
**Engineering Research Centers:
Partnerships for Competitiveness**

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Driving the discovery, integration, dissemination, and employment of new knowledge in service to Industry and the Nation

The Engineering Research Centers (ERC) Program of the National Science Foundation (NSF) stands as a landmark in federal support for university research in partnership with industry. These centers provide an environment where academe and industry together can focus on next-generation advances in complex engineered systems important for the Nation's future. Over the past decade this partnership has produced numerous engineered systems technologies, productive new engineering processes, and other innovative products and services, along with a new generation of graduates who have proven to be highly effective in industry. Today the Program continues to expand and evolve to address national needs, making important contributions to U.S. industry's long-range ability to compete in global markets.

The ERC mission has three main elements:

- **Cross-disciplinary and Systems-oriented Research**— ERCs bring diverse engineering and scientific disciplines together to address fundamental research issues crucial to the next generation of technological advances in areas that will enhance the international competitiveness of U.S. industry in a global economy. ERC research lies at the
- **Education and Outreach**— Each ERC develops a culture in which graduate and undergraduate students work in cross-disciplinary teams, in close collaboration with the center's industrial partners. ERCs integrate engineering education and research and expose students to the integrative aspects of engineered systems and industrial practice to build competence for their future careers. They develop curriculum innovations derived from the systems focus of the ERC's strategic goals. Thus, they produce graduates with the depth and breadth of education needed for leadership throughout their careers.
- **Industrial Collaboration and Technology Transfer**— ERCs form strong partnerships between academe and industry. Some ERCs may also involve collaboration with practitioners in service industries, such as the health care industry, and public agencies. Industry is actively involved

interface between the discovery-driven culture of science, on the one hand, and the innovation-driven culture of engineering on the other. With their focus on next-generation engineered systems, these centers create a synergy between science, engineering, and industrial practice.

The major technological areas upon which current ERCs focus are—

- Bioengineering
- Design, Manufacturing, and Product Development Systems
- Earthquake Engineering
- Microelectronic Systems and Information Technology

BIOENGINEERING

Georgia Tech/Emory Center for the Engineering of Living Tissues
Georgia Institute of Technology, Atlanta, GA (lead institution) in partnership with Emory University

Marine Bioproducts Engineering Center
University of Hawai'i at Manoa, Honolulu, HI (lead institution) in partnership with the University of California at Berkeley

Computer-Integrated Surgical Systems and Technology ERC

The Johns Hopkins University, Baltimore, MD (lead institution) in partnership with the Brigham and Women's Hospital, Carnegie Mellon University, Johns Hopkins Medical Institutions, MIT, and ShadySide Hospital

Biotechnology Process Engineering Center

Massachusetts Institute of Technology, Cambridge, MA

VaNTH ERC in Bioengineering Educational Technologies

Vanderbilt University, Nashville, TN (lead institution) in partnership with the Harvard University-MIT Division of Health Sciences and Technology, Northwestern University, and the University of Texas at Austin,

Engineered Biomaterials Engineering Research Center

University of Washington, Seattle, WA

DESIGN, MANUFACTURING, AND PRODUCT DEVELOPMENT SYSTEMS

NSF/SRC ERC for Environmentally Benign Semiconductor Manufacturing
University of Arizona, Tucson, AZ (lead institution) in partnership with Arizona State University, the University of California at Berkeley, Cornell University, MIT, MIT Lincoln Laboratory, and Stanford University

Center for Advanced Engineering Fibers and Films

Clemson University, Clemson, SC (lead institution) in partnership with MIT

ERC for Particle Science and Technology
University of Florida, Gainesville, FL

Center for Innovation in Product Development
Massachusetts Institute of Technology, Cambridge, MA

ERC for Reconfigurable Machining Systems

University of Michigan, Ann Arbor, MI

in ERCs through participation in strategic planning, joint research, mentoring students, and involvement in proof-of-concept testbeds—all modes that strengthen the partnership with industry and speed technology transfer. Thus ERCs provide the intellectual foundation for industry to collaborate with faculty and students on resolving generic, long-range challenges, producing the knowledge needed to ensure steady advances in technology and speed their transition to the marketplace, while training graduates who are more effective in industry.

From their inception the ERCs have embodied NSF's strategic interests in the integration of research and education, in partnerships with industry, in the development of shared infrastructure, and in the improvement of science and engineering graduates' ability to contribute to National interests. In many ways the program has redefined the concept of an academic research center, serving as a model for the development of other Centers programs in the U.S. and around the world.

Each ERC is established as a three-way partnership involving academe, industry, and NSF (in some cases with the participation of state, local, and/or other Federal government agencies). Total annual funding for each Center ranges from \$3.1 to \$19.4 million, with NSF's contribution ranging from \$2.0 to \$2.9 million per year, averaging \$2.5 million per year.

