

CENTERS OF EXCELLENCE: A CATALOGUE

Summarizing information on jointly-funded
State-university-industry R&D centers for
advanced technology development and application.

Compiled by

Paul B. Phelps

Program Associate
Industry & Technology Development Division
LFW Management Associates, Inc.

in cooperation with

Governor's Office of Science and Technology
Department of Energy and Economic Development
State of Minnesota
Beverly Jones, Director

January 1988

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LFW Management Associates, Inc.
P.O. Box 25167
Alexandria, Virginia 22313-5167
(703) 684-6331

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PREFACE

This report summarizes information on State-sponsored "Centers of Excellence" gathered during a survey of State programs conducted in the Fall of 1987. For the purposes of this catalogue, "Centers of Excellence" refers to organizations or activities with the following characteristics:

- o institutionalized, focused, cooperative R&D programs;
- o supported in part by State governments, in addition to universities, industry and (in some cases) Federal agencies;
- o performed by teams that may include both industry and university employees; and
- o concentrated on relatively specific R&D agendas, usually with near-term commercial or governmental applicability.

Most of these activities involve state-of-the-art advancement of new technologies under conditions leading to early practical applications. Not included in this catalogue are project-level matching-grant programs, such as California's MICRO program. These and other types of State-supported programs are described in a companion volume, to be published in Spring 1988 by the Governor's Office of Science and Technology of the State of Minnesota.

The principal purpose of this catalogue is to help NASA program management, at all levels, to identify and where appropriate to initiate relationships with other technology-developing organizations. These State-sponsored programs should be of particular interest, because:

- o they present an opportunity to leverage NASA's R&D investments;
- o they are concentrated at the frontier, yet have a concern for practical applications; and
- o they involve industrial participation under conditions that increase the probability of prompt, widespread dissemination in the form of new or enhanced commercial products, processes or services.

In other words, this volume identifies a set of institutions through which NASA may be able to invest effectively some of its R&D dollars, in pursuit of the Nation's space and aeronautical objectives, while at the same time enhancing the achievement of the agency's technology utilization mandate. This document is only a working tool, however -- it is too early to know whether relationships can be developed to capitalize on the programs it describes.

At the same time, we hope that the information will be of value to policy officials and R&D managers in other Federal agencies, to State officials responsible for science- and technology-based programs for economic development, and to senior industrial executives interested in identifying cooperative R&D investment opportunities under conditions favorable to their commercial interests.

We expect to compile a supplement in 1988-89 to cover newly created centers, as well as existing centers that may not have reached our attention.

Paul R. Brockman
Vice President
Industry & Technology Development
LFW Management Associates, Inc.

January 1988

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ARIZONA

1. Statewide Policy Coordination

C. Roland Haden, P.E., Ph.D.
College of Engineering and Applied Science
Arizona State University
Tempe, AZ 85287
(602)965-1722

2. State-Designated Centers of Excellence

a. Center of Excellence in Engineering

C. Roland Haden, P.E., Ph.D.
College of Engineering and Applied Science
Arizona State University
Tempe, AZ 85287
(602)965-1722

Research Focus:

- o *solid state electronics;*
- o *computers and computer science;*
- o *computer aided processes;*
- o *energy systems;*
- o *transportation systems;*
- o *thermosciences; and*
- o *telecommunications* (launched in 1986).

Established: 1981.

Budget Information: \$32 million initial capitalization, including \$9 million from industrial participants. \$13 million to be used to build new engineering research center. Balance to support 60 new engineering faculty positions, increased teaching salaries, and expanded graduate and undergraduate programs.

Companies:

- o Garrett Turbine;
- o Honeywell;
- o Motorola;
- o Sperry Flight Systems.



ARKANSAS

1. Statewide Policy and Coordination

Dr. Joe P. Gentry
Vice President for Research
Arkansas Science and Technology Authority
200 Main Street, Suite 200
Little Rock, AR 72201
(501)371-3554

ASTA is attempting to create a "science corridor" based on the National Center for Toxicological Research and Pine Bluff Arsenal (both in Pine Bluff) and several university facilities in the Little Rock area. Rehabilitated VA hospital in Little Rock might be site for future center. For present, however, programs are limited to two matching grants from industry for campus-based applied research projects.



COLORADO

1. Statewide Policy and Coordination

Charles W. Henning
Executive Director
Colorado Advanced Technology Institute
555 17th Street, Suite 2900
Denver, CO 80202
(303)292-3640

Budget Information: For all programs:

- o \$300,000 FY 84-85;
- o \$413,000 FY 85-86;
- o \$1.2 million FY 86-87.

3. Other Research Centers

a. Advanced Materials Institute

J. Morse
Director
Advanced Materials Institute
Colorado School of Mines
Golden, CO

Research Focus: *polymers and amorphous materials.*

Apparent interest in *space applications*: AMI joined with CSM's Welding Research Center and Steel Research Center to submit application for NASA Center for Commercial Development of Space. NASA asked them to resubmit in April 1986; disposition unknown.

Established: 1985.

Budget Information: In 1985 AMI awarded 14 seed grants of about \$5,000 each for campus research in areas targeted by industry; total commitment would be about \$70,000.

Industrial Participation: AMI is governed by a board with representation from each of the four major research universities and the nine corporations who are also financial contributors.

Companies:

- o Adolph Coors Corporation;
- o AMAX, Inc.;
- o Ball Aerospace Systems Division;
- o Digital Equipment Corporation;
- o Gates Corporation;
- o Hewlett-Packard;
- o Honeywell, Inc.;
- o Manville Service Corporation;



- o Martin Marietta Corporation;
- o Rockwell International.

b. Supercomputer Network Center

CATI funded the creation of a high-speed data link between the Cyber supercomputer at Colorado State University and the Computer Science Center at Colorado University-Boulder. Completed in 1985, the link spreads the cost of the Cyber and makes additional computational power available to more users. CATI hopes to expand the link into a statewide network, providing access to large and small companies as well as academic researchers and Federal installations (e.g., NCAR and USAFA).

c. Center for Artificial Intelligence and Optoelectronics

Established: still in the planning stage in 1986.

Budget Information: Two small seed grants in 1984 led to cooperative research program in optoelectronics, and CATI's commissioners have targeted AI for similar support and encouragement.



FLORIDA

1. Statewide Policy and Coordination

Ray Iannucci
Executive Director
Florida High Technology and Industry Council
203 Barnett Bank Annex
Tallahassee, FL 32301

Council's budget for FY1987 included \$3.3 million for "research and continued study," at centers located throughout the state, in five fields:

- o electro-optics;*
- o lasers;*
- o materials sciences;*
- o microelectronics; and*
- o biomedicine.*



GEORGIA

1. Statewide Policy and Coordination

Dr. Tom Daniel
Board of Regents of the University System of Georgia
244 Washington Street, S.W.
Atlanta, GA 30334
(404)656-2211

The Georgia Research Consortium was created in the aftermath of Atlanta's second-place finish in the bidding for MCC in 1983. A major responsibility of the Consortium is to provide financial support to establish Centers of Excellence in the research universities of Georgia. It provides funds for "university research initiatives with the potential for stimulating high technology economic development." It also links and coordinates the State's colleges and universities in cooperative ventures with business and industry. The Consortium has no staff; its activities are coordinated by a Research Consortium Policy Committee appointed by the Governor. Operating budget was \$1 million in FY87.

The consortium had an initial capitalization of \$30 million, and in its first 4 years it has committed or allocated \$69.42 million to research programs at four of the State's universities. About \$10 million of this was spent to purchase and install a Cyber 205 supercomputer at the University of Georgia, which Control Data matched with the donation of a smaller computer and the location of its ETA subsidiary in Athens. Other investment priorities, identified by the consulting firm of McKinsey & Co., include "six research areas that hold promise for large-scale economic development: aerospace, biotechnology, health care applications, materials, microelectronics, and software."

2. State-Designated Centers of Excellence

a. Software Development Research Center

University of Georgia
Athens, GA

Research Focus: *Software development.*

Established: November 1983.

Budget Information: \$10 million grant from State for purchase of Cyber 205 supercomputer.

Industrial Participation: Control Data donated smaller computers of approximately equal value and located ETA Systems, Inc., (software development subsidiary) in Athens. Location decision was made public same day grant was announced.

Companies: Control Data Corp. (ETA Systems, Inc.).

b. Microelectronics Research Center

N. Walter Cox
Director
Microelectronics Research Center
Georgia Institute of Technology
Atlanta, GA

Research Focus:

- o Compound semiconductor materials;*
- o Microwave;*
- o Millimeter wave;*
- o Integrated optics.*

Established: 1985.

Budget Information: \$15 million State grant for construction of new 100,000-ft² building. Georgia Tech raised \$17 million in matching funds to equip and operate center. Construction underway, due to open September 1988.

3. Other Research Centers

a. Center of Excellence in Flexible Automation

Southern College of Technology
Marietta, GA

Consortium provided grant of \$320,000 to construct building.

b. Apparel and Textile Engineering Center

Professor Larry Haddock
Director
Department of Textiles and Apparel
Southern College of Technology
Marietta, GA

John Adams
Economic Development Laboratory
Georgia Tech Research Institute
Atlanta, GA 30332
(404)894-4138

Georgia Tech received a \$5-million, 3-year grant from the Defense Logistics Agency to manage one of its three Apparel Advanced Manufacturing Demonstration Centers (the other two are at Clemson University and the Fashion Institute of Technology in New York). Research Consortium gave grant of \$1.6 million to construct pilot plant at



Southern to demonstrate new technologies. Center will be jointly designed by Georgia Tech and Southern and operated by Southern Tech students and personnel from local apparel manufacturers.

Research Focus: *Flexible automation technology applied to apparel manufacturing*, initially the assembly of military trousers and later shifting to civilian trousers and military/civilian shirts. Topics include:

- o *robotic vision systems;*
- o *computer integrated manufacturing; and*
- o *plant management.*

Industry Participation: Georgia Tech will seek a core of industries to pledge support to continue to operation beyond the pilot stage. The State hopes that it will encourage additional companies to bid on government contracts.

c. O. Wayne Rollins [Life Sciences] Research Center

O. Wayne Rollins Research Center
Emory University
Atlanta, GA

Research Focus: *Life sciences.*

Budget Information: \$3.3 million State grant and commitment of additional \$6.7 million for construction.

d. Biosciences Complex

University of Georgia
Athens, GA

\$32 million in State funds have been committed for proposed biosciences complex.

e. Manufacturing Research Center

Manufacturing Research Center
Georgia Institute of Technology
Atlanta, GA

Research Focus: *Electronics manufacturing*, with special emphasis on automation for products too small for human workers to produce by hand.

Established: 1986.

Budget Information: Research Consortium has already provided \$500,000 planning grant, and Governor Harris will ask the Legislature to allocate an additional \$14.5 million.



Georgia Tech is expected to raise \$15 million in corporate contracts, grants and other assistance.

Industrial Participation: Motorola has already committed \$1 million to help launch Center, and it will encourage other companies to do so.

Companies: Motorola.



HAWAII

1. Statewide Policy and Coordination

Bill Bass
Director
Hawaii High Technology Development Corporation
P.O. Box 2780
Honolulu, HI 96803
(808)548-8996

HHTDC is responsible for developing both PICHTR (see below) and the Manoa Research Park, for which PICHTR will be the anchor tenant. The Park is scheduled to open in 1989.

2. State-Designated Centers of Excellence

a. Pacific International Center for High Technology Research

Dr. Paul Yuen
Dean
College of Engineering
University of Hawaii at Manoa
2540 Dole Street, Holmes 240
Honolulu, HI 96822
(808)948-7850

Research Focus: The Center directs a joint U.S.-Japanese cooperative research program in advanced technologies, including four major areas:

- o **Biotechnology —**
 - * *plant genetic engineering;*
 - * *plant disease and pest control;*
 - * *marine microbial products and improved methods for aquaculture;*
 - * *monoclonal antibody production.*
- o **Energy and resources —**
 - * *open-cycle ocean thermal energy conversion;*
 - * *ocean resources development;*
 - * *geothermal energy applications;*
 - * *marine materials development;*
 - * *hydrogen fuel research;*
 - * *energy storage;*
 - * *desalination.*
- o **Information technology —**
 - * *computer vision, with applications in robotics and devices for the disabled;*
 - * *natural language processing;*
 - * *sensors.*
- o **Education and International** (the South Pacific Consortium for Regional Centers in Higher Education).



Established: Created by the State of Hawaii in 1983; became nonprofit corporation in 1985.

Budget Information: \$500,000 state funds FY87, with additional support from private sector and government sources, including \$1 million/yr for 8 years from Japan and up to \$26 million in DOE grants and directed appropriations for OTEC. Total operating budget \$3.5 million per year. PICHTR has 20 full-time staff and a total staff of 100.

Industrial Participation: International board of directors included representatives of U.S. and Japanese business and industry, as well as State government and university.

Companies: Following are represented on board of directors:

- o Coalinga Corp.;
- o Tokyu Corp.;
- o Wang Laboratories Inc.



ILLINOIS

1. Statewide Policy and Coordination

Mr. John Strauss
Executive Director
Governor's Commission on Science and Technology
100 West Randolph Street, Suite 3-400
Chicago, IL 60601
(312)917-3982

Illinois doesn't designate Centers of Excellence *per se*, although their promotional literature speaks of eight "Technology Commercialization Centers," most of which are described below. These Centers receive their funding from higher education rather than economic development budgets. The State government is currently working with a consortium of universities (UI, UC, IIT, and Northwestern) and private firms to develop an Illinois Space Institute, which would identify, encourage and coordinate space-related research, applications and spinoffs *in Illinois*.

3. Other Research Centers

a. Microelectronics Technology Center

Mr. Greg Stillman
Director
Microelectronics Center
University of Illinois at Urbana-Champaign
Champaign, IL 61820

This Center, along with the three other microelectronics- and computer-related centers at UIUC (see below), is developing a joint proposal for NSF's new Basic Science and Technology Centers program.

Research Focus:

- o *quantum well heterostructures and superlattices;*
- o *semiconductor device physics;*
- o *metalorganic chemical vapor deposition;*
- o *molecular beam epitaxy,*
- o *thin-film physics;*
- o *acoustic charge transport devices; and*
- o *gallium-arsenide and other III/V compounds.*

- b. Also located at the University of Illinois at Urbana-Champaign:
- o Center for Supercomputing Research and Development (university);
 - o National Center for Supercomputing Applications (NSF);
 - o Beckman Institute for Advanced Graduate Studies (a new \$40-million center for AI research; director Ted Brown at 217-244-1176);



- o Materials Research Center; and
- o Biotechnology Center.

c. Materials Technology Center

Dr. Kenneth Tempelmeyer
 Dean
 College of Engineering and Technology
 Southern Illinois University at Carbondale
 Carbondale, IL 62901
 (618)453-4321

Research Focus: The center coordinates interdisciplinary research in six areas:

- o *composite materials (e.g. graphite/carbon fiber-reinforced plastics);*
- o *catalysts;*
- o *chemical feedstocks;*
- o *coal-derived materials;*
- o *material characterization procedures; and*
- o *project evaluation guidelines to measure cost efficiencies and markets.*

The College of Engineering and Technology also operates the Applied Research Center as a modern engineering experiment station organized in the following areas:

- o *mining and processing;*
- o *high-sulfur coal conversion and utilization;*
- o *alternate energy;*
- o *electrical;*
- o *fluids, materials and mechanics;*
- o *industrial productivity.*

Industrial Participation: "Technical cooperation between the center and industry or private sources is expected to speed the development and application of new materials and techniques. . . . The development of long-term ties with industrial research and management personnel who can help in the formulation of worthwhile research programs is considered vital to the success of the Materials Technology Center."

d. Center for Advanced Manufacturing and Production

Jerry Bratsche
 Director
 Center for Advanced Manufacturing and Production
 Southern Illinois University at Edwardsville
 Edwardsville, IL 62025
 (618)692-2169

CAMP was established in February 1985 to assist regional business and industry in the application of advanced technology. Recent industry-sponsored research



on the SUIE campus has included studies of *materials characterization and chromogenic detection systems*.

e. Basic Industry Research Institute

Dr. Ray Fessler
Director
Basic Industry Laboratory
Northwestern University
Evanston, IL 60201
(312)491-4941

Research Focus: The Institute is made up of a number of interdisciplinary research groups, including the following:

- o Center for Engineering Tribology;
- o Center for Manufacturing Engineering;
- o Materials Research Center;
- o Center for Concrete and Geomaterials;
- o Center for Catalysis and Surface Science;
- o Energy Engineering Council;
- o Program in Mineral Resource Engineering and Management;
- o Program in Engineering Management; and
- o Basic Industry Research Laboratory, recently completed with a \$26-million Federal grant.

