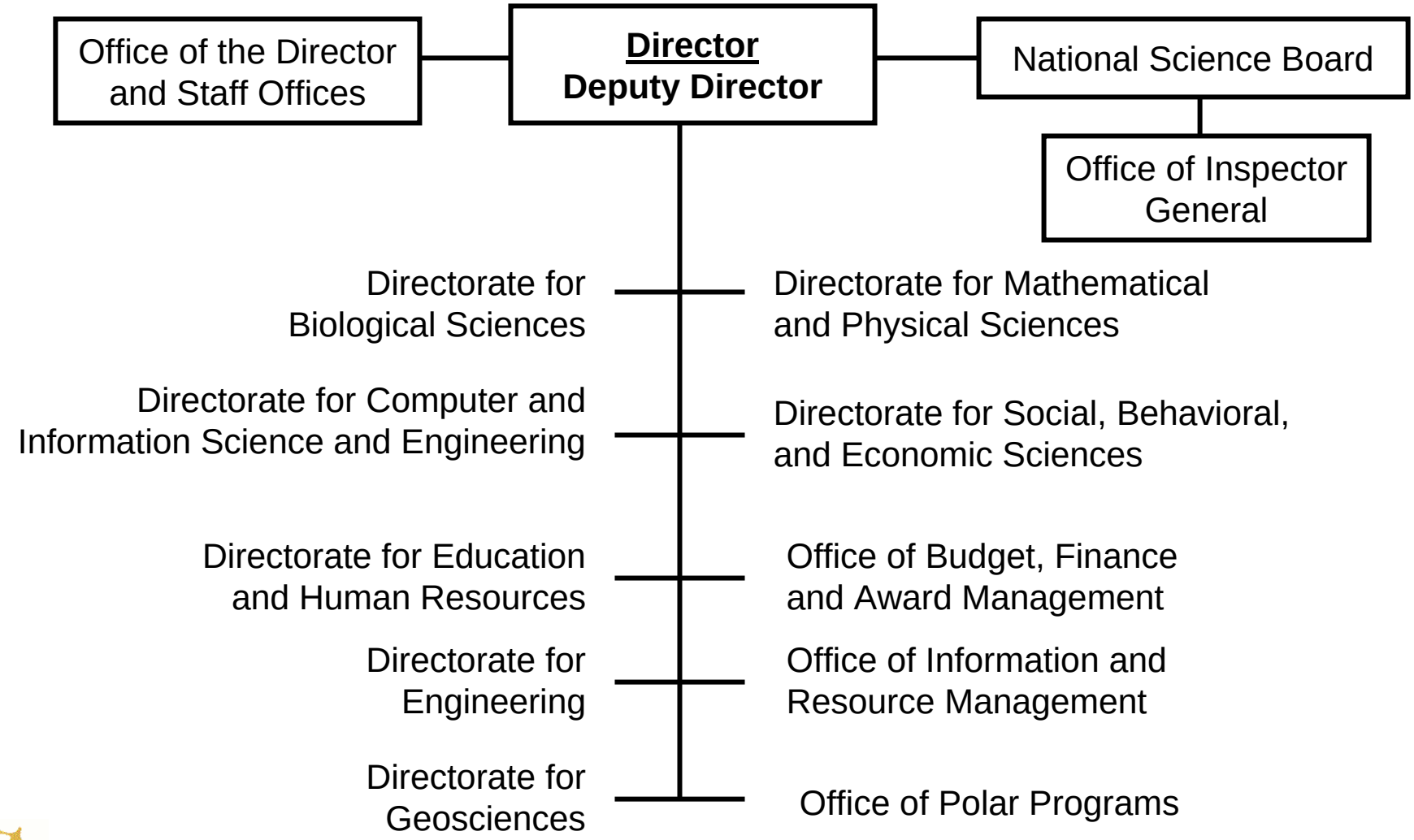
1945 — Vannevar Bush, head of the government's wartime Office of Scientific Research and Development, issues a report to President Franklin Delano Roosevelt, "Science--The Endless Frontier." The report becomes famous as the prescription for government support of science.

1950 — On May 10, President Harry S. Truman signs Public Law 507, creating the National Science Foundation. The act provides for a National Science Board of twenty-four part-time members and a Director as chief executive officer, all appointed by the president.