While the ERCs differ from one another, each must possess the following key features:

- A strategic vision guiding both the production of advances in a complex, next-generation engineered system and the creation of a new generation of engineers needed to strengthen the competitive position of U.S. industry in a global economy;
- A dynamic, evolutionary strategic research plan to focus the ERC on achieving its vision;
- A cross-disciplinary research program promoting the synthesis of engineering, science, and other disciplines, that spans the continuum from discovery to proof-of-concept in testbeds and involves undergraduate and graduate students in research teams;
- An active, long-term partnership with industry and practitioners in planning, research, and education to achieve a more effective flow of knowledge into innovation and the education of a new breed of engineers;
- An education program for undergraduate and graduate students that produces an integrative, systems-oriented intellectual environment and corresponding curriculum innovations; and
- Outreach to other institutions to enhance the capacity of the ERC to achieve its goals and broaden the impact of the ERC culture in academe and society;

EARTHQUAKE ENGINEERING¹

Multidisciplinary Center for Earthquake Engineering Research
Headquartered at the University at Buffalo, in partnership with Cornell University, University of Delaware, University of Nevada at Reno, and University of Southern California, as well as other collaborating institutions and private entities throughout the U.S.

Pacific Earthquake Engineering Research Center
University of California at Berkeley, CA (lead institution) in partnership with University of California at Davis, California Institute of Technology, University of California at Irvine, University of California at Los Angeles, University of California at San Diego, the University of Southern California, Stanford University, the University of Washington, and nine affiliate institutions

Mid-America Earthquake Center
University of Illinois at Urbana-Champaign, IL (lead institution) in partnership with Georgia Institute of Technology, the University of Memphis, MIT, St. Louis University, Texas A&M University, and Washington University

MICROELECTRONIC SYSTEMS AND INFORMATION TECHNOLOGY

Center for Neuromorphic Systems Engineering
California Institute of Technology, Pasadena, CA

Packaging Research Center
Georgia Institute of Technology, Atlanta, GA

Center for Wireless Integrated MicroSystems
University of Michigan, Ann Arbor, MI (lead institution) in partnership with Michigan State University and Michigan Technological University

Center for Subsurface Sensing and Imaging Systems
Northeastern University, Boston, MA (lead institution) in partnership with Boston University, Rensselaer Polytechnic Institute, University of Puerto Rico at Mayaguez, and four strategic affiliates: Lawrence Livermore National Laboratory, Massachusetts General Hospital, Brigham and Women's Hospital, and Woods Hole Oceanographic Institution

Integrated Media Systems Center
University of Southern California, Los Angeles, CA

Center for Power Electronics Systems
Virginia Polytechnic Institute & State University, Blacksburg, VA (lead institution) in partnership with North Carolina A&T State University, University of Puerto Rico at Mayaguez, Rensselaer Polytechnic Institute, and University of Wisconsin at Madison

¹ The Earthquake Engineering Research Centers (EERCs) were established under a special program in 1997 to further knowledge and technology for earthquake hazard mitigation.

At the end of their funding period as NSF-supported Engineering Research Centers, most ERCs will become self-sustaining. Currently there are sixteen self-sustaining ERCs:

Bioengineering

ERC for Emerging Cardiovascular Technologies
Duke University & other North Carolina Institutions
(established in 1987 and self-sustaining from 1998)

Center for Biofilm Engineering
Montana State University
(established in 1990 and self-sustaining from 2001)

Design and Manufacturing

ERC for Engineering Design, current title: Institute for Complex Engineered Systems
Carnegie Mellon University
(established in 1986 and self-sustaining from 1997)

Institute for Systems Research
University of Maryland/
Harvard University
(established in 1985 and self-sustaining from 1996)

Center for Computational Field Simulation
Mississippi State University
(established in 1990 and self-sustaining from 2001)

Center for Interfacial Engineering
University of Minnesota
(established in 1988 and self-sustaining in 1999)

ERC for Net Shape Manufacturing
Ohio State University
(established in 1986 and self-sustaining from 1997)

Center for Intelligent Manufacturing Systems, reestablished as the ERC for Collaborative Manufacturing
Purdue University
(established in 1985, reestablished in 1994, and self-sustaining from 1999)

Energy, Environment, and Infrastructure

Advanced Combustion Engineering Research Center
Brigham Young University/
University of Utah
(established in 1986 and self-sustaining from 1997)

Center for Advanced Technology for Large Structural Systems
Lehigh University
(established in 1986 and self-sustaining from 1997)

Offshore Technology Research Center
Texas A&M University/University of Texas
(established in 1988 and self-sustaining from 1999)

Opto/Microelectronics, Communication, and Information Technology

Data Storage Systems Center
Carnegie Mellon University
(established in 1990 and self-sustaining from 2001)

Optoelectronic Computing Systems Center
University of Colorado/
Colorado State University
(established in 1987 and self-sustaining from 1998)

Center for Telecommunications Research
Columbia University
(established in 1985 and self-sustaining from 1996)

Center for Compound Semiconductor Microelectronics
University of Illinois
(established in 1986 and self-sustaining from 1997)

Center for Advanced Electronic Materials Processing
North Carolina State University & other North Carolina Institutions
(established in 1988 and self-sustaining from 1999)

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