The Institute, along with the city of Evanston, also operates the Evanston-University Research Park on 26 acres adjacent to the campus. The first facility is the Basic Industry Lab.

f. Center for Plant Molecular Biology

Harvey Drucker
Argonne National Laboratory
(312)972-3804

Being developed at NIU in cooperation with Argonne and with active participation of representatives from agribusiness companies. *NOTE: As the result of a July 1984 workshop, Argonne is also sponsoring a "Midwest Plant Biotechnology Consortium," through which industrial sponsors have been found for 22 of 59 research proposals submitted by universities and institutes.*

Research Focus: Active research programs are already underway in the following areas:

- o *enzymology;*
- o *genetic engineering (recombinant DNA technology);*
- o *developmental biology;*
- o *mutagenesis and DNA repair;*
- o *physiology;*
- o *membrane chemistry;*
- o *hybridomas and immunogenetics; and*
- o *molecular modeling and computer graphics.*



- g. Also at Northern Illinois University:
 - o Programs in Materials Science;
 - o Center for Biochemical and Biophysical Studies; and
 - o Cartography and Spatial Analysis Laboratory.
- h. Biotechnology Center (University of Illinois at Chicago)

Nina Klarich
Director
Chicago Technology Park
Chicago, IL
(312)829-7252

A joint venture of UIC and the Rush-Presbyterian St. Luke's Medical Center, with support from the City of Chicago and the State of Illinois.



KANSAS

1. Statewide Policy and Coordination

Dr. William Brundage
President
Kansas Technology Enterprise Corporation
400 S.W. 8th Street, Suite 500
Topeka, KS 66603
(913)296-5272

State-owned quasi-private corporation became operational in January 1987 to replace Kansas Advanced Technology Commission, established in 1983. Responsible for encouraging new technology growth and facilitating industry/university relations. KATC advises the Board of Regents in the implementation of Centers of Excellence and provides both operating funds and research grants.

Budget Information: Operating funds are divided evenly among the three centers and must be matched 1:2 by industry; research grants are more or less competitive and matched almost 2:1 by industry.

o FY86--	Operating budget	\$ 390,000
	Matching grants	780,000
	Total State funds	1,170,000
o FY87--	Operating budget	516,000
o FY88--	Operating (request)	528,000
o FY89--	Operating (proposed)	1,250,000

2. State-Designated Centers of Excellence

a. Center for Bioanalytical Research

Dr. Theodore Kuwana
Director
Center for Bioanalytical Research
2099 Constant Avenue
University of Kansas
Lawrence, KS 66046
(913)864-5140

Developments by the Center are patented and commercialized by Oread Laboratories, Inc., a wholly-owned subsidiary of the UK Endowment Association.

Research Focus: Mission-oriented research leading to the development of sophisticated *bioanalytical techniques* -- specifically, the detection of minute quantities of substances -- for the pharmaceutical and biological research industries.

FY86 grants:

- o *microsampling;*
- o *transdermal drug movement;*



- o *ultrasensitive assay;*
- o *microprocessor test system;*
- o *advanced chromatograph hardware;*
- o *computer-assisted modeling;*
- o *AI algorithms; and*
- o *expert systems R&D.*

Established: 1984.

Budget Information: FY86 \$130,000 operating funds plus \$335,000 in grants, matched by a total of \$568,000 from industry and an unknown amount from KU. Operating funds increased to \$172,000 in FY87 and \$176,000 in FY88, with 1:2 match from industry.

Industrial Participation: Industrial participants match State funds at 1:2 for operating budget and about 2:1 for project grants. Role in governance similar to that of NSF UICR centers (advisory board and project monitors).

Companies: In addition to Oread Laboratories (above), Center received matching grants in FY86 from following:

- o Astra Lakemadel;
- o Boeing;
- o IPRX;
- o Phillips Petroleum;
- o Puritan-Bennett; and
- o United Telecom.

b. Center for Excellence in Computer-Controlled Automation

Dr. J. Garth Thompson
 Director
 Center of Excellence in Computer-Controlled Automation
 Durland Hall
 Kansas State University
 Manhattan, KS 66506
 (913)532-5844

Research Focus: Focuses on development of advanced control systems for design and manufacturing:

- o *control strategies and stereoscopic vision for robots* (e.g., image segmentation and enhancement);
- o *industrial automation;*
- o *CAD-CAM;*
- o *computer systems; and*
- o *artificial intelligence* (e.g., expert systems for avionics).

Established: 1984.

Budget Information: FY86 \$130,000 operating funds and \$109,000 project grants, matched by a total of \$230,000 from industry. FY87 \$172,000 operating funds, matched by \$86,00



from industry. FY88 \$176,000 operating funds, matched by \$88,000 from industry.

Industrial Participation: "The Center works closely with existing industry in the State." Industrial participants match State funds at 1:2 for operating budget and about 2:1 for project grants.

Companies: FY86 matching grants:

- o Boeing;
- o Buck Rogers Co.;
- o Collins Avionics;
- o Funk Manufacturing-Caterpillar Tractor;
- o Goodyear;
- o Osborne Industries; and
- o Pioneer Hi-Bred.

c. Center for Productivity Enhancement

Dr. Richard Graham
Associate Director
Center for Productivity Enhancement
Campus Box 146
Wichita State University
Wichita, KS 67208
(316)689-3525

CPE is a component of the larger Institute for Aviation Research (see below).

Research Focus: The Center does a considerable amount of training and applied research, but it focuses increasingly on the transfer of advanced technology to manufacturers in four areas of technology:

- o *advanced composite materials* (especially the *producibility of advanced composite structures* for use in aircraft);
- o *CAD-CAM*;
- o *robotics*; and
- o *digital electronics*.

Established: 1983.

Budget Information: FY86 \$130,000 operating funds and \$203,000 project grants, matched by a total of \$426,000 from industry. FY87 \$172,000 operating funds, matched by \$86,000 from industry. FY88 \$176,000 operating funds, matched by \$88,000 from industry. Director reports current (FY87) budget of about \$250,000/year, plus another \$500,000 or \$600,000 for research under the Institute, plus another \$500,000 to \$700,000 for a special 2-year project -- total \$1 million to \$1.2 million.



Industrial Participation: Industrial participants match State funds at 1:2 for operating budget and about 2:1 for project grants.

Companies: FY86 matching grants:

- o Boeing;
- o Electromech;
- o EPRI-KEURP; and
- o NCR.

3. Other Research Centers

a. Center for Technology Transfer

Vic Sullivan
Director
Center for Technology Transfer
Pittsburg State University
Pittsburg, KS
(316)231-7000, ext. 4366

Research Focus: Technology transfer to smaller companies in the southeastern region of the State, including large numbers of machine shops. According to the mission statement, "Nationally recognized programs . . . particularly those related to the woods and plastics industries, shall be the nucleus of the efforts of the Center with a focus on *design, testing, and development of products and processing methods.*"

Established: 1985; center designation approved by Legislature 1986.

Budget Information: FY86 project grants \$132,500, matched by \$210,000 from industry.

Industrial Participation: Industrial participants match State funds at 1:2 for operating budget and about 2:1 for project grants. Role in governance: national advisory board.

Companies: Matching grants FY86:

- o Ah's, Inc.;
- o Arpeda;
- o Atkinson Industries;
- o Industrial Control Concepts;
- o Medical Industrial Technologies;
- o Parsons Precision Products;
- o S&B Manufacturing;
- o Shellvick Industries;
- o Stevens Manufacturing.



b. Institute for Aviation Research

John Breaseale
Director
Institute for Aviation Research
Wichita State University
Wichita, KS
(316)689-3678

Research Focus: The Institute has five components Centers, each with its own strengths and agenda:

- o **Center for Basic and Applied Research --**
 - * *low-speed aerodynamics;*
 - * *stall-spin dynamics;*
 - * *propulsion;*
 - * *advanced materials.*
- o **Center for Aviation Safety --**
 - * *electro-impulse de-icing;*
 - * *dynamic testing;*
 - * *human factors laboratory.*
- o **Center for Aviation Education and Training.**
- o **Center for Management and Human Development --**
 - * *personnel;*
 - * *international development;*
 - * *management enhancement.*
- o **Center for Productivity Enhancement --**
 - * *composite materials;*
 - * *CAD-CAM;*
 - * *advanced software systems; and*
 - * *robotics and computer-integrated manufacturing.*

Established: 1987.



KENTUCKY

1. Statewide Policy and Coordination

Ray M. Bowen
Dean
School of Engineering
177 Anderson Hall
University of Kentucky
Lexington, KY 40506-0046
(606)257-1687

2. State-Designated Centers of Excellence

a. Center for Robotics and Manufacturing Systems

William A. Gruver
Director
Center for Robotics and Manufacturing Systems
775 Anderson Hall
University of Kentucky
Lexington, KY 40506
(606)257-7272

Research Focus:

- o *Information systems in CIM environment —*
 - * *CAD for manufacturing;*
 - * *CNC machining;*
 - * *artificial intelligence;*
 - * *integrated manufacturing systems.*
- o *Robotics —*
 - * *design of end-effectors and actuators;*
 - * *computer vision;*
 - * *robotics materials;*
 - * *applications in hazardous environments (e.g., mining).*

The Center will also have a technology transfer mission.

Established: 1986.

Budget Information: Initial funding of \$10 million in 1986, of which \$9 million was used for a new building and \$1 million for equipment. Operating funds \$3.2 million/yr FY87 and FY88, for both research and outreach, with matching funds up to 1:1 from Federal and industry sources. The Center awarded \$1.2 million in grants to 27 university research projects in January 1987.

Industrial Participation: Research proposals were solicited from university departments in the first round of funding, but this procedure is under review. The Center will also function as a small business assistance program and as part of the State's industrial recruitment strategy.



MARYLAND

1. Statewide Policy and Coordination

Dr. Rita Colwell
Director
Maryland Biotechnology Institute
3300 Metzert Road
University of Maryland
College Park, MD 20783
(301)853-3611

MBI provides an administrative umbrella for four centers of excellence, which are in various stages of development.

Budget Information: FY86 \$2.4 million for two centers, FY87 \$4.5 million for three centers. MBI is trying to obtain appropriation for \$60 million over 5 years to launch all five centers.

2. State-Designated Centers of Excellence

a. Center for Advanced Research in Biotechnology

Dr. Thomas Poulos
Acting Director
Center for Advanced Research in Biotechnology
9600 Gudelsky Drive
Rockville, MD 20850
(301)975-4509

Joint venture of University of Maryland, National Bureau of Standards, and Montgomery County government.

Research Focus: *Protein engineering, X-ray and neutron diffraction crystallography.*

Established: 1985.

Budget Information: FY86 \$1.2 million, FY87 \$1.5 million from State.

Industrial Participation: Half of the permanent staff will come from the National Bureau of Standards and University of Maryland, respectively. Visiting researchers, paid for by their companies, will be accepted as they are at NBS.



b. Center of Marine Biotechnology

Dr. Fred Singleton
Director
Center of Marine Biotechnology
University of Maryland at Baltimore
600 East Lombard Street
Baltimore, MD 21202
(301)783 4800

Research Focus: Use of *biotechnology for study of marine environments and organisms*. Basic research, but with an eye to the development of new products.

Established: 1986.

Budget Information: FY86 \$1.2 million and 18 faculty lines.
FY87 \$1.5 million.

c. Center for Medical Biotechnology

Dr. Maimon Cohen
Co-Director
Medical Biotechnology Center
University of Maryland at Baltimore
South Pine Street
Baltimore, MD 20101
(301)328-3480

Research Focus:
o *bioelectronics;*
o *biomaterials; and*
o *vaccine development.*

Established: 1986.

Budget Information: FY86 \$1.2 million and 18 faculty lines;
FY87 \$1.5 million.

Industrial Participation: Based on existing "strong relationships" with industry.



3. Other Research Centers

a. Agricultural Biotechnology Center

Dr. Shain-Dow Kung
Director
Agricultural Biotechnology Center
c/o Sea Grant College
H.J. Patterson Hall
University of Maryland
College Park, MD 20742
(301)454-6056

Research Focus: *Agricultural applications of plant biotechnology.*

b. Program for Human Bioethics

Under development.



MASSACHUSETTS

1. Statewide Policy and Coordination

Ms. Megan Jones
Director
Massachusetts Centers of Excellence Corporation
1 Ashburton Place, Suite 2110
Boston, MA 02138
(617)727-7430/7438

Founded in 1985, MCEC is governed by a board of directors from industry, academia and government. MCEC has established "distributed centers" through a program of competitive R&D grants for joint university-industry projects in three areas:

- o biotechnology;
- o marine science; and
- o polymer science.

In the first round of grants, about July 1986, \$1 million was awarded to fund 21 projects -- 6 in biotechnology, 7 in marine science, and 8 in polymer science. The second round of grants, totaling \$1.2 million, was scheduled for July 1987.

Budget Information: FY87 \$1.2 million, matched by \$2.6 million from industry. FY88 total budget \$4.2 million (proposed).

2. State-Designated Centers of Excellence

a. National Polymer Center

Ms. Frances Eagle
Project Director for Polymer Science
Massachusetts Centers of Excellence Corp.
1 Ashburton Place, Suite 2110
Boston, MA 02138
(617)727-7430/7438

Research Focus: Based on grant topics FY86:

- o *AI for injection mold design and operation;*
- o *gas-separation membranes;*
- o *biopolymer extraction of heavy metals.*

Established: 1986.

Budget Information: \$24 million project. Initial State funding of \$6 million from the FY87 general fund; also received \$15 million directed appropriation from Federal Government in 1986. MCEC grants of \$330,000 in FY86, matched by \$770,000 from industry and universities.

Companies:

- o Automated Assemblies;
- o Cape Cod Research;



- o Digital Equipment Corporation;
- o Dynisco, Inc.;
- o General Electric Plastics Group;
- o LMI, Inc.;
- o Millipore Corporation;
- o Monsanto Polymer Products Company;
- o Nypro, Inc.

3. Other Research Centers

a. Massachusetts Microelectronics Center

Phillip Hollahan
 Assistant Director
 Massachusetts Technology Park Corporation
 Boston, MA
 (617)870-0312

MTPC was created as a quasipublic corporation to establish and operate one or more educational centers with design, fabrication and testing facilities, and training programs needed by specific businesses and industries. Its first major project is the construction of the Massachusetts Microelectronics Center; it hopes to get another \$20 million to build the proposed Massachusetts Advanced Materials Center.

Research Focus: *Microchip design, fabrication and testing.*

Budget Information: \$20 million initial funding from a bond issue, matched by \$22 million from private sources.

b. Massachusetts Photovoltaics Center [of Excellence]

This Center, separately administered by the State's Office of Energy Resources, was opened at Logan Airport in March 1986. A complementary program of Technology Services at the University of Lowell was established in January 1987 with a \$1-million training grant from the U.S. Department of Energy.

Research Focus: The Center has four components:

- o a demonstration center where foreign visitors can see PV technologies and applications;
- o export assistance services for Massachusetts PV companies;
- o training and consulting assistance in PV installation and maintenance; and
- o financial services and information on Federal and State export services.

The Office of Energy Resources has recently awarded \$800,500 in 14 grants to State agencies as part of its Massachusetts Photovoltaic Utilization Project.



c. Biotechnology Center of Excellence

Mr. Fernando Quezada
Project Director for Biotechnology
Massachusetts Centers of Excellence Corp.
1 Ashburton Place, Suite 2110
Boston, MA 02138
(617)727-7430/7438

MCEC awarded a grant of \$165,000 to the Massachusetts Biotechnology Research Institute for the development of its Innovation Center, located at the Biotechnology Research Park in Worcester. The Park is a joint venture of U.Mass. Medical Center, Worcester Foundation for Advanced Biological Studies and Worcester Polytechnic Institute, along with the Worcester Business Development Corporation. At present, however, BCE remains a "distributed" grant program.