National Science Foundation

- NSF accounts for 40% of support for basic research at US academic institutions (excluding life sciences)
- 90% of funding is allocated through a rigorous competitive process
- NSF funds approximately one third of proposals received each year
- The science and engineering programs are administered by scientists/engineers
- A number of scientists and engineers at NSF are in temporary visiting positions
- There is close connection between NSF and academic community

National Science Foundation Organizational Chart



The U.S. Government Performance Results Act Requires:

- A 5-year Strategic Plan for the Agency
- An Annual Performance Plan
- An Annual Performance Report
- Plans submitted with the Proposed Agency Annual Budget

NSF GPRA Strategic Plan FY 2001-2006

- Areas of Focus
  - People
  - Ideas
  - Tools
- Core Strategies
  - Developing intellectual capital
  - Integrating research and education
  - Promoting Partnerships

NSF Goals for Strategic Outcomes

- → **PEOPLE**—Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."
- → **IDEAS**—Enabling "discoveries across the frontier of science and engineering, connected to learning, innovation, and service to society."
- → **TOOLS**—Providing "broadly accessible, state-of-the-art shared research and education tools."

NSF Goals for Management

- Proposal and Award Process
- Award Portfolio
- Facilities Management
- Business Practices
- Human Resources and Workplace

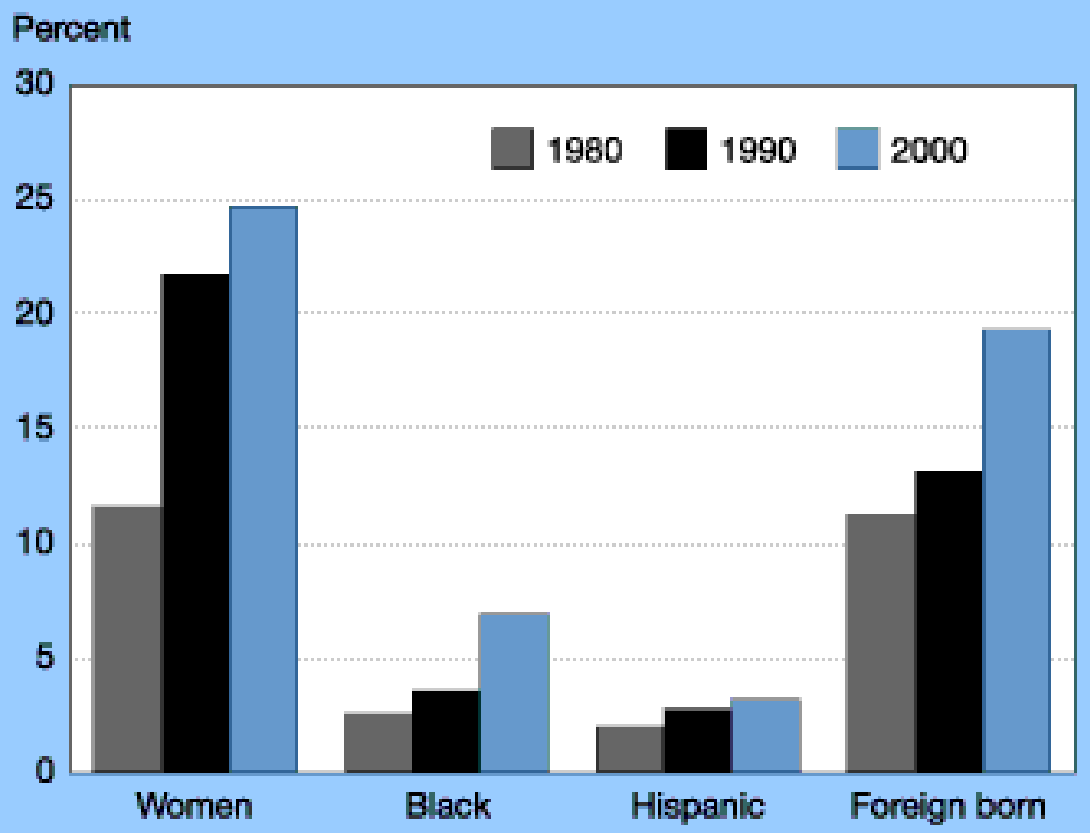
Next Steps

- Merging of Accountability Report with Performance Report—like a business Annual Report - all submitted with Annual Budget
- Continuing to move toward totally electronic environment
- Continued to focus on human resource needs
- Streamline/simplify reporting requirements, make user friendly by supplying necessary data/information
- Search for more effective ways for Basic Researchers to tell their stories

Underrepresented Groups in U.S. Science and Engineering: Issues

- Broadening the pipeline
- Increasing numbers of degrees awarded at post graduate levels
- Increasing numbers of high level positions in science, “glass ceiling” problem

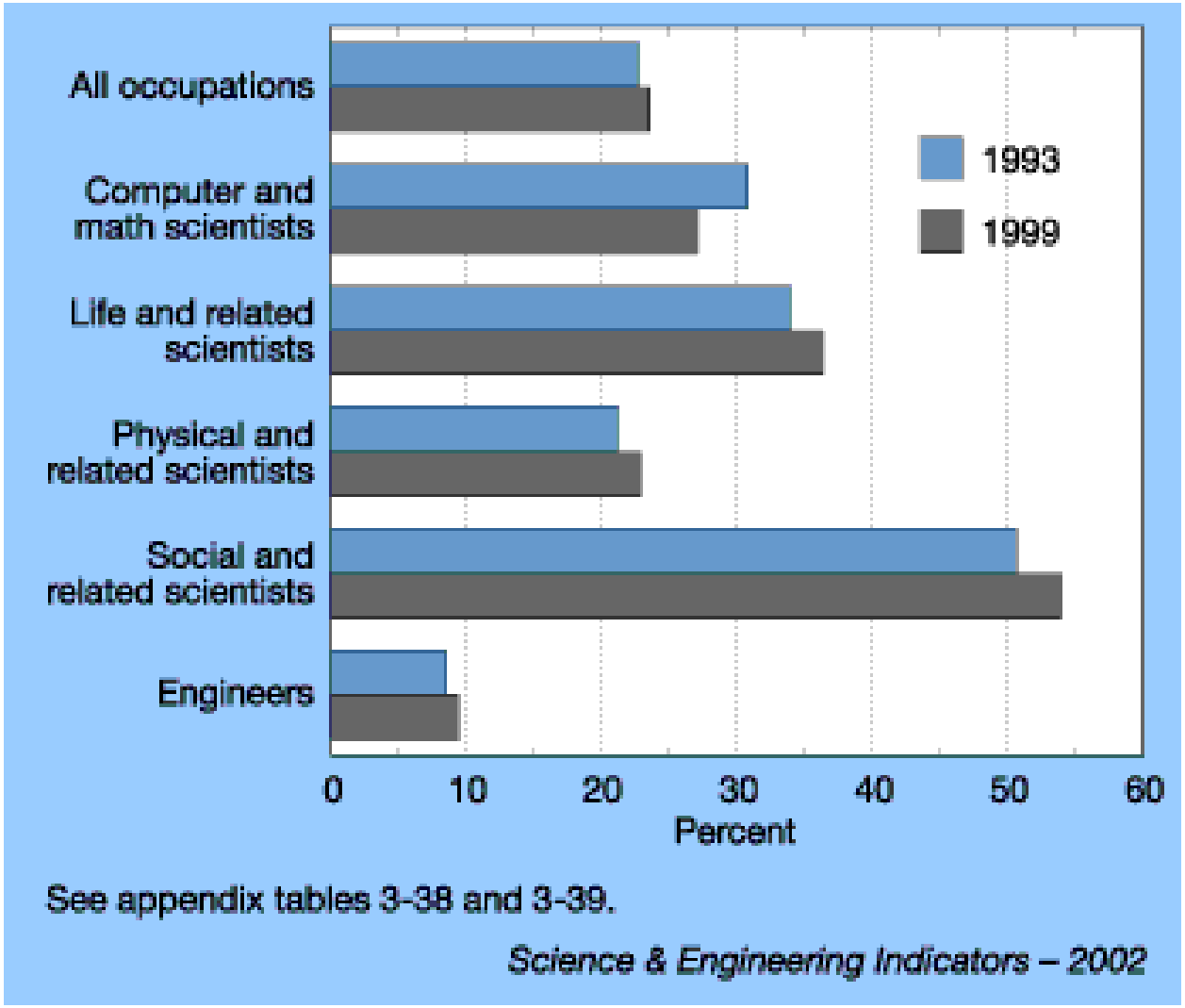
College Graduates in Nonacademic S&E Occupations: Women and Minorities