Research Focus:

- o *diagnostic and therapeutic drugs;*
- o *agriculture and animal health;*
- o *toxic waste degradation and treatment.*

Companies: FY87 matching grants:

- o Nourse Farms, Inc.;
- o Monsanto;
- o The Bars;
- o East Acres Biologicals;
- o Applied Biotechnology, Inc.

b. Marine Science Center of Excellence

A "distributed center," like PSCE and BCE, which awards grants for research projects and institution building. MSCE focuses its activities on Woods Hole Oceanographic Institute, Southeastern Massachusetts University, the National Aquaculture Center, and NOAA's marine electronics center.

Research Focus: Three areas:

- o *marine electronics* (global positioning system instrumentation, sonar image processing, satellite transmitters);
- o *marine resources* (shellfish toxin assay, surimi development); and
- o *water quality* (training programs for State and local officials).

Companies: FY87 matching grants:

- o Datamarine International, Inc.;
- o Marine Imaging Systems, Inc.;
- o Ferranti ORE, Inc.
- o Associates of Cape Cod;



- o Biotechnica Diagnostics, Inc.;
- o Forbes & Co.



MICHIGAN

1. Statewide Policy and Coordination

Dr. James Kenworthy
Manager, Research and Technology Programs
Michigan Strategic Fund
P.O. Box 30234
Lansing, MI 48909
(517)373-7550

Michigan Strategic Fund, created in 1984 to fill capital gaps in Michigan, grew out of the Michigan Economic Development Authority, which had been established in 1981. The Fund partially funded the creation of three "centers of excellence" (below), and it has other programs in seed capital, product development, and follow-on funding.

2. State-Designated Centers of Excellence

Total budget FY87 \$2.67 million -- \$1 million startup for MMPI and \$0.5 million each to three other centers.

a. Industrial Technology Institute

D. Falkenberg, Acting President
Bob DiGiovani, Manager of Public Affairs
Industrial Technology Institute
2901 Hubbard Road
P.O. Box 1485
Ann Arbor, MI 48106
(313)769-4311

Deployment of manufacturing technologies is handled by the Michigan Modernization Service. ITI has joined with the Environmental Research Institute of Michigan, two universities, and eight companies in a proposal for a NASA Center for the Commercial Development of Space.

Research Focus: ITI pursues its mission -- enhancing the productivity and competitiveness of American industry -- through coordinated programs of R&D, integration, and implementation in its four component centers:

- o Advanced Manufacturing Technologies Laboratory --
 - * *Manufacturing Systems Group;*
 - * *Design for Manufacture Group;*
 - * *Factory Control Group;*
 - * *Automated Inspection and Monitoring Group*
(sensor, diagnostic, and dimensional gaging systems).
- o Center for Social and Economic Issues --
 - * Manufacturing Economics and Strategy Group
(cost analysis);



- * Industry Affairs and Policy (macroeconomic and public policy analysis);
- * Training and Technical Assistance.
- * Organization and Technology Group (impact of automation on job design, work rules, organizational structure and communication).
- o Communications and Distributed Systems Laboratory --
 - * *Distributed Factory Control* (architectural modeling and AI for control-scheduling applications);
 - * *Network Evaluation and Testing* (conformance of MAP/TOP devices and model-based evaluation of complex distributed systems);
 - * *System Integration Tools*;
 - * *Manufacturing Systems Development Tools* (communications protocols like MMS); and
 - * *Network Management* (algorithms and utilities for MAP/TOP and other profiles).
- o Information Transfer Center (retrieval and dissemination of data and publications).

Established: 1983.

Budget Information: Initial capitalization in 1983 of \$17.5 million over 5 years; proposed recapitalization of \$7.5 million through FY91. Operating funds about \$550,000 FY87.

b. Michigan Biotechnology Institute

Dr. J. Gregory Zeikus, President
 Dr. Jack H. Pincus, VP - Economic Development
 Michigan Biotechnology Institute
 3900 Collins Road
 P.O. Box 27609
 Lansing, MI 48909
 (517)337-3181

Research Focus: Focuses on biotechnological applications to product new substances, such as food and flavor ingredients, biopolymers, vitamins, industrial enzymes, and specialty chemicals from natural and renewable resources.
 Three areas:

- o *Industrial Enzymes and Bioelectronics Technology* (research in thermoactive enzymes; applications in food processing, pulp and paper, waste treatment, pharmaceuticals, and biosensors for measuring/monitoring devices);
- o *Fermentation and Biochemical Products Technology* (improved bioprocess technologies for conversion of renewable resources into higher value products -- e.g. pharmaceuticals, food additives, fuels, chemical feedstocks, enzymes -- and recovery of by-products and energy).



- o **Biomaterials Utilization and Waste Treatment Technology** (anaerobic digestion and fungal treatment of wastes for disposal or conversion to higher value products; applications in food and chemical industries and in industrial and municipal waste treatment).

Established: Incorporated November 1981.

Budget Information: Initial capitalization from MEDA (above) and the W.K. Kellogg and Dow Foundations; hopes to be self-supporting by 1993. Recently dedicated \$18-million facility, paid for with \$5 million in MBI funds, \$10 million IRB, and \$3 million State loan; 15-acre tract was donated by Michigan State University. Operating funds from State about \$550,000 FY87; also received \$150,000 grant from Mott Foundation for operating expenses.

Industrial Participation: MBI undertakes contract R&D for industrial sponsors and offers a variety of services, including scale-up and pilot plant, consulting, and visiting scientist programs. Board of Trustees includes members from Upjohn, Neogen Corp., Kellogg Co., Woodlands Mead Corp.

Companies:

- o Cambridge Scientific Inc.

3. Other Research Centers

a. Metropolitan Center for High Technology

Located in the former Kresge Corp. headquarters in downtown Detroit, MCHT is described by a State official as "more than an incubator but less than a center of excellence." It includes some programs with auto companies and some toxicology research, both from Wayne State University.

b. Michigan Materials Processing Institute

Established in 1986 with \$1 million in MSF funds, the Institute is described by a State official as a forum for developing a consensus or strategy; it is not likely to result in the creation of a R&D center.



MINNESOTA

1. Statewide Policy and Coordination

Ms. Beverly Jones
Director
Governor's Office of Science & Technology
Department of Energy and Economic Development
900 American Center Building
150 East Kellogg Avenue
St. Paul, MN 55101
(612)297-4368

The Office of Science & Technology was created in 1983 to (1) conduct science policy research; (2) advise Governor and other policymakers; (3) build closer ties among government, university and industry in the State; (4) expand the science and technology resources in the State; and (5) make existing resources more widely known. FY86-87 budget of \$2.6 million includes \$1.0 million for Midwest Technology Development Center.

State provides funds for two "research centers" (a & b below) and three "technology centers" (c, d & e). State also provides a variety of other services to support technology transfer, commercialization, and high-tech business development. A new initiative, the Greater Minnesota Corporation, will provide large amounts of additional funding in the future; program guidelines are currently under development.

3. Other Research Centers

a. Biotechnology Research Center

Dr. Victor Bloomfield
Director
Biotechnology Research Center
240 Gortner Laboratory
University of Minnesota
St. Paul, MN 55108
(612)376-1787

Research Focus:

- o *biological process technology;*
- o *plant molecular biology;*
- o *clinical diagnostics;*
- o *biomedical engineering;*
- o *pharmaceutical and immunological technology;*
- o *reproductive biology;*
- o *food processing biotechnology;*
- o *biomass conversion; and*
- o *environmental biotechnology.*

Budget Information: Since 1983 there has been a major effort to strengthen program in *biological process*



technology. State provided \$600,000 grant in FY86-87 to establish Institute for Advanced Studies in Biological Process Technology. Center also received planning grant from NSF to establish UICR Center in Biological Process Technology.

b. Microelectronics and Information Sciences Center

Dr. Wallace W. Lindemann
Executive Director
Microelectronics & Information Sciences Center
227 Lind Hall
20t Church Street, S.E.
Minneapolis, MN 55455
(612)625-8005

Research Focus: Sponsor and conduct research in *microelectronics and information sciences*, strengthen the educational offerings of UM in these areas, and enhance university-industry linkages. Recent project include:

- o *intelligent systems;*
- o *high-performance integrated circuits;*
- o *artificially structured materials for microelectronics;*
- o *III-V compound semiconductors and high-speed devices.*

Budget Information: Funding comes from several large computer and data processing firms, several smaller companies, and the State of Minnesota (\$1.3 million FY86-87). Additional funds from federal agencies have been secured for some projects.

Industrial Participation: Management Board and Technical Coordinating Committee, made up of representatives of the university and private industry, cooperatively set the research agenda for MEIS. Center holds program reviews, symposia, and workshops for industry, and makes seminars available on videotape. MEIS Doctoral fellows take tours and summer jobs at member companies.

Companies: Larger "sponsors" include:

- o Control Data;
- o Honeywell;
- o IBM;
- o 3M;
- o Sperry.

Smaller "associate sponsors" include:

- o ADC Telecommunications Inc.;
- o Cray Research;
- o VTC Inc.;
- o Zycad Corp.; and
- o four other companies.



c. Mineral Resources Research Center

Dr. Kenneth Reid
Director
Mineral Resources Research Center
103 MRRC
56 East River Road
University of Minnesota
Minneapolis, MN 55455
(612)373-3341

Research Focus: *Fundamentals, copper-nickel, and iron ore and steel studies.*

Established: 1911.

Budget Information: Funded by Federal grants and contracts, State appropriations and contracts (\$1.43 million FY86-87), and private contracts.

d. Natural Resources Research Institute

Michael Lalich
Director
Natural Resources Research Institute
421 Darland Administration Building
Duluth, MN 55812
(218)726-6139

Operated by University of Minnesota-Duluth and located in remodeled building on former Duluth Air Force Base.

Research Focus: *Biomass, energy, water, and minerals.* Conducts applied research in order to develop the natural resources of Minnesota into economically viable products. Also provides R&D assistance to local businesses in marketing, financing, and production where commercial application is feasible.

Budget Information: \$4.7 million in State funds FY86-87.

e. Science and Technology Resource Center

Research Focus: Encourage and assist inventors, entrepreneurs and small businesses to develop new products and processes for the continued economic development of southwest Minnesota. Located at Southwest State University.



MISSISSIPPI

1. Statewide Policy and Coordination

Dr. David L. Murphree
President
Institute for Technology Development
3825 Ridgewood Road
Jackson, MS 39211
(601)982-6545

2. State-Designated Centers of Excellence

a. Institute for Technology Development

James Perkins, Ph.D.
Vice President for Research & Development
Institute for Technology Development
3825 Ridgewood Road
Jackson, MS 39211
(601)982-6545

Research Focus: Conducts scientific research and transfers useful technology into commercial applications, working in conjunction with the State's universities through six semi-independent divisions:

- o **Advanced Living Systems Group. — Human factors design** for elderly and handicapped markets, including barrier-free environments and rehabilitation devices. In conjunction with University of Mississippi, and supported by Research Division of the National Association of Home Builders.
- o **Acoustics Research and Development Division. — Ultrasonic sensors and transducers** for commercial products including light aircraft detector, ultrasonic telephone, and acoustic catfish counter; also exploring applications in **robotic sensing**. In conjunction with UM, and supported by military agencies.
- o **Biomaterials/Biomedical Engineering Division. —** Products under development include **fully implantable hearing aid, rehabilitation products** (such as mouthstick for quadraplegics), and **Foam Immobilization System** (fast-setting splint for battlefield and emergency situations). Division uses expertise of UM Medical Center and is supported by contracts with five private companies and U.S. Navy.
- o **Microelectronics Design Division. — Super-scientific computer** for use in aircraft design, reservoir engineering, chemical reactions, and other applications involving fluid dynamics; **semi-custom microchip design**. Joint effort with Mississippi State University, supported by industrial partners and contracts from DARPA and NSA.



- o **Polymer Development Division.** — *Testing in coatings, flammability, composition, physical and infrared testing* for the 207 polymer-related companies in Mississippi. Works in collaboration with the University of Southern Mississippi.
- o **Space Remote Sensing Center.** — NASA Center for Commercial Development of Space, supported by 5-year \$5-million grant. At least nine companies pledged first-year support, and EOSAT will cooperate in market development and sales of satellite data. Will be located in new Mississippi Technology Transfer Center in Hancock County.

Established: Incorporated August 1983, startup February 1985.

Budget Information: In 1984, Congress designated ITD a National Demonstration project and authorized a 4-year, \$20-million appropriation to be matched by \$16 million in State funds and \$2 million in private funds over the same period. ITD hopes to be self-supporting at the end of 5 years.

- o FY85--\$7 million Federal, \$4 million State;
- o FY86--\$6 million Federal, \$4 million State;
- o FY87--\$4 million Federal, \$4 million State;
- o FY88--\$3 million Federal, \$4 million State.

Industrial Participation: Board of Directors includes eight representatives from industry and seven from government or university.

Companies: In addition to industrial partners in specific programs (see above), contracts have been negotiated with many nation sponsors, including:

- o Boeing Military Airplane Company;
- o General Motors;
- o Federal Express;
- o Dow Chemical U.S.A.;
- o Bechtel;
- o Johnson and Johnson;
- o Monsanto;
- o Richards;
- o Synthes;
- o National Association of Home Builders.



MISSOURI

1. Statewide Policy and Coordination

John Johnson
Executive Director
Missouri Corporation for Science & Technology
P.O. Box 118
Jefferson City, MO 65102
(314)751-3906

The Missouri Legislature authorized the creation of Centers of Advanced Technology in 1986. The centers will conduct basic and applied research, product and process development, and technology transfer in collaboration with industry in areas of technology identified as having significant potential for economic growth in Missouri. MCST, which was assigned responsibility for developing the program, received 12 proposals. Designation of initial centers is scheduled for January 1988. Budget of \$2 million had been requested for FY87-88.



NEBRASKA

1. Statewide Policy and Coordination

Frank Sekara
President
Nebraska Research and Development Authority

Darrell A. Ullman
Department of Economic Development
P.O. Box 94666
301 Centennial Mall South
Lincoln, NE 68509
(402)471-3786

3. Other Research Centers

a. Center for Food Processing

The Center is a unit of the Institute for Agriculture and Natural Resources, University of Nebraska, Lincoln.

Research Focus:

- o *Commodity development* (new crops and new uses for existing crops);
- o *Process R&D* (new and more efficient uses of Nebraska produce, such as meat flaking and forming and cheese whey protein);
- o *System evaluation* (process test and pilot plant facilities, including miniature bakery, ultrafiltration equipment for reverse osmosis, and prototype enzyme reactors).

Center also assists with product testing, market research, and pilot marketing.

Established: 1983.

Budget Information: \$50,000 FY87.



NEW JERSEY

1. Statewide Policy and Coordination

Edward Cohen, Director
David M. Goodman, Deputy Director
New Jersey Commission on Science & Technology
122 West State Street, CN-832
Trenton, NJ 08625
(609)984-1671

Created in 1982 to develop a comprehensive strategy for S&T, and became permanent State agency in 1985 to carry out that strategy. In addition to Advanced Technology Centers (ATCs, below), it administers programs for research grants, technology transfer, incubators, venture capital, and SBIR bridge financing. Total budget (including ATCs) \$8.1 million FY85, \$16.1 million FY86, \$18.8 million FY87. ATC construction was capitalized with \$57 million of a \$90-million bond issue in 1984 (the balance went to undergraduate science and engineering programs). The Commission has proposed another bond issue of \$50 million in 1988.

2. State-Designated Centers of Excellence

a. Center for Advanced Biotechnology and Medicine

Dr. Aaron J. Shatkin
Director
Center for Advanced Biotechnology and Medicine
Waksman Institute of Microbiology
P.O. Box 759
Piscataway, NJ 08854
(201)463-4665

Administered jointly by the University of Medicine and Dentistry of New Jersey and Rutgers University.

Research Focus: *Molecular biology, fermentation processes and medical applications.* Center is also developing a system of Network Laboratories that provide specialized services to academic and industrial clients in the following areas:

- o protein microchemistry;*
- o biomaterials development;*
- o DNA synthesis;*
- o flow cytometry and cell sorting;*
- o molecular biology computing;*
- o bioimaging.*

Established: 1985.

Budget Information: State provided \$20 million toward capital construction costs for four new buildings. State



funds for operating budget \$1.4 million FY85, \$1.5 million FY86, \$3.2 million FY87.

Companies: None.

b. Center for Hazardous and Toxic Substance Management

Dr. Richard S. Magee
Director
CHTSM
New Jersey Institute of Technology
323 Dr. Martin Luther King Jr. Blvd.
Newark, NJ 07102
(201)596-3006

Involves over 50 researchers from NJIT, Princeton, Stevens Institute of Technology, UMDNJ, and Rutgers, working with scientists from private industry on more than 40 research projects.

Research Focus: Research programs in six divisions:

- o *incineration* (incineration chemistry, co-firing in existing facilities, facility design, assessment and evaluation, feed and emission control systems, analysis of residuals);
- o *biological and chemical treatment* (photo-oxidative and microbial degradation, chemical and physical-chemical degradation of organic pollutants, genetically engineered organisms for biodegradation of hazardous substances, control and reduction of heavy metal toxicity effects);
- o *physical treatment* (filtration, separation processes, concentration technologies, adsorption, fixation, stabilization and immobilization);
- o *site assessment* (transport and transformation of contaminants in groundwater systems, containment of contaminants at land disposal sites, in-situ treatment of contaminated groundwaters, aquatic life impacts of effluents and leachates);
- o *health effects* (bioavailability, biodynamics, tissue distribution and organic impacts of hazardous materials; properties of mixtures and their effects on toxic properties of chemicals); and
- o *public policy and education.*

Established: The Center was originally created as an NSF University-Industry Cooperative Research Center in September 1984. The Commission designated it part of the Advanced Technology Center program in 1986.

Budget Information: State contributed \$8.2 million toward construction of new, specially equipped facility. State funds for operating budgets \$1.2 million FY85, \$2.5 million FY86, \$2.2 million FY87. Industry contributed \$600,000 in FY87.



Center received \$32,000 grant from N.J. Hazardous Waste Siting Commission to develop design specifications for haz-mat landfill.

Industrial Participation: Industrial Advisory Board includes AT&T and other companies.

Companies:

- o Allied-Signal;
- o American Cyanamid;
- o Amoco Oil Co.;
- o AT&T;
- o Bristol-Myers Products;
- o Buonicore-Cashman Associates;
- o Combustion Engineering Co.;
- o Elf-Aquitaine Inc.;
- o Enviresponse Inc.;
- o Exxon Research & Engineering;
- o Hoffman-LaRoche Inc.;
- o Hydro Group Inc.;
- o IBM;
- o Jersey Central Power & Light Co.;
- o Port Authority of NY & NJ;
- o Public Service Electric & Gas Research Corp.;
- o Rohm & Haas Co.;
- o S&W Waste Co.;
- o Schering-Plough Corp.;
- o Solvents Recovery Service;
- o Standard Oil Co.;
- o Stone & Webster Engineering;
- o U.S. Army, Aberdeen Proving Ground.

c. Center for Plastics Recycling Research

Dr. Darrell R. Morrow
Director
CPRR
Rutgers University, College of Engineering
P.O. Box 909
Piscataway, NJ 08854
(202)932-2127

Research Focus:

- o *Separation techniques* capable of separating polyethylene terephthalate (PET) from soda bottles at 99-percent purity (ready for licensing);
- o *Pilot recycling plant and market development* for recycled products;
- o *Techniques for recycling PVC plastics and commingled wastes*, including extrusion molding of structural elements.

Established: 1986.



Budget Information: Commission funds for operating budget \$100,000 FY86 and \$400,000 FY87.

Industrial Participation: Center is the research headquarters of a nonprofit foundation established in 1984 by the Society of the Plastics Industry. Commission and N.J. Office of Recycling matched Society's contribution to bring center to N.J. Technologies have been licensed to out-of-state company, and cooperative programs are being developed with several other companies.

Companies:

- o Allegheny Leeter;
- o Allied Corp.;
- o Boise Graham Co.;
- o Coca-Cola (NY);
- o Coca-Cola USA;
- o Conair Inc.
- o Continental Can Co.;
- o Eastman Chemical Products Inc.;
- o E.I. duPont de Nemours & Co.;
- o Goodyear Tire & Rubber Co.;
- o ICI Americas Inc.;
- o Johnson Controls;
- o National Brands Beverages;
- o Nelmor;
- o North American Kaneka Texas Co.;
- o Occidental Chemical Corp.;
- o Owens-Illinois Inc.;
- o Pepsico Inc.;
- o Seven-Up;
- o Sewell Plastics Inc.;
- o Society of the Plastics Industry;
- o Society of the Soft Drink Technologies;p
- o Sundor Brands;
- o U.S. Industries Chemicals.

d. Center for Industrial Ceramics Research

Dr. John B. Wachtman
Director
Center for Industrial Ceramics Research
Department of Ceramics and Engineering
Rutgers College of Engineering
P.O. Box 909
Piscataway, NJ 08854
(201)932-2220

Center is a partner (with University of Delaware) in an NSF ERC in the field of composites manufacturing science and the proposed ERC in Surface Processing.



Research Focus:

- o *Structural ceramics* (toughening materials to overcome brittleness);
- o *Thin-film ceramics* (problems of bonding ceramic and metallic substrate materials); and
- o *Electronic ceramics* (materials for microelectronics packaging and casing).

Established: 1985, as Center for Ceramics Research. Fiber Optics Materials Program became increasingly independent in 1986.

Budget Information: Commission has provided \$9 million for Center facility and \$3 million for adjacent facility for fiber optic program (see below). State funds for *combined* operating budgets \$1.9 million FY85, \$3.0 million FY86, \$3.1 million FY87. Johnson and Johnson awarded \$1.65 million grant for biomedical optics program.

Industrial Participation: Member companies support visiting researchers at the Center.

Companies:

- o Abex;
 - o Airco/BOC;
 - o Borg-Warner Co.;
 - o Celanese Research;
 - o Certainteed Corp.;
 - o Corning Glass Works;
 - o DSM;
 - o Dow Chemical Co.;
 - o Dow Corning;
 - o E.I. duPont de Nemours & Co.;
 - o Englehard Corp.;
 - o Ferro Corp.;
 - o FMC Corp.;
 - o Frenchtown Ceramics Corp.;
 - o Hoogovens Groep;
 - o Lockheed Electronics;
 - o Martin Marietta Labs;
 - o Norton Co.;
 - o Nuodex, Inc., division of Huls;
 - o RCA Corp.;
 - o Rhone-Poulenc Inc.;
 - o Rolls-Royce Inc.;
 - o Siemens;
 - o Sohio Engineered Materials Co.;
 - o Solvay Technologies Corp.;
 - o 3M Co.;
 - o Union Carbide Corp.
- Prospective additional members include Elf-Aquitaine, Royal Sphinx Ltd., Philips, and Thompson-CSF.



e. Fiber Optics Materials Research Program

Dr. George Sigel, Jr.
Director
Fiber Optics Materials Research Program
Department of Ceramics and Engineering
Rutgers College of Engineering
P.O. Box 909
Piscataway, NJ 08854
(201)932-2739

Increasingly independent division of the Center for Ceramics Research (see above). Commission is seeking separate charter and budget.

Research Focus:

- o *Drawing-induced defects;*
- o *Fiber optic communications;*
- o *Biomedical applications* (including fiber sensors, optical imaging, and laser power propagation);
- o *Chemically durable overcladdings for fluoride glasses;*
- o *Infrared transmitting fibers;*
- o *Porous optical fiber* (for moisture sensors).

Established: Commission applied for independent status in 1987

Budget Information: Commission has provided \$9 million for ceramics facility (see above) and \$3 million for adjacent facility for fiber optic program. State funds for combined operating budgets \$1.9 million FY85, \$3.0 million FY86, \$3.1 million FY87. Johnson and Johnson awarded \$1.65 million grant for biomedical optics program.

Companies:

- o Alcoa;
- o AT&T Bell Laboratories;
- o Corning Glass Works;
- o Ensign Bickford Corp.;
- o Galileo Electro-Optics Corp.;
- o Geocenters;
- o Hereaus Amersil;
- o Hoya;
- o ITT;
- o Johnson and Johnson;
- o Los Alamos National Lab;
- o Nippon Mining Co.;
- o Nippon Silica Glass;
- o Nippon Telegraph and Telephone;
- o Photon Kinetics;
- o Sonetran;
- o SpecTran;
- o 3M Co.;
- o U.S. Army (Fort Monmouth).



f. Center for Computer Aids for Industrial Productivity

Dr. Herbert Freeman
Director
CAIP Center
Room 605 Hill Center, Brett Road
CN 1390
Rutgers University, Busch Campus
Piscataway, NJ 08854
(201)932-4208

Research Focus: *Parallel processing* (using NCUBE/ten computer array) to support:

- o *machine vision*;
- o *automated mechanical design* based on user-friendly expert systems; and
- o *software engineering* for applications in telecommunications and banking, as well as manufacturing.

Established: 1985.

Budget Information: Commission will appropriate \$5 million for CAIP facility that will be shared with Rutgers' Computer Science Department.

Companies:

- o Allied-Signal Inc.;
- o AT&T Information Systems;
- o Computervision Corp.;
- o Concurrent Computer Corp.;
- o FAA Technical Center;
- o NCUBE Corp.;
- o RCA Corp.;
- o Siemens Research and Technology Laboratories;
- o Xerox Corp.

g. John von Neumann Center for Advanced Scientific Computing

Dr. Doyle Knight
President
Consortium for Scientific Computing
John von Neumann Center for Advanced Scientific Computing
665 College Road East
P.O. Box 3717
Princeton, NJ 08854
(609)520-2000

A nonprofit consortium of 13 research universities from around the nation, and one of five supercomputer centers designated by NSF. Commission's pledge of \$12 million over 5 years influenced NSF commitment of more than \$60 million.



Research Focus:

- o *Computational chemistry* (of interest to pharmaceutical industry);
- o potential applications in *electronics, mechanical and industrial engineering, applied mathematics and physics, computer science, and computer networking.*

Established: 1986.

Budget Information: Commission has pledged \$12 million over 5 years, and NSF has committed over five times as much. State funds for operating budgets \$3.0 million FY86 and \$2.3 million FY87.

Institutional Consortium:

- o Brown University;
- o Columbia University;
- o Harvard University;
- o Institute for Advanced Study;
- o Massachusetts Institute of Technology;
- o New York University;
- o Pennsylvania State University;
- o Princeton University;
- o Rutgers University;
- o University of Arizona;
- o University of Colorado;
- o University of Pennsylvania;
- o University of Rochester.

Companies:

- o Exxon Research & Engineering.

h. Center for Advanced Food Technology

Dr. Myron Solberg
Director
Center for Advanced Food Technology
Cook College
P.O. Box 231
New Brunswick, NJ 08903
(201)932-8306

Research Focus: Multidisciplinary generic research companion to Rutgers' respected Department of Food Science. Current projects include the following:

- o *cooking extrusion process;*
- o *behavior of water and moisture in food processes;*
- o *mass spectrometry* to measure freshness;
- o *rapid inverse gas chromatograph/sorption isotherm* (negotiations underway to license method for manufacture and marketing);
- o *in-line sensors* to measure moisture and consistency.



Established: 1985.

Budget Information: Commission provided \$6 million toward construction of a new research facility, to be completed in 1989. State funds for operating budgets \$1.2 million FY85, \$1.2 million FY86, \$1.4 million FY87. Additional funds come from industrial members and Rutgers University of Food

Industrial Participation: Member companies support industrial research fellowships.

Companies:

- o Borden Inc.;
- o Campbell Soup Co.;
- o CPC International Inc.;
- o Frito-Lay;
- o General Foods Corp.;
- o Kraft Inc.;
- o Thomas J. Lipton Inc.;
- o M&M-Mars;
- o Nabisco Brands Inc.;
- o National Starch & Chemical Corp.;
- o Proctor & Gamble Co.;
- o Ralston-Purina Co.;
- o RJR Nabisco Inc.;
- o Unilever Research.

i. Center for Biomolecular Research in the Agricultural and Natural Sciences (BRANS)

Dr. Peter Day
Director
BRANS
Martin Hall
Rutgers University/Cook College Campus
New Brunswick, NJ 08903
(201)932-9447

Research Focus: *Plant molecular biology* applied to development of higher value products that can be grown or raised on smaller tracts and brought to market for higher revenues; specifically:

- o *nature and mechanisms of plant growth and development;*
- o *genetic basis of disease resistance;*
- o *animal growth and reproduction.*

Established: 1986.

Budget Information: Commission supports construction of 50,000-ft² research facility.



j. Center for Advanced Manufacturing Engineering Systems

Dr. Michael Kelly
Director
Center for Advanced Manufacturing and Engineering
Sciences
New Jersey Institute of Technology
323 Dr. Martin Luther King Jr. Blvd.
Newark, NJ 07103
(201)596-5819

Proposed Center (CMES) was approved by Commission in October 1987. It will be located at New Jersey Institute of Technology (NJIT)

Established: 1987.

Budget Information: Commission will seek appropriation of \$6 million as contribution to the construction costs of NJIT Information Technology Center, which will house CMES.



NEW MEXICO

1. Statewide Policy and Coordination

Dr. Patrick Rodriguez
Executive Director
Science and Technology Commission
Bataan Memorial Building
Santa Fe, NM 87503
(505)827-0288

The 1983 Legislature designated five "Centers of Technical Excellence" tied to the State's university system. They are part of a larger effort to develop the Rio Grande Research Corridor, which also contains five National Laboratories. The Centers attract high-tech plants to nearby research parks, as well as research contracts. They are expected to be self-supporting after 5 years of State funding. The Science and Technology Advisory Committee became a permanent Commission in 1986.

Budget Information: Centers of Technical Excellence received \$5.5 million FY87 from general funds. Additional funds were contributed through university budgets and research grants from Research and Development Institute.

2. State-Designated Centers of Excellence

a. Center for Non-Invasive Diagnosis

Director
Center for Non-Invasive Diagnosis
Cancer Center Room 228
University of New Mexico
900 Camino de Salud N.E.
Albuquerque, NM 87131
(505)277-8512

Research Focus: *Nuclear magnetic resonance and NMR spectroscopy* to develop the next generation of diagnostic and therapeutic procedures in several areas:

- o oncology;*
- o neurology;*
- o cardiology;*
- o applications of monoclonal antibodies.*

Established: 1983.

Industrial Participation: Technical Advisory Committee to develop research strategies and help with public relations and solicitation of funds.



Companies:

- o General Electric Medical Systems;
- o Los Alamos National Laboratory.
- o U.S. Veterans Administration.

b. Center for High Technology Materials

Director
Center for High Technology Materials
Department of Electrical and Computer Engineering
Tapy Hall
University of New Mexico
Albuquerque, NM 87131
(505)277-3317

Research Focus: Coordinates research at UNM's Institute of Modern Optics and Institute of Microelectronics and Thin Films in *lasers, modern optics and microelectronics* for applications including:

- o *semiconductor annealing;*
- o *materials processing (e.g. thin films);*
- o *isotope separation;*
- o *underwater communications;*
- o *photochemistry;*
- o *surgery;*
- o *laser damage.*

Established: 1983.

Industrial Participation: Technical Advisory Committee to develop research strategies and help with public relations and solicitation of funds.

Companies: The Center has contracts with over 40 industrial and government laboratories and has developed strong liaison with the following:

- o BDM Corp.;
- o Bell Labs;
- o Intel;
- o International Laser Systems;
- o Los Alamos National Laboratory;
- o Monolithic Memories;
- o Motorola;
- o Sandia National Laboratory;
- o Signetics;
- o Tetra Corp.



c. Center for Explosives Technology Research

Director
Center for Explosive Technology Research
New Mexico Institute of Mining and Technology
Campus Station
Socorro, NM 87801
(505)835-5733/5818

Research Focus: Developing novel *industrial applications for explosives, including powder metallurgy and ceramic material handling*, through research on:

- o *shock wave synthesis;*
- o *ceramics modification;*
- o *synthetic materials* (such as cubic boron nitride as an abrasive and diamonds for cutting and drilling);
- o *explosive welding and cladding;*
- o *energetic materials* (pyrotechnics and propellants).

Established: 1983.

Industrial Participation: Technical Advisory Committee to develop research strategies and help with public relations and solicitation of funds.

Companies:

- o General Electric;
- o McDonnell Douglas.

d. Center for Plant Genetic Engineering

Director
Plant Genetic Engineering Laboratory
Box 3GL
New Mexico State University
Las Cruces, NM 88003
(505)646-2920

Research Focus: *Plant genetic engineering for desert adaptation*, including research in the following areas:

- o *molecular biology* (molecular markers, recombinant DNA, and gene characterization aimed at commercially applied gene transfer);
- o *cellular genetics* (micropropagation, cell selection and regeneration);
- o *stress physiology* (water, salt and temperature tolerance);
- o *biochemistry;*
- o *desert plant resource acquisition and evaluation.*

Established: 1983.