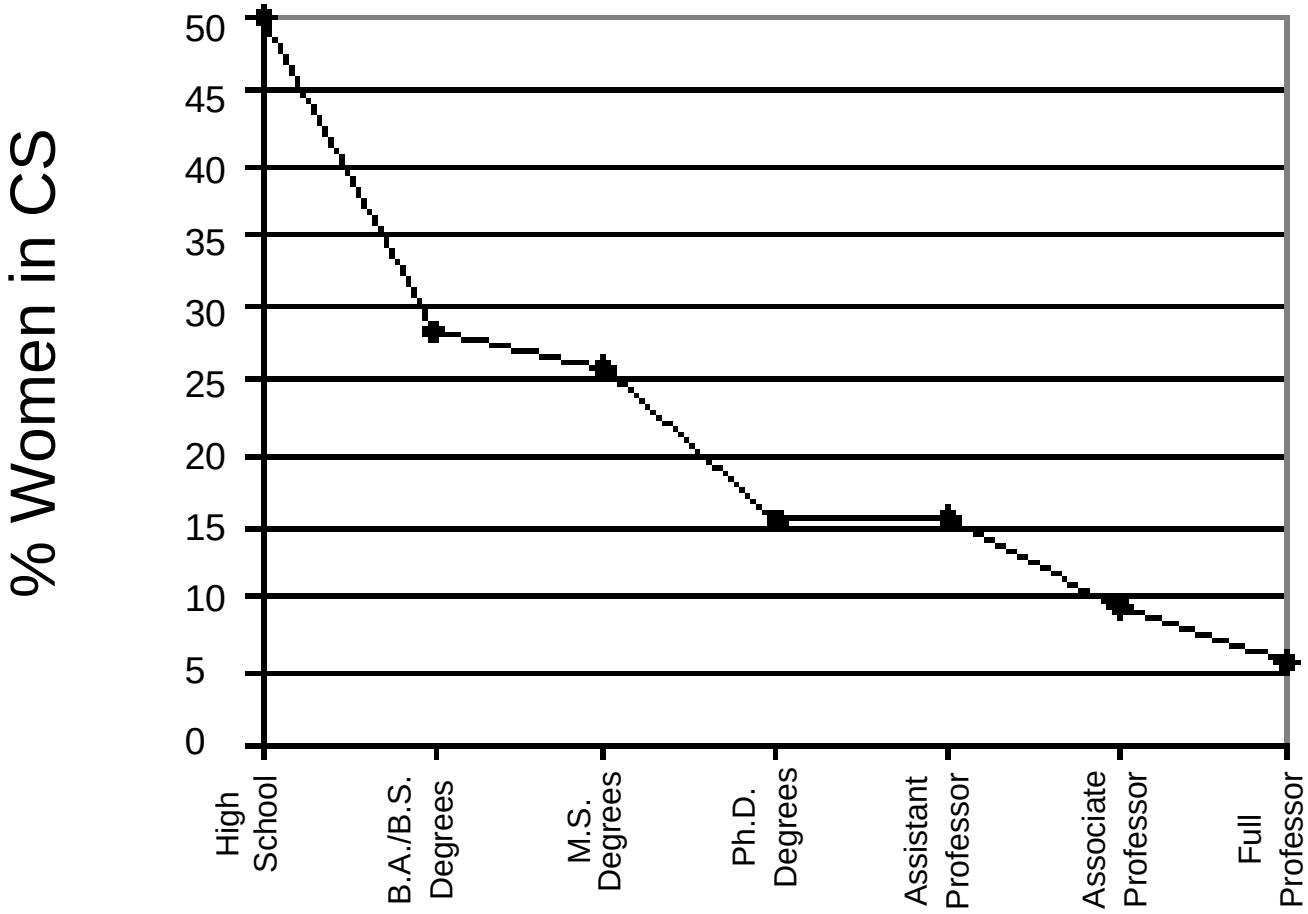
SOURCE: U.S. Department of Commerce, Bureau of the Census, 1980 and 1990 U.S. Decennial Census Public Use Microdata Sample, and March 2000 Current Population Survey.

Science & Engineering Indicators – 2002

Women as Proportion of S&E Workforce, by Broad Occupation



Women in Computer Science
The Shrinking Pipeline 1993-94



Examples of NSF's Activities Aimed at Increasing Participation of Underrepresented Groups in Science and Engineering

- Systemic activities at K-12 level
- Broadening participation of Minority Serving Institutions
- Increased stipends for graduate students
- Review emphasis on broader impacts of proposed projects
- Emphasis on mentoring and role models
- Special workshops and studies
- Targeted programs, e.g., POWRE and ADVANCE

Framework for Guiding Organization Change for Managing and Valuing Cultural Diversity

LEADERHIP

- Top management commitment
- Steering and advisory groups
- Communications strategy

STARTUP

- Comprehensive organizational assessment
- Baseline data
- Benchmarking

EDUCATION

- Awareness training
- Development of in-house expertise
- Training and development

CHANGES IN CULTURE AND MANAGEMENT SYSTEMS

- Recruitment
- Orientation
- Performance appraisal
- Compensation and benefits
- Promotion

FOLLOW-UP

- Evaluation process
- Accountability
- Ensuring continuous improvement

Types of Organizations

Dimension	*Monolithic*	*Plural*	*Multicultural*
Culture	Ignores or actively discourages diversity	Ignores or tolerates diversity	Values diversity
Acculturation process	Assimilation	Assimilation	Pluralism
Institutional cultural bias in HR systems	Ubiquitous	Prevalent	Minimized or eliminated
Intergroups conflict	Minimal due to identity homogeneity	Significant	Minimized by management attention

Tools for Organizational Transformation

Dimension	*Tools*
Create climate in which members of all identity groups excel	✓ Hire or promote people who embrace the new values ✓ Reinforce values in rewards and appraisal ✓ Educate and communciate
Ensure influence of minority culture perspectives on ocre organization norms and values	✓ Language training ✓ Diversity in key committees ✓ Explicit treatment of diversity in mission statements
Eliminate barriers to entry and participation	✓ Support groups
Eliminate bias ingrained in management systems	✓ Changes in manager performance evaluation and rewards

Useful Resources

- Alice Sapienza “Managing Scientists: Leadership Strategies in Research and Development,” Wiley-Liss, Inc. 1995
- Henry Mintzberg “Covert Leadership: Notes on Managing Professionals”, Harvard Business Review, November-December 1998, pp. 140-147
- Kevin Rogers, “Managing Science/Management Partnerships: A Challenge of Adaptive Management”, Conservation Ecology, http://www.ecnsecol.org/vol2/iss/resp1
- Taylor Cox “Cultural Diversity in Organizations,” Berett-Kohler Publishers, 1994.
- Peter Drucker “Management Challenges for the 21st Century,” Harperbusiness, 1999.
- Caulde Geles et al. “Managing Science: Management for R&D Laboratories,” Willey, 2000.
- Cathy A. Trower and Richard P. Chait “Faculty Diversity”, Harvard Magazine, March-April 2002, available at http://www.harvard-magazine.com/on-line/030218.html
- A. Runco and R.S. Albert (Eds) “Theories of Creativity,”1990

Useful URLs

- Large facility project management
  http://www.nsf.gov/bfa/lfp/start.htm
- Project management--Gary Sanders
  http://131.215.125.172/related/Sanders_intro.pdf
- References on adaptive management
  http://www.for.gov.bc.ca/hfp/amhome/ANNOBIB/Ambib.htm
- Government performance and results act at NSF
  http://www.nsf.gov/od/gpra/start.htm
- NSF: Engineering Research Centers--Best practices
  http://www.erc-assoc.org/manual/bp_index.htm
- History of science
  http://www.aip.org/history/web-link.htm
- The shrinking pipeline phenomenon in Computer Science
  http://www.mines.edu/fs_home/tcamp/cacm/paper.html
- Science and Engineering Indicators 2002
  http://www.nsf.gov/sbe/srs/seind02/start.htm