Industrial Participation: Technical Advisory Committee to develop research strategies and help with public relations



and solicitation of funds. Center cosponsored 1985 Research Corridor Plant Biotechnology Conference and provides tours and tech transfer workshops.

e. Center for Computer Research Applications

Director
Computing Research Laboratory
Box 3452
New Mexico State University
Las Cruces, NM 88003
(505)646-1838/5466

Research Focus: *Artificial intelligence and robotics* for manufacturing applications, with three major components:

- o *human-computer interface* (natural language understanding, human factors, training and instruction systems, integrated work stations for scientific applications, and information displays and computer graphics);
- o *intelligent vision systems* (mechanical senses of vision, hearing and touch for application in flexible, self-adaptive systems);
- o *knowledge representation and reasoning* (AI applications in user-friendly computers and fighter cockpits).

Established: 1983.

Industrial Participation: Technical Advisory Committee to develop research strategies and help with public relations and solicitation of funds.



NEW YORK

1. Statewide Policy and Coordination

Dr. Vernon Ozarow
Manager, University-Industry Programs
New York State Science and Technology Foundation
99 Washington Avenue, Suite 1730
Albany, NY 12210
(518)474-9744

Centers for Advanced Technology (CAT) Program, created in 1982, targets State investment on universities that are "centers of excellence" in eight (later ten) technologies designated by the Foundation as having "significant potential for economic growth in New York." State provides competitive planning grants to develop centers and program support for existing centers.

Budget Information: Foundation budget totalled \$21 million in FY87. CAT Program budget:

- o \$1.8 million FY83-84;
- o \$6.5 million FY84-85;
- o \$7.0 million FY85-86;
- o \$7.8 million FY86-87;
- o \$9.0 million FY87-88.

State has set a ceiling of \$1 million/year on grants to individual centers; those that raise \$1 million in non-State funds get the full amount, and those that don't get an amount equal to what they do raise independently.

2. State-Designated Centers of Excellence

a. Center for Advanced Ceramic Technology

Dr. Richard Spriggs
Director
Center for Advanced Ceramic Technology
NYS College of Ceramics
Alfred University
Alfred, NY 14802
(607)871-2486

Research Focus: Development and engineering of high-performance and communication ceramic materials, with particular emphasis on those with the potential for major commercial applications. Activities will be divided among three task groups:

- o *structural ceramics;*
- o *electronic ceramics; and*
- o *amorphous materials.*

Established: 1987.



Budget Information: \$400,000 planning grant FY87; up to \$1 million/yr in grants FY88, to be matched at least 1:1 by industry and other sources.

b. Center for Advanced Materials Processing

Dr. William Wilcox
Director
Center for Advanced Materials Processing
301 Peyton Hall
Clarkson University
Potsdam, NY 13676
(315)268-2336

Research Focus: Specialized research in *colloids and surface science*, organized in four areas:

- o fine particles;*
- o crystal growth;*
- o polymer processing; and*
- o electronics.*

Established: 1987.

Budget Information: \$400,000 planning grant FY87; thereafter, up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

c. Center for Advanced Optical Technology

Dr. Duncan Moore
Director
Center for Advanced Optical Technology
Wilmot Building
University of Rochester
Rochester, NY 14627
(716)275-5248/2314

Research Focus: Center's initial program will focus on five areas deemed most likely to result in rapid transfer of technology to industry:

- o integrated optics and fiber optics;*
- o optical fabrication and testing (gradient index technology developed at the center has been commercialized);*
- o optoelectronic systems for image recognition, medical optics and robotics;*
- o optical materials, including thin films;*
- o image evaluation, digital image processing and color science; and*
- o phase conjugation techniques in laser development.*

Established: 1983.



Budget Information: Up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

Industrial Participation: Center provides member companies with continuing education and technical training programs, as well as joint research, internships, visiting research programs, and access to faculty, facilities and research results.

Companies:

- o Bausch and Lomb Inc.
- o Corning Glass Works;
- o Eastman Kodak Co.;
- o General Electric Co.;
- o IBM Corp.;
- o Jet Propulsion Lab;
- o TRW Inc.;
- o Welch-Allyn;
- o Xerox Inc.

d. Center for Advanced Technology in Telecommunications

Dr. Richard Van Slyke
Director of Operations
Center for Advanced Technology in Telecommunications
Polytechnic Institute of New York
333 Jay Street
Brooklyn, NY 11201
(718)260-3050/643-5160

Research Focus:

- o *CAD for radio system design;*
- o *image communication using phase information only;*
- o *office communications and LANs; and*
- o *related research areas --*
 - * *active media for optical communications;*
 - * *optical beam propagation and guidance;*
 - * *materials for high-speed electronics; and*
 - * *office automation.*

Established: 1983.

Budget Information: Up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

Industrial Participation: Associates can support overall activities, specific areas of research, or joint research projects; they also participate on Center's Policy Board and Advisory Boards. Center provides access to faculty expertise, campus facilities, and incubator services.



Companies:

- o Argo Communications;
- o Aurigen;
- o Contel Business Systems;
- o Energy Conversion Devices;
- o GTE;
- o Hazeltine;
- o IBM;
- o New York Telephone.

e. Center for Biotechnology in Agriculture

Dr. Gordon G. Hammes
Director
Center for Biotechnology in Agriculture
Baker Laboratories
Cornell University
Ithaca, NY 14853
(607)255-4259/2300

Research Focus: Interdisciplinary studies in chemical, agricultural and veterinary sciences, focusing on *molecular genetics and gene transfer technology*. Current programs include:

- o *genetic engineering of plant chloroplasts;*
- o *genetics and biochemistry of microorganisms used in dairy fermentation;*
- o *introduction of new gene material into chicken embryos; and*
- o related research areas --
 - * *structural mapping of cell surface receptors;*
 - * *tomato mutant for studies of ripening process;*
 - * *plant defensive chemicals;*
 - * *bacterial bioprocessor for ethanol from hemicellulose; and*
 - * *granulosis virus for insect pest control.*

Established: 1983.

Budget Information: Up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

Industrial Participation: Access to university faculty and students; space and support for resident industrial scientists; participation in the selection of research projects; interaction with State and Federal agencies; consulting and incubator services for startup companies.

Companies:

- o Eastman Kodak Co.;
- o General Foods Corp.;
- o Union Carbide Corp.



f. Center for Computer Applications and Software Engineering

Dr. Bradley J. Strait
Managing Director
Center for Computer Applications and Software Engineering
120 Hinds Hall
Syracuse University
Syracuse, NY 13244-1190
(315)423-1062/1060

Research Focus: Research projects are concentrated in three main areas:

- o **Computer enhanced reasoning —**
 - * **logic programming;**
 - * **large database management;**
 - * **computer architecture.**
- o **Computer tools research —**
 - * **software error detection and prevention;**
 - * ***VLSI design and simulation.**
- o **Cross-Disciplinary research —**
 - * **CAE applications in printed circuits, antennas and radar scattering;**
 - * **NMR imaging and analysis applications in medicine, chemistry and physics research;**
 - * **expert systems applications in medical diagnosis, engineering analysis, and management of natural resources.**

Established: 1983.

Budget Information: Up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

Industrial Participation: Membership in Research Advisory Board, participation in educational and cooperative research activities, access to computer facilities and study centers, and incubation facilities and services for startup companies.

Companies:

- o Adaptive Technology Inc.;
- o Allyn Foundation;
- o Anaren Microwave;
- o AT&T Corp.;
- o Carrier division of United Technologies Corp.;
- o Corning Glass Works;
- o Digital Equipment Corp.;
- o General Electric;
- o IBM;
- o Niagara Mohawk Power Corp.;
- o O'Brien & Gere Engineers Inc.;
- o Singer-Link;
- o Southeastern Center for Electrical Engineering Education;



- o Sperry Corp.;
- o Symbolics Inc.;
- o Texas Instruments Inc.;
- o TRW Inc.;
- o Westinghouse Electric.

g. Center for Computers and Information Systems

Prof. Yechiam Yemini
 Acting Director
 Center for Computers and Information Systems
 450 Computer Science Building
 Columbia University
 New York, NY 10027
 (212)280-8190

Research Focus:

- o *Supercomputers* (DADO technology, applicable to special high-speed computers for AI applications, is being transferred from Columbia to a startup firm that will manufacture the computer);
- o *Computer networking and distributed computing;*
- o *Large-scale scientific and engineering computing;*
- o *High-speed computer circuits;*
- o *Digital image processing* for real-time applications in videoconferencing, digital television and robotic vision; and
- o Related research areas --
 - * *expert systems;*
 - * *computer vision;*
 - * *intelligent information systems;*
 - * *microelectronics; and*
 - * *information-centered approach to uncertainty.*

Established: 1983.

Budget Information: Up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

Industrial Participation: Participation in actual R&D as well as information exchange; enhanced education and access to students; advanced training for company researchers; opportunity to identify growth areas and investment opportunities in products and services.

Companies:

- o AT&T;
- o Contel Information Systems;
- o Contel Telecom;
- o Digital Equipment Corp.;
- o Dupont;
- o GTE Laboratories;
- o Hewlett Packard;



- o IBM;
- o Intel Corp.;
- o Merrill Lynch & Co.;
- o NCR Corp.;
- o NUVATEC;
- o Philips Laboratories;
- o Semiconductor Research Corp.;
- o Texas Instruments Inc.;
- o Timeplex Inc.;
- o Valid Logic Corp.;
- o Western Union.

h. Center for Health Care Instruments and Devices

Dr. Robert E. Baier
 Director
 Health Care Instruments and Devices Institute
 105 Parker Hall
 SUNY Buffalo
 Buffalo, NY 14214
 (716)831-2446

Research Focus: Multidisciplinary R&D and evaluation of existing devices in the following areas:

- o *surface science applications;*
- o *rehabilitation engineering;*
- o *medical instruments and devices;*
- o *advanced instrumentation;*
- o *advanced dental diagnostic technologies;*
- o *biosensor devices;*
- o *biomedical materials;*
- o *implants and prosthetic devices; and*
- o *laser surgery.*

Established: 1983.

Budget Information: Up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

Industrial Participation: Opportunities to initiate R&D projects, preferential licensing on products and processes, and assistance in commercialization; access to laboratory facilities; and instructional and consulting services.

Companies:

- o American Biorganics Inc.;
- o A.O.-Reichert;
- o Bud Industries;
- o Colgate-Palmolive Co.;
- o CMX Laboratories;
- o Eastman Kodak;
- o Gaymar Industries Inc.;
- o Howmedia;



- o IBM Corp.;
- o Lever Research Inc;
- o Liposome Technology;
- o New England Nuclear;
- o Nova Biomedical;
- o Pennwalt Pharmaceutical Corp.;
- o SSI Medical Services Inc.;
- o Ultron Corp.;
- o Visidyne;
- o Warner Lambert Inc.;
- o Westwood Pharmaceuticals Inc.

i. Center for Medical Biotechnology

Dr. Richard Koehn
 Dean, Division of Biological Sciences
 Center for Medical Biotechnology
 Life Sciences Building, Room 130
 SUNY Stony Brook
 Stony Brook, NY 11794-5208
 (516)632-8521

Research Focus: The Center has a special mandate to stimulate collaborative ventures with industry in five areas:

- o *genetic engineering;*
- o *immunodiagnostics;*
- o *drug development;*
- o *oral diagnostics; and*
- o *bioengineering.*

Established: 1983.

Budget Information: Up to \$1 million/yr in grants from S&T Foundation, matched at least 1:1 by industry and other sources.

Industrial Participation: Collaborating corporations participate in the definition of joint research activities and in decisions about applying university resources to industry needs. Center also provides assistance in training, product development and testing, and equipment sharing.

Companies:

- o Abbott Laboratories;
- o Academic Research Associates;
- o Ayerst Laboratories;
- o Behningwerke;
- o Burroughs-Wellcome Co.;
- o Eli Lilly;
- o Enzo Biochemical;
- o Genetic Diagnostics Corp.;
- o Harco Electronics;
- o Interstate Drug Exchange;
- o Johnson & Johnson;



- o Litton Bionetics;
- o Pfizer Pharmaceutical;
- o Richardson-Vicks Inc.;
- o Schering Corp.;
- o Toyo Jozo Co.;
- o University Genetics Co.;
- o Warner-Lambert;
- o Zimmer Inc.



NORTH CAROLINA

1. Statewide Policy and Coordination

Dr. Earl MacCormac
Executive Director
N.C. Board of Science and Technology
Office of the Governor
116 West Jones Street
Raleigh, NC 27611
(919)733-6500

Board was established in 1979 to promote the effective use of S&T resources by (1) identifying and supporting the research needs of public and private agencies and institutions, and (2) recommending policies, organizational structures, and financial requirements. In addition to technology centers (below), Board supervises a Small Business Research Grants Program.

2. State-Designated Centers of Excellence

a. Microelectronics Center of North Carolina

Donald S. Beilman
President
Microelectronics Center of North Carolina
P.O. Box 12889
Research Triangle Park, NC 27709
(919)248-1800

Research Focus: Full-service development laboratory, with special emphasis on manufacturability. Basic programs in three technical areas:

- o *semiconductor materials, devices and fabrication processes;*
- o *computer science and computer-aided design;*
- o *VLSI and ULSI circuit design* to support advanced microelectronics applications.

Special facilities include 10,000 ft² of Class 10 clean room and a 4,000-ft² fabrication facility at NC State.

Established: 1980.

Budget Information: Legislature appropriated an initial grant of \$24 million in 1981, and another \$19 million over the next 2 years. Of this initial funding, some \$30 million has been used to construct an 80,000-ft² facility in Research Triangle Park. In 1986 the Legislature appropriated another \$13 million in operating funds. All funds have come from State general funds.

Industrial Participation: Industrial affiliates pay \$750,000 or equivalent in-kind payment for initial 3-year membership;



subsequent fees are lower. As one of their benefits, affiliates may place up to three staff members at MCNC for research or advanced degrees, with MCNC paying tuition at participating universities. Affiliate advisory council gives industry a voice in research agenda, and affiliates get temporary advantage obtaining results on preferred-royalty basis.

Companies: General Electric was the first industrial affiliate. Others NA.

3. Other Research Centers

a. North Carolina Biotechnology Center

Dr. Charles Hamner
President
North Carolina Biotechnology Center
P.O. Box 13547
Research Triangle Park, NC 27709
(919)541-9366

NCBC is organized as a nonprofit corporation, like MCNC, but it conducts no research itself. It serves instead as a funding pass-through in two areas:

- o competitive grants to university researchers and small research companies who are working on projects likely to lead to commercial products and processes; and
- o unsolicited grants to aid in developing the research potential of the state, particularly by strengthening university education and research programs.

Only 8 percent of grants in FY85-86 went to private firms; but 15 percent went to small business in FY86-87, and a higher percentage is anticipated in FY87-88. NCBC requires no match, equity or payback on such grants.

Research Focus: The Center has recently been undergoing considerable soul-searching about what its identity and role should be in the future. It awards grants over the entire range of biotechnology subdisciplines, with the possible exception of waste treatment and mineral recovery. It has not targeted particular applications in the past but may do so in the future.

Established: 1981, as a program area of the Board of Science and Technology. Became an independent nonprofit corporation in 1984.

Budget Information: \$6.5 million/year FY85, 86, 87, and 88. Appropriations are biennial, and come from State general funds.



OHIO

1. Statewide Policy and Coordination

Christopher M. Coburn
Executive Director
Thomas Alva Edison Partnership Program
Department of Development
P.O. Box 1001
30 East Broad Street
Columbus, OH 43216-1001
(614)466-3086

The Thomas Alva Edison Partnership Program encourages economic development through technological innovation by fostering cooperative R&D efforts that will generate new technologies, new products, and new jobs. In addition to the Edison Technology Centers (below), the Edison Partnership administers a Seed Development Fund (matching grants for feasibility and advanced applied research), Edison Incubators (six university-based facilities), and a Tie-Ins Program (identify available resources and transfer technologies with commercial potential). Program has close ties with Ohio Technology Transfer Organization (OTTO), a network of technical and management experts linked to the State's four universities and 24 technical and community colleges.

Budget Information:

- o Edison Program received \$32.4 million in 1983 for FY84-85 biennium, with \$23.6 million going to launch the six original ETCs.
- o Edison Program received \$35.0 million for the FY86-87 biennium, with \$25.75 million going to ETCs (\$15.25 to "support and expand" the original six, and \$10.5 to establish three new centers).

Funding to ETCs is in 5-year grants, and centers are required to be self-supporting at the end of 5 years. Program expects them to achieve this goal by 1988, "selling to businesses a wide array of services such as basic research conducted to satisfy the needs of a groups of sponsoring companies, applied research contractually available to individual organizations, technology transfer mechanisms, scientific education and technological training and retraining programs."



2. State-Designated Centers of Excellence

a. Applied Information Technologies Research Center

Mr. George Minot
President
Applied Information Technologies Research Center
1880 Mackenzie Drive, Suite 111
Columbus, OH 43220
(614)442-1955

Research Focus: Information transfer and retrieval, targeted on the following areas and applications:

- o *intelligent user interfaces* with on-line systems through natural language systems, grammatical analysis, speech input or generation, domain and task knowledge, and inference systems (one application is in airline and travel data bases);
- o *expert systems* (AI and software systems that emulate knowledge-based reasoning, with applications in "smart" interfaces that allow less experienced users to interact effectively with computers);
- o *electronic publishing* (new products and delivery techniques for information distribution; translating electronic typesetting formats to new standard developed by American Association of Publishers); and
- o *personal identification and authentication technologies* (identifying and qualifying remote users, with applications in security devices and "smart cards");
- o other fields of interest in AITRC's future include technologies for *voice input/output, intelligent full-text database searching, and reduced-instruction-set computers (RISC)* in real-world applications.

Established: 1984.

Budget Information: \$4.1 million startup funding in 1984, plus an expansion grant of \$2 million in 1986.

Industrial Participation: AITRC is a nonprofit consortium of scientific, academic and business organizations. Academic partners are Ohio State and Wright State Universities. AITRC staff and specialists at member academic institutions conduct both shared and proprietary research. Access to results is determined by individual member's investment, including staff and facilities as well as funding. Member companies also receive technical assistance and can be part of preferential licensing agreements. Some members also share the profits from AITRC-developed products and services that are licensed through the for-profit Applied Information Technologies Corp.



Companies:

- o Battelle Memorial Institute;
- o Carnegie-Mellon University;
- o Chemical Abstracts Service (division of American Chemical Society);
- o CompuServe Inc.;
- o Mead Data Central (division of Mead Corp.);
- o On-line Computer Library Center Inc.;
- o The Carnegie Group.

b. Cleveland Advanced Manufacturing Program

Robert G. Brown
President
Cleveland Advanced Manufacturing Program
c/o Parker-Hannifin Corp.
17325 Euclid Avenue
Cleveland, OH 44112
(216)531-8211

Research Focus: Basic research, application, and training in new manufacturing technologies through programs at three academic participants:

- o **Center for Automation and Intelligent Systems**
Research, Case Institute of Technology, Case Western Reserve University. -- Basic research in the following areas:
 - * *intelligent systems;*
 - * *sensors;*
 - * *imaging and vision (e.g. lasers);*
 - * *graphics and display;*
 - * *electronic systems design;*
 - * *software for integrated computer-based systems;*
 - * *automatic control; and*
 - * *distributed and concurrent processing.*
- o **Advanced Manufacturing Center, Fenn College of Engineering, Cleveland State University.** -- Applied research and applications engineering to integrate technology into operations on the plant floor, with capabilities in four areas:
 - * *computer-aided design and manufacturing;*
 - * *in-process sensing and control (e.g. automated selective inspection system);*
 - * *integrated manufacturing systems; and*
 - * *man-machine interface.*
- o **Unified Technologies Center, Cuyahoga Community College.** -- \$20 million facility (\$11.3 million from State) to prepare workers to install, operate and maintain technologically advanced systems. Center can also provide customized training to individual companies on contractual basis.

Established: 1984.



Budget Information: \$4.1 million in startup funding in 1984, plus an expansion grant of \$2 million in 1986 and a separate grant of \$2 million to establish an associated center to develop sensor technology.

Industrial Participation: Businesses can participate in one or all of the centers at several different levels of sponsorship:

- o financial or in-kind contributions to the overall work of the centers;
- o basic and applied research in a subject of interest to a group of sponsoring companies;
- o demonstration projects made possible by business financial support;
- o individual contract research projects preformed for businesses on a proprietary basis;
- o contract applications engineering for specific plants.

Companies:

- o Allen-Bradley Co.;
- o Cleveland Pneumatic Co.;
- o Eaton Corp.;
- o General Electric Co.;
- o Reliance Electric Co.;
- o TRW Inc.;
- o White Consolidated Industries Inc.

c. Edison Animal Biotechnology Center

Dr. Thomas E. Wagner
Director
Edison Animal Biotechnology Center
116 Wilson Hall -- West Green
Ohio University
Athens, OH 45701
(614)593-4713

Research Focus: EABC channels funds for basic research to its three academic partners:

- o Institute of Mammalian Recombinant Genetics, Ohio University (*gene transfer*);
- o School of Medicine, Case Western Reserve University (*molecular biology*); and
- o Ohio Agricultural R&D Center, Ohio State University (*molecular animal science*).

EABC also has a staff of 20 scientists and technicians who conduct applied research and develops commercial applications in three principal areas:

- o *speeding swine growth* by inserting genes to produce pigs that grow to market size faster and consume less feed;
- o *improving chicken and cattle health* by inserting genes that increase disease resistance; and



- o *developing new animal products* by using animals to produce proteins other than food, such as *pharmaceuticals and specialty biochemicals*.

Established: 1984.

Budget Information: \$3.1 million in startup funding in 1984, plus an expansion grant of \$2 million in 1986.

Industrial Participation: Funding from the Thomas Edison Program is matched by a new company, Embryogen, which was created to (1) channel private research contracts and private investment funds to EABC, and (2) market or license the results of the research. EABC has exclusive rights to all technology EABC creates.

Companies:

- o Embryogen, Inc.;
- o Ohio Farm Bureau Federation.

d. Edison Polymer Innovation Corporation

Dr. Robert J. Fawcett
President and CEO
Edison Polymer Innovation Corporation
3505 East Royalton Road
Broadview Heights, OH 44147
(216)838-5015

Research Focus: EPIC has two academic partners, each with its own area of polymer expertise:

- o Institute of Polymer Science and Polymer Engineering Center, University of Akron, focus on *polymer development*:

- * *synthesis and scale-up of new polymers* in a versatile new mini-plant;
- * *thermoplastic processing* through new design procedures, including computer models and simulations of *mixing, extrusion, molding, and fiber-spinning technologies*, combined with *on-line sensing and closed-loop feedback controls*;
- * *engineering performance of fabricated parts*, using advanced structural analysis and stress analysis techniques.

- o Center for Applied Polymer Research and macromolecular Science Department, Case Western Reserve University, concentrate on improving performance and finding new uses for polymeric materials in five areas:

- * *polymers in electronics and optics*, particularly *thin films for conductors, semiconductors and ferro-electronics*;
- * *lightweight composites* for applications from semiconductors to automobiles;



- * *polymer blends and alloys;*
- * *membranes and coatings* for transport, separation, sealing, and lubrication, with applications in artificial joints and biomedical fluids storage.

Established: 1984.

Budget Information: \$4.1 million in startup funding in 1984, plus an expansion grant of \$2 million in 1986.

Industrial Participation: Member companies have the opportunity to influence the direction of basic research, the right to share research results on a preferential basis before publication, and special rights to patents and licenses generated by the research. Member companies can also utilize EPIC's resources for proprietary research.

Companies:

- o B.F. Goodrich Co.;
- o Dow Chemical Co.;
- o Ferro Corp.;
- o Firestone Tire & Rubber Co.;
- o Monsanto Polymer Products Co.;
- o Premix Inc.;
- o Rubbermaid Inc.;
- o Standard Oil Co. of Ohio;
- o Sherwin-Williams Co.;
- o TRW Inc.

e. Edison Welding Institute

Dr. Karl Graff
Director
Edison Welding Institute
1100 Kinnear Road
Columbus, OH 43213
(614)486-9400

EWI is a cooperative effort of Ohio State University, the Battelle Memorial Institute, Columbus Technical Institute, and the Welding Institute (Cambridge, England).

Research Focus: EWI is organized into three interdisciplinary centers:

- o **Center for Welding Research.** -- Basic and applied research projects to assist the welding industry through the development of new welding processes and joining technologies. Sample research projects include:
 - * *robotic welding* (improving the accuracy of sensing and control methods for arc welding processes; an innovative "coaxial viewing"



system is currently in product assessment stage);

- * ***laser welding*** (including laser brazing and use of lasers for defect suppression and ultra-high-speed welding); and
 - * ***thick-section materials*** (submerged-gas, tungsten-arc and variable-polarity plasma arc welding processes for use in thick plate welding);
 - * other areas of cooperative research include ***fatigue analysis, resistance welding, microwelding, integrated welding manufacturing systems, and joining of nonmetallic and powdered materials.***
- o **Center for Welding Education.** -- Workshops, seminars and conferences aimed at technology transfer to company engineers and technicians. Companies also have access to videotapes, training aids, and customized training, as well as assistance in developing operator and maintenance manuals.
 - o **Center for Welding Applications.** -- Evaluation of existing welding systems, development of new systems, and other consulting services.

Established: 1984.

Budget Information: \$4.1 million in startup funding in 1984, plus an expansion grant of \$3.2 million in 1986. Approximately \$2.5 million (from all sources) was allocated for cooperative welding research over 1985-87.

Industrial Participation: Cooperative research, group-sponsored projects, and projects sponsored by individual companies (including confidential proprietary research). Proposals are submitted to Industry Advisory Board for review and approved by Board of Trustees.

Companies: Battelle Memorial Institute and The Welding Institute were founding business partners. EWI has attracted over 110 industry members nationwide.

f. Institute of Advanced Manufacturing Sciences

Charles F. Carter, Jr.
Executive Director
Institute of Advanced Manufacturing Sciences
1111 Edison Drive
Cincinnati, OH 45216
(513)948-2000

Located in a new, 64,000-ft² facility on a 135-acre site in a research park in Cincinnati. Managed by the Columbus Division of the Battelle Memorial Institute, but drawing on the research expertise of the University of Cincinnati and



the training capabilities of the Advanced Technology Center at Lorain County Community College.

Research Focus: Improve manufacturing quality, resource utilization and response time through four central research activities:

- o **manufacturing systems analysis** (including CIM);
- o **automated equipment development and integration** (customized CAD-CAM for specific production operations);
- o **measurements and controls** (sensor development and applications); and
- o **robotics** (software development to interface robotics and machine tools for flexible manufacturing).

Research activities of the Center are supported center by the expertise and special facilities of the University of Cincinnati, including the following:

- o Center for Robotics Research;
- o Solid State Electronics Laboratory;
- o Artificial Intelligence and Computer Vision Laboratory;
- o Structural Dynamics Research Laboratory;
- o Laboratory for Microtransducer and Signal Processing Research;
- o Work Place Design and Human Factors Laboratory.

Established: 1984.

Budget Information: About \$4 million in startup funding in 1984, plus an expansion grant of \$2 million in 1986.

Industrial Participation: Institute conducts both proprietary and generic research. Members receive an annual technology audit of their facilities and on-site consultation on technological opportunities and strategies. Membership benefits also include seminars, publications, demonstrations, and lectures.

Companies:

- o Cincinnati Milacron;
- o General Electric Aircraft Engine Group;
- o The Kroger Company;
- o Procter & Gamble Co.

3. Other Research Centers

a. Edison Industrial Systems Center

Mr. Charles Depew
Director
Edison Industrial Systems Center
1700 N. Westwood Avenue, Suite 228G
Toledo, OH 43607-1207
(419)247-8119



Funds were set aside in FY87-88 budget for a new center supported by University of Toledo, Owens Technical College, Bowling Green State University, and Medical College of Ohio.

Research Focus:

- o *large-scale integration* of engineering, manufacturing and business systems;
- o *quality control inspection devices*; and
- o *mathematical modeling and optimization of industrial processes.*

Established: 1986.

Budget Information: \$4 million set aside for startup funds in 1986.

Companies: 25 Toledo area businesses are founding members, including:

- o ASK Computer Systems;
- o Atlas Crankshaft;
- o Champion Spark Plug/Devlbiss;
- o Dana;
- o Digital Equipment Corp.;
- o Doehler Jarvis/Farley Industries;
- o Hewlett Packard;
- o Hydramatic Divison of General Motors;
- o NCA;
- o Owens-Illinois;
- o Therma-Tru; and
- o Toledo Trustcorp.

b. Edison Materials Technology Center

Dr. Frank Moore
Director
Edison Materials Technology Center
3171 Research Drive
Kettering, OH 45420
(513)259-1365

Funds were set aside in FY87-88 budget for creation of new center supported by Wright State University, University of Dayton, Central State University, and Sinclair Community College. The Center is located in Dayton's Miami Valley Research Park and will tap the resources of the \$400-million Materials Laboratory at Wright-Patterson Air Force Base.

Research Focus: Applying *advanced materials and their fabrication processes* to the private sector and Federal laboratories.

Established: 1986.



Budget Information: \$4 million set aside for startup funds in 1986.

Companies:

- o Advance Foundry Co.;
- o Dayton Power & Light Co.;
- o Diconix Co.;
- o Hobart Corp.;
- o General Motors Corp.;
- o Ledex Inc.;
- o Mead Corp.;
- o Monarch Marking Systems Division of Pitney Bowes Co.;
- o NCR Corp.;
- o Speco Division of Kelsey Hayes Co.

c. Edison Biotechnology Center

Ms. Dorothy Baunach
Acting President
Edison Biotechnology Center
c/o Enterprise Development, Inc.
11000 Cedar Avenue
Cleveland, OH 44106
(216)229-9445

Research Focus: Development and commercialization of advances in biotechnology, mainly for biomedical applications but also for possible industrial uses. Research will concentrate on three areas:

- o **Diagnostics --**
 - * *imaging processes;*
 - * *sensors for blood pressure and gases; and*
 - * *monoclonal antibodies and gene probes.*
- o **Bioprocesses --**
 - * *organ assists or substitutes;*
 - * *nutritional sciences; and*
 - * *biological waste management.*
- o **Biomaterials --**
 - * *implantable devices;*
 - * *drug delivery systems; and*
 - * *prosthetic devices.*

Established: 1987.

Budget Information: \$1.5 million set aside as startup funds in 1986.

Companies:

- o BP America (formerly Standard Oil);
- o C-Bio Management Co.;
- o Ernst & Whinney;
- o Invacare Corp.;



- o Ricerca Inc.;
- o Life Systems Inc.;
- o Siemens Medical Systems;



PENNSYLVANIA

1. Statewide Policy and Coordination

Jacques Koppel
Executive Director
Ben Franklin Partnership
Department of Commerce
463 Forum Building
Harrisburg, PA 17120
(717)787-4147

Created in 1982 to replace the Pennsylvania Science & Engineering Foundation, BFP is one of the largest and most comprehensive State S&T initiatives. Its goals include assistance to tradition business as well as technology development and business creation. BFP's four Advanced Technology Centers (below) are more regional than sectoral in focus: each has several "specialties," often overlapping with other centers, in order to provide timely response and support to the differing needs of their areas of the State.

In addition to the ATCs, BFP administers several other programs:

- o **Challenge Grants for Technological Innovation.** -- State funds, matched at least 1:1 (typically 3:1 or more) for research conducted at ATCs.
- o **Incubator Programs.** -- Twenty incubators are operated or supported by the ATCs; the Small Business Incubator Loan Program (financed by a \$17-million bond issue) helps finance new facilities.
- o **Technical and Managerial Assistance.** -- The ATCs also provide entrepreneurial assistance to new and existing businesses.
- o **Seed Capital Funds.** -- Each ATC has a seed fund, matched 3:1 by private sources, for product conceptualization and development. \$3 million fund was capitalized by a bond issue in FY86-87..n
- o **Research Grants.** -- Grants for feasibility and applied research are available to firms under 250 employees.
- o **Engineering School Equipment Grant Program.** -- Provides funds for acquiring or upgrading equipment.
- o **Tax Incentives.** -- Department of Commerce allows up to \$25 million in tax credits to investors for investments in high technology projects.

Non-BFP programs provide industrial loans (25 percent target for high-tech firms) and venture capital (up to \$100 million in State employee pension funds, invested with private venture capital firms), as well as technical training and technology transfer activities; but the four ATCs function as field offices for many of these services.



Budget Information:

- o FY81-82 -- \$1 million program startup;
- o FY82-83 -- \$1 million center startup (\$250,000 each);
- o FY83-84 -- \$9.9 million to centers (competitive);
- o FY84-85 -- \$17.9 million to centers (competitive);
- o FY85-86 -- \$21.3 million to centers (competitive);
- o FY86-87 -- \$26.4 million to centers (competitive);
- o FY87-88 -- \$28.5 million to centers (competitive).

Industrial Participation: Current Challenge Grant program guidelines give highest priority to sponsored or contract research, which are deemed likely to create the most jobs in the shortest time. A lesser priority to industrial affiliate programs with broader objectives, unless it can be demonstrated that they will benefit groups of small companies. State funds must be matched 1:1 by private funds or 3:1 with in-kind contributions, up to a maximum of \$750,000 from any single company for any single project.

2. State-Designated Centers of Excellence

a. Advanced Technology Center of Central and Northern Pennsylvania

Executive Director
Advanced Technology Center fo Central and Northern
Pennsylvania
416 Old Main
Pennsylvania State University
University Park, PA 16802
(814)863-0532

To cover its 40-county service area adequately, ATC-CNP has established two "satellite centers": the Northwest Satellite Center at Behrend College in Erie, and the South Central Satellite Center at Capital College in Middletown. ATC-CNP has also supported the creation of 14 business incubators.

Research Focus:

- o *Food, forestry and agricultural sciences* (e.g. mushroom growth and processing technology; frozen soup development and production).
- o *Advanced materials, coal and minerals* (e.g. limestone quarry waste and lime plant flue dust to neutralize acid mine drainage; foundry sand reclamation).
- o *Manufacturing, management and control systems* --
 - * *VLSI systems design* automation and development;
 - * *integrated material handling* systems;
 - * *robotic welding*;
 - * *applications engineering for computer-automated process planning and computer integrated manufacturing* systems).



- o **Biotechnology** (e.g. *automated immunochemistry*, silver-coated fibers as bacteriostatic-bactericide in carpets, shoes and bandages.

Established: 1983.

Budget Information:

- o FY82-83 -- \$0.25 million;
- o FY83-84 -- approximately \$2.4 million;
- o FY84-85 -- \$3.2 million;
- o FY85-86 -- \$4.71 million;
- o FY86-87 -- approximately \$6.6 million.

Companies: Membership includes 38 public and private colleges and universities, 398 private sector firms, and other groups and organizations.

b. Advanced Technology Center of Southeastern Pennsylvania

Executive Director
 Advanced Technology Center of Southeastern Pennsylvania
 University City Science Center
 3624 Market Street
 Philadelphia, PA 19104
 (215)387-2255

Research Focus: ATC-SEP has recently launched its own "centers of excellence" program in five primary R&D areas:

- o **Sensor Technologies.** -- *Magnetic resonance spectroscopy* for human diagnostics, *arthroscopic and ultrasonic devices*.
- o **Medical Biotechnologies.** -- *Veterinary drug delivery system, surgical instrumentation.*
- o **Materials Engineering and Processing.** -- Improved *powder molding technology* for continuously cast steel, *high-speed robotic inserter* for printed circuit board assembly.
- o **Space Productivity and Adaptability.** -- ATC-SEP has been designated a NASA Center of Excellence in *bioprocessing and pharmaceuticals*, emphasizing its expertise in *microgravity research* and in *manufacturing drugs and chemicals in space*.
- o **Computer science and information processing.** -- A new "R&D thrust area" for FY85-86, with emphasis on *telecommunications, information networks, and artificial intelligence*.

Established: 1983.

Budget Information:

- o FY82-83 -- \$0.25 million startup;
- o FY83-84 -- approximately \$2.4 million (competitive);
- o FY84-85 -- \$5.03 million (competitive);



- o FY85-86 -- approximately \$5.9 million (competitive).
- o FY86-87 -- approximately \$6.6 million.

Companies: Membership includes 41 public and private universities, over 300 private sector firms, and over 20 public agencies and foundations.

c. North East Tier Advanced Technology Center

Executive Director
North East Tier Advanced Technology Center
125 Goodman Drive
Lehigh University
Bethlehem, PA 18015
(215)758-5200

Research Focus:

- o **CAD-CAM.** -- Projects that have reached commercial stage include *low-cost assembly inspection cell* (using off-line CAD-CAM programming) and *thermal profiling system* (for microelectronics assembly).
- o **Microelectronics.** -- NET-ATC received \$250,000 grant from Semiconductor Research Consortium to establish program in *semiconductor packaging services*. Additional funds from NET-ATC, industry, and NSF and other Federal agencies will provide \$2.7 million/yr budget for this activity.
- o **Materials.** -- Modification of equipment for *extruding high-performance RSP metal alloys*.
- o **Biotechnology.** -- Patent applications for *colorimetric medical assay sticks*.

Established: 1983.

Budget Information:

- o FY82-83 -- \$0.25 million (startup);
- o FY83-84 -- \$2.9 million (competitive);
- o FY84-85 -- \$5.13 million (competitive);
- o FY85-86 -- approximately \$5.9 million (competitive).
- o FY86-87 -- approximately \$6.6 million.

Companies: Membership includes 78 public and private colleges and universities (51 active), 72 foundations and other organizations, and 447 private sector firms.

d. Western Pennsylvania Advanced Technology Center

Executive Director
Western Pennsylvania Advanced Technology Center
4516 Henry Street, Suite 103
Pittsburgh, PA 15213
(412)681-1520



Research Focus:

- o **Robotics and Intelligent Systems.** -- The Flexible Manufacturing Laboratory at Carnegie-Mellon's Robotics Institute is working with a consortium of western Pennsylvania companies to develop and transfer new product lines in robotics and CAM for smaller manufacturers. Examples include *software for automated welding and die-making* and a *flexible mold for stainless steel building parts*.
- o **Advanced Materials, Processes and Devices.** -- New products and processes to revitalize the *steel industry*; collaborative effort of Pitt's Basic Metals Processing Research Institute and Casting Industries Science & Engineering Institute, with CMU's Center for Iron and Steelmaking Research, and 31 private sponsors. Other research has resulted in prototype device for *stress simulation and equipment malfunction detection*.
- o **Biotechnology.** -- Former Gulf Oil R&D facility became University of Pittsburgh Applied Research Center in 1986; functions as incubator rather than research program. Research focuses on bioengineering and biomedical applications, including *fluorescent labeling reagents* and *diagnostic imaging microscope*; *optical filter* for laser research and scientific instruments; and *lightweight low-cost CO₂ laser* for outpatient medical market.

Established: 1983.

Budget Information:

- o FY82-83 -- \$0.25 million (startup);
- o FY83-84 -- approximately \$2.4 million (competitive);
- o FY84-85 -- \$4.72 million (competitive);
- o FY85-86 -- \$4.85 million (competitive).
- o FY86-87 -- approximately \$6.6 million.

Companies: Consortium Council had grown to over 350 members in 1986, including 37 public and private colleges and universities, several foundations, and over 400 private sector firms.

3. Other Research Centers

Five new federally funded research centers have been established in Pennsylvania since BFP's inception in 1983, bringing the total from 8 to 13.

- a. NASA Bioprocessing and Pharmaceutical Research Center (Philadelphia)
- b. DOD Software Engineering Institute (Pittsburgh).
- c. NSF Supercomputer Center (Pittsburgh).



d. NSF Engineering Research Center

Lehigh University

Research Focus: *Advanced technology for large structural systems.*

Budget Information: \$10.4 million over 5 years from NSF; commitment from NET-ATC for \$1 million in sponsored research over 5 years.

e. NSF Engineering Research Center (Carnegie-Mellon University).



SOUTH CAROLINA

1. Statewide Policy and Coordination

Dr. Robert E. Henderson
Director
South Carolina Research Authority
P.O. Box 12025
Columbia, SC 29211-2025
(803)799-4070

SCRA was created in 1983 as a public corporation to enhance the research capabilities of the State's public and private institutions and to promote the development of high-technology industries and research facilities in South Carolina. The State provided large parcels of land for the creation of three research parks, to be developed by the Authority and tied to the university system.

Research Focus: The three Research Parks will be specialized in (1) *robotics*, (2) *electronics and computers*, and (3) *medical and life sciences*. It is assumed that some central research activity or facility will emerge in each park.

Budget Information: The Authority received \$500,000 in startup funds in 1983, plus the deeds to land for the Parks. Any revenue (in excess of operating expenses) derived from the Research Parks will be used for competitive grants for basic research projects that are relevant to SC industries and have the best probability of leading to industrial applications.



TENNESSEE

1. Statewide Policy and Coordination

Dr. John M. Crothers
Assistant Commissioner
Energy Division
Department of Economic and Community Development
320 6th Avenue North, 6th Floor
Nashville, TN 37219-5308
(615)741-2994/1671

David Patterson
President
Tennessee Technology Foundation
P.O. Box 23184
Knoxville, TN 37933-1184
(615)694-6772

TTF receives State appropriations and disseminates funds to various high-technology programs throughout the State. Most of its initiatives are real estate-based rather than research-based.

Budget Information: Initial operating funds for TTF came from a 5-year, \$1.2-million grant from the Appalachian Regional Commission. \$2 million initial State investment 1985. \$200,000 operating budget FY87.

Research Focus: Four research "themes," proposed by the New Business Development Committee of the Oak Ridge Chamber of Commerce, were adopted by TTF in 1983:

- o measurement and control technologies;*
- o biotechnology;*
- o materials technologies; and*
- o energy technologies.*

Action has been taken on only the first two at this time (see below).

2. State-Designated Centers of Excellence

a. Tennessee Center for Research and Development

Research Focus: Technology transfer and commercial applications resulting from the State's resource base in the following research areas:

- o Center for Biotechnology --*
 - * plant tissue culture;*
 - * hazardous waste management; and*
 - * pharmaceuticals and innovative drug delivery systems.*
- o Power Electronics Applications Center.*
- o Center for Laser Technology.*



Established: Originally established in 1983 as the Tennessee Center for Biotechnology, and reorganized in late 1985 to broaden its research focus.

Budget Information: Independent, not-for-profit technology transfer company, with a for-profit subsidiary Technology Development Corporation. Initial funding from TTF in 1983 is supplemented by royalties and by research contracts from industry; original plans also called for property income from a Biotechnology Industrial Park designed for research facilities and spinoff firms.

b. Centers of Excellence at Tennessee Tech

Anthony Volpe
President
Tennessee Tech University
Cookeville, TN

Research Focus: Two Centers were launched in 1984, with the following specialties:

- o *manufacturing and technology use;*
- o *water resources.*

Established: 1984.

Budget Information: TTF provided \$2 million initial investment for the two Centers in 1984.

3. Other Research Centers

a. Tennessee Technology Corridor

TTF has devoted much of its attention to developing the corridor between Oak Ridge and Knoxville, which is home to an extensive and growing range of research institutions including the following:

- o Oak Ridge National Laboratory;
- o University of Tennessee;
- o Tennessee Valley Authority;
- o Tennessee Center for Biotechnology (above);
- o Institute for Advanced Studies in Measurement and Control Sciences and Engineering; and
- o Oak Ridge Associated Universities, a consortium of universities that have pooled resources and talent for R&D and technology transfer.

c. Biomedical Research Zone

Tom Trotter
Manager
Biomedical Research Zone
Memphis, TN
(901)526-1165



BRZ is designed to help those in the southwestern part of the State who are engaged in basic and applied biomedical research.

Research Focus: *Basic and applied ;biomedical research,* particularly in the following areas:

- o human implants;*
- o genetics;*
- o instrumentation;*
- o pharmaceuticals; and*
- o research software.,*

Budget Information: BRZ is a private enterprise with funding from local industry, education, government, and TTF.

d. University of Tennessee Space Institute

Tom Bailey
Director of Research
University of Tennessee Space Institute
Tullahoma, TN 37388
(615)455-0631, ext. 333

The Southern Middle Tennessee High Technology Initiative, which emphasizes technology and entrepreneurial opportunities in its region, is working to form university-industry partnerships based on the resources of UTSI (Tullahoma) and nearby Huntsville, Alabama.

Research Focus: Graduate education and research in the following areas:

- o applied physics;*
- o atmospheric science;*
- o computational fluid dynamics;*
- o computer applications;*
- o electro-optics/instrumentation;*
- o energy conversion;*
- o flight testing;*
- o gas dynamics;*
- o laser applications;*
- o materials;*
- o propulsion/combustion;*
- o remote sensing;*
- o space systems; and*
- o spectroscopy.*

Established: 1964.

Budget Information: In 1984, UTSI received a 5-year, \$5-million grant from the State to expand existing activities into a Center of Excellence for Laser Applications.



Industrial Participation: Industry Advisory Group, made up of 30 representatives from private industry, Air Force and NASA, provides industry view on academic and research activities.

Companies: The following companies are represented on the Industry Advisory Group:

- o Avco Lycoming Co.;
- o Ball Corp.;
- o Calspan Field Services Inc.;
- o CVI Inc.;
- o Energy & Environmental Research Corp.;
- o General Electric Aircraft Engine Division;
- o General Motors;
- o Hughes Aircraft Co.;
- o Lockheed Advanced Aeronautics Co.;
- o Martin Marietta Corp.;
- o McDonnell Douglas Astronautics Co.;
- o Northrop Services Inc.;
- o Orbital Sciences Corp.;
- o Otis Elevator Co.;
- o Pan American World Services Inc.;
- o Piper Aircraft Corp.;
- o Pratt & Whitney Aircraft;
- o Rockwell International;
- o Sverdrup Technology Inc.;
- o United Space Boosters;
- o Wyle Laboratories.



TEXAS

1. Statewide Policy and Coordination

Texas Science and Technology Council
Office of the Governor
Austin, TX

Created in 1984 as part of the Governor's Office to recommend actions that will allow the State to achieve the following goals:

- o promote technology development and transfer;
- o increase the amount of basic and applied research conducted at State colleges and universities;
- o increase the available pool of venture capital;
- o develop a mechanism for direct State investment in high-technology development; and
- o promote potentially self-sustaining university ventures.

The State has also created a new Advanced Technology Department to coordinate government activities in technology development, including information dissemination and technical training and manpower. Other programs provide technology transfer, entrepreneurial assistance, and technical support.

3. Other Research Centers

a. Microelectronics and Computer Technology Corporation

Grant A. Dove
Chairman and CEO
Microelectronics and Computer Technology Corp.
9430 Research Blvd.
Austin, TX 78759
(512)343-0978

MCC, a consortium of 20 major corporations, decided to locate in Austin in large part because of the resources of the University of Texas, including a commitment by the State to endow a rumored 35 full professorships (at approximately \$1 million apiece) in electrical engineering and computer science. The State also kicked in 2 years' free use of a Learjet and \$20 million in below-market home loans. Competition for MCC was important to the efforts of several other States to launch their own technology-development initiatives.

Research Focus: Five areas that, collectively, form the foundation for the so-called Fifth Generation of computers technology:

- o Advanced computer architectures includes three areas:
 - * *artificial intelligence;*
 - * *systems technology; and*
 - * *designing easier-to-use software.*



- o **Semiconductor packaging** involves designing high-density chips, including:
 - * **connectors;**
 - * **materials;**
 - * **test and cooling technology; and**
 - * **process reliability.**
- o **VLSI applications of CAD** (NCR has already marketed expert-systems software for design of applications-specific ICs).
- o **Superconductivity**, a new program area, expected to deal with designs for faster and more powerful electronic systems.

Established: 1982.

Budget Information: 1987 budget of about \$75 million to support some 400 researchers.

Industrial Participation: Research cooperative with costs shared by member companies, who also place about 100 researchers and project monitors at a time in MCC's labs.

Companies:

- o Boeing Electronics;
- o Control Data Corp.;
- o General Electric Co.;
- o Honeywell;
- o 3M;
- o NCR Corp.;
- o others.

Texas Instruments may join in 1988, and there are efforts to recruit more small companies. However, three companies have announced that they would allow their memberships to lapse at the end of 1987:

- o Allied-Signal;
- o Lockheed Missiles and Space;
- o Unisys.

b. Semiconductor Technology Corporation (SEMATEC)

Another research consortium, but this time with a significant amount of DOD funding. Announced in January 1988 that they, too, would locate in Austin.



UTAH

1. Statewide Policy and Coordination

Dr. Lynn Blake
Director
Centers of Excellence Program
Business and Economic Development Division
Department of Community and Economic Development
6290 State Office Building
Salt Lake City, UT 84114
(801)538-3377

In 1985, the Legislature created a \$2.5 million fund for the creation of "centers of excellence" with the following goals:

- o accelerate the growth of targeted technologies by catalyzing interdisciplinary research activities within Utah's colleges and universities;
- o stimulate and assist the translation of research products from university laboratories into Utah's economy; and
- o enhance the image of the State as a center for Technology-based industry.

The resulting program was modeled on NSF's successful University-Industry Cooperative Research Centers Program, with the State providing up to \$500,000 in 3-year startup grants, to be matched at least 2:1 by Federal and private dollars, for collaborative research in university-based centers. A unique feature of the program is the creation of multischool consortia in six of the seven target technologies (see below), and the resulting program goal of facilitating cooperation among centers on different university campuses.

Research Focus: A total of 22 centers have been funded in seven target technologies:

- o *biotechnology;*
- o *biomedical technologies;*
- o *communications and information technologies;*
- o *engineering technologies;*
- o *manufacturing and materials technologies;*
- o *natural resources;*
- o *space engineering and applications.*

Established: The first 13 centers were funded in September 1986; 9 more were funded in 1987.

Budget Information: \$2.5 million startup funding FY85-86; additional funding of \$1.3 million FY86-87.

Companies: At least 123 private companies are associated with one or more of the centers, and 7 new spinoff companies have already been launched to commercialize the results of center research.



2. State-Designated Centers of Excellence

a. Biotechnology Consortium

Center for Controlled Chemical Delivery
University of Utah

Center for Biotechnology
Utah State University

Research Focus:

- o *chemical delivery techniques* for the pharmaceutical, medical device, biotechnology, and chemical process industries (e.g., transdermal patch, subdermal implant, fluoride delivery for dental caries);
- o *plant recombinant DNA* for crop and forage hybrids with improved protein content and disease resistance;
- o *agricultural microbiologicals*, including antagonists to plant pathogens and growth-promoting microbes;
- o *monoclonal antibodies* for disease control in livestock; and
- o *food processing and engineering control*, including use of *recombinant DNA for enzyme production* in improved cheese cultures and enhanced cheese production.

Established: CCCD 1986, CB 1987.

Companies:

- o Ciba-Geigy;
- o HyClone Laboratories Inc.;
- o Kimberly-Clark;
- o Kraft;
- o Miles Laboratories;
- o Travenol Labs;
- o Pan-Agro;
- o Penwalt;
- o Royal Pharmaceutical;
- o Theratech.

b. Biomedical Technologies Consortium

Center for Biopolymers at Interfaces
Center for Sensor Technology
Center for Total Artificial Hearts and Biomedical Devices
Laser Institute
(all University of Utah)

Research Focus:

- o *absorption or binding of proteins and other biomolecules onto surfaces*, with applications in prevention of blood clotting, protein-proof coatings for blood bags and medical devices, and development of artificial red cells;
- o *sensor technology*;



- o *design, fabrication, implantation, and monitoring of artificial organs, including fully implantable hearts and cardiac assist, kidney dialysis, artificial ear, and artificial urinary tract;*
- o *laser R&D for medical applications.*

Established: 1986.

Companies:

- o Bausch & Lomb;
- o Biomaterials International;
- o Datascope;
- o Dupont Biomedical Products;
- o Eastman Kodak;
- o Eli Lilly;
- o HGM Medical Lasers;
- o Hoffman-LaRoche;
- o Johnson & Johnson;
- o LEX Co.;
- o Life Extenders Corp.;
- o Procter & Gamble;
- o Symbion Inc.;
- o Therapeutic Technologies;
- o Vital Assist;

c. Communications and Information Technologies Consortium

Center for Communications Research
University of Utah

Center for Computer-Based Education Technologies
Brigham Young University

Center for Computer Information Networks Research
Utah State University

Center for Microelectronics
University of Utah

Center for Signal Processing Systems
Brigham Young University

Research Focus:

- o *Design and evaluation of communications systems, including:*
 - * *computer networking;*
 - * *data compression;*
 - * *signal processing; and*
 - * *VLSI applications.*
- o *Computer-based instructional systems, including software development, adaptive programs, and AI-based systems.*
- o *Computer-based tools for design, implementation and operation of large telecommunications systems,*



- including advanced design workstation with analytic, optimization and simulation capabilities.
- o *Developing materials, design tools, and process technologies for VLSI circuits and devices.*
- o Signal processing applications in five areas:
 - * *image processing for videoconferencing;*
 - * *digital hearing aid;*
 - * *robotics for warehousing;*
 - * *covert surveillance and communications;*
 - * *VLSI design and implementation.*

Established: 1986.

Companies:

- o Adaptive Digital Systems;
- o Antin Group;
- o Excalibur Electronics;
- o Hewlett Packard;
- o Sondstream Inc.;
- o Unisys;
- o Wicat International;
- o Westinghouse.

d. Engineering Technologies Consortium

Center for Advanced Supercritical Fluid Separation
Brigham Young University

Center for Engineering Design
University of Utah

Center for X-Ray Imaging
University of Utah

Research Focus:

- o *Supercritical fluid chromatography for analysis of very large and/or thermally labile molecules, with applications in agrochemicals, biochemicals, environmental pollutants, petrochemicals, and pharmaceuticals.*
- o *Engineering design in seven principal areas:*
 - * *artificial limbs;*
 - * *drug delivery;*
 - * *physiological monitors;*
 - * *artificial kidneys;*
 - * *robotics; and*
 - * *microelectromechanical devices.*
- o *X-ray microlithography for applications in microelectronics design, fabrication and test, including:*
 - * *curved multilayer mirrors for focusing soft x-rays;*
 - * *bright sources of x-rays;*



- * **high-contrast masks** for imaging patterned x-ray shadows.

Established: 1986 and 1987.

Companies:

- o Animated Systems Inc.;
- o Biomaterials International;
- o Digital Equipment Corp.;
- o Disney Enterprises;
- o Dow Chemical;
- o Exxon Research & Engineering.
- o General Electric;
- o Hewlett Packard;
- o IBM;
- o Lee Scientific;
- o Microfield Devices Inc.;
- o Motion Control Inc.;
- o Nikon;
- o Sarcos Inc.;
- o Symbion;
- o Therapeutic Technologies.

e. Manufacturing and Material Technologies Consortium

Center for Computer-Aided Design and Computer-Aided
Manufacturing
Utah State University

Center for Computer Integrated Manufacturing
Brigham Young University

Center for Materials and Advanced Manufacturing
Technologies
University of Utah

Research Focus:

- o **CAD-CAM** -- assisting Utah industry, especially smaller firms, to adopt this technology through continuing education, consulting, and software development.
- o **CIM** -- Research and product development in three areas:
 - * **applications software** (generative and variant process planning, electronic component selection, and shop-floor data collection);
 - * **knowledge-based training** (courseware and videodisc delivery systems); and
 - * **system integration** (miniature computer-controlled factory to test and demonstrate advanced software, hardware and integration concepts).
- o **Materials** -- design, synthesis and manufacturability of engineered materials for applications in aerospace, energy, electronics, and medicine.



Established: 1986 and 1987.

f. Natural Resources Consortium

Center for Advanced Coal Technology
University of Utah

Center for Advanced Combustion Engineering (CACE)
Brigham Young University and University of Utah

Center for Selective Separation and Removal
University of Utah

CACE, a joint venture of BYU and UU, was designated an NSF Engineering Research Center in 1986. It was one of the first ERCs to combine research resources from two or more universities, as well as private companies and research institutes.

Research Focus: Application of new technology to the development of Utah's natural resources (coal, oil, water).
Special expertise and projects in the following areas:

- o differential liquefaction, gasification and chemical characterization of solid and liquid fossil fuels;*
- o separation, upgrading and stability of synfuels;*
- o environmental and health effects of fossil fuels;*
- o computer-aided systems for combustion engineering;*
- o macrolytic reagent separation of metal ions, currently in pilot plant demonstration, with potential commercial applications including:*
 - * reducing toxics in water supplies;*
 - * recovering potassium from brines;*
 - * recovering high-value metals (e.g. silver) from waste materials;*
 - * recovering strontium and cesium from aqueous solutions;*
 - * disposable electrodes for qualitative detection of selected elements;*
 - * selective macrolytic reagents designed for neutral and charged organic species, gas molecules, and enantiometric molecules.*

Established: 1986.

Companies:

- o Amoco;*
- o Atlantic-Richfield;*
- o Babcock & Wilcox Research Corp.;*
- o Bethlehem Steel;*
- o Electric Power Research Institute;*
- o Gas Research Institute.*



g. Space Engineering and Applications Consortium

Center for Aerospace Science & Technology
Weber State College

Center for Space Engineering Research
Utah State University

CSER at Utah State has also been recognized as a
Center of Excellence by the U.S. Air Force.

Research Focus:

- o Measurement of physical and chemical phenomena in the upper atmosphere and near-space environments.**
- o Small satellite technology**, including design fabrication and operation of experiments, devices and systems for applications including the following:
 - * feasibility testing** (low-cost, quick-turnaround, experimental satellites to determine the potential for producing or using industrial products in space);
 - * radar calibration** (NUSAT launched for FAA by NASA in 1985);
 - * remote sensing;**
 - * materials processing; and**
 - * space structures.**

Established: 1986.

Companies: In addition to contracts from NASA, FAA and the Air Force, the centers receive support from:

- o Boeing;**
- o Hercules;**
- o Lockheed;**
- o Martin-Marietta;**
- o Morton-Thiokol;**
- o Rockwell International.**



VIRGINIA

1. Statewide Policy and Coordination

Dr. Edward M. Davis
President
Center for Innovative Technology
Suite 201, The Hallmark Building
13873 Park Center Road
Herndon, VA 22071
(703)689-3000

CIT is a private, not-for-profit corporation established by the Commonwealth of Virginia. Its mission is to enhance the prosperity of Virginia through the transfer of university-based research and technological resources to industry. In addition to its research centers programs (below), CIT programs include research grants, incubators facilities, and technical and managerial assistance (delivered through a network of extension agents located at community colleges). In recent years CIT has increased its activities in the area of technology commercialization.

Virginia has three programs that correspond to "centers of excellence" in other States:

- o **Technology Development Centers** are located in university laboratories and conduct industrially oriented research in specific technologies that are deemed to have economic potential for the State. Five Centers had been created by September 1987 (see below), with 5-year financial commitments; the centers are expected to be self-supporting after that time.
- o **Research Institutes** identify, recommend and administer cooperative R&D projects for co-funding by CIT, usually for one year. Projects are aimed at enhancing industrial productivity and/or university research capabilities. More than 220 individual projects were funded through these Institutes during 1984-86. And although the Institutes operate on a limited, project-by-project basis, they identified the need for broader programmatic thrusts, leading to the development of the TDC program.
- o **Commonwealth Centers**, currently under development, will have a long-range, continuous funding commitment for "clusters of university research capability" in targeted technologies. CIT will cooperate with the State Council for Higher Education, Secretary of Education, universities, and industrial partners in identifying and financing these Centers. No Commonwealth Centers had yet been designated by September 1987.

CIT has also organized a **Commercial Space Group**, with 33 member companies, to advise the Governor on initiatives that would promote the growth of the commercial space industry in the Commonwealth. Their report is due in early 1988.

Established: 1984.



Budget Information: Total CIT budget, all programs, from the general fund:

- o \$30.3 million FY83-85;
- o \$10 million FY86;
- o \$10 million FY87;
- o \$10.8 million FY88;
- o \$12.1 million FY89 (proposed);
- o \$14.3 million FY90 (proposed).

Commonwealth Centers and Research Institutes:

- o \$7.37 million FY86;
- o \$6.25 million FY87;
- o \$6.9 million FY88 (planned);
- o \$8.2 million FY89 (proposed);
- o \$9.7 million FY90 (proposed).

CIT research funding is intended to be matched 1:1 by industry; these matching funds rose from \$3.4 million FY85 and \$5.0 million FY86 to \$8.1 million FY87.

Companies: As of September 1987, CIT had worked with over 200 companies to sponsor almost 300 individual projects at 12 colleges and universities. In addition to sponsors listed for individual centers below, research has been sponsored at one or more CIT centers by the following U.S. and international corporations:

- o A.I. Robotics;
- o Air Products and Chemicals Co.;
- o Alcon Laboratories;
- o Aluminum Co. of America;
- o Anser Corp.;
- o ARCO Chemical Co.;
- o Beckman Instruments;
- o Biochemical Marketing Corp.;
- o Biotechnical Resources Inc.;
- o Boeing Computer Services;
- o Burroughs Wellcome Co.;
- o Celanese Corp.;
- o Chromealloy Corp.;
- o Ciba-Geigy;
- o Computer Technology Associates;
- o Cortest Inc.;
- o Cosmos Imaging Systems;
- o Crystal Specialties Inc.;
- o Diet-Tec;
- o Dow Chemical Corp.;
- o E.I. Dupont de Nemours & Co.;
- o Electrosynthesis Corp.;
- o Exxon Research & Engineering;
- o Engelhard Industries;
- o Fairchild Industries;
- o Hewlett Packard;
- o Hughes Aircraft Co.;
- o Imaging Technologies;
- o Interlan Ethernet Hardware;
- o International Technology Underwriters;



- o KNM Inc.;
- o LECO;
- o Lilly Research Labs;
- o 3M Co.;
- o Medi-Tech;
- o Mine Safety Appliance Co.;
- o Modula Corp.;
- o Monsanto;
- o Morton Thiokol Inc.;
- o Motorola;
- o Philadelphia Biologics Center;
- o Phillips Petroleum Co.;
- o PPG Industries Inc.;
- o Procter & Gamble;
- o Reprotect;
- o Research Corp.;
- o Reynolds Metal Co.;
- o Rockwell International;
- o Rogers Corp.;
- o Rutherford/Appleton Labs;
- o Science Applications International Corp.;
- o Shell Development Co.;
- o Smith, Klein & French Labs;
- o SNCORP;
- o Specific Scientific & Co.;
- o Sperry Corp.;
- o Synertech Inc.;
- o Systems Industries Hardware;
- o Tennessee Eastman;
- o Tensar Corp.;
- o Texas Research Institute;
- o Tripos Associates Inc.;
- o TRW Inc.;
- o Union Carbide;
- o Universal Leaf Tobacco Co.;
- o Varian;
- o Velsicol Chemical Corp.;
- o Virginia International Terminals Inc.;
- o Virginia Power Co.;
- o Warner Lambert;
- o Xerox.

2. State-Designated Centers of Excellence

a. Center for Software and Systems Engineering

Dr. James Palmer
 Director
 Software and Systems Engineering Center
 School for Information Technology & Engineering
 Modular D
 George Mason University
 Fairfax, VA 22053
 (703)323-2737



The GMU Software Engineering Center is one of five TDCs created by CIT in FY87; like the others (below) it began as a component of a CIT Institute (in this case of Information Technology), although it may have more independence and integrity than the other TDCs. The Center will conduct research and design software systems in cooperation with the Software Productivity Consortium, Inc., a Reston-based consortium of 14 aerospace companies dedicated to achieving dramatic increases in the productivity of software engineers.

Research Focus: *Software engineering.*

Established: 1987.

Budget Information: \$2.4-million, 3-year grant from CIT in FY87, to be matched by an expected \$1.25 million in corporate support. Goal is to be self-supporting after 5 years. (State Department of Economic Development also provided \$2-million, 3-year special fund to provide office space for Software Productivity Consortium; CIT administers the fund.)

b. Center for Semicustom Integrated Systems

Dr. James Aylor
Director
Center for Semicustom Integrated Systems
Department of Electrical Engineering
Thornton Hall
University of Virginia
Charlottesville, VA 22901
(804)924-6100

Originally component of the CIT Institute of Computer-Aided Engineering (below).

Budget Information: Received about \$150,000 in CIT grants in FY86. CIT has made financial commitment for 5 years, after which Center is to be self-supporting.

c. Center for Fiber and Electro-Optics

Dr. Richard Claus
Director
Center for Fiber and Electro-Optics
Department of Electrical Engineering
340 Whittemore Hall
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061
(703)961-7203



Originally a component of the CIT Institute of Computer-Aided Engineering (below).

Research Focus:

- o **Fiber communications** (high-speed LAN design and implementation);
- o **Fiber fabrication** (secure communications, fiber coatings and processing, coupler fabrication); and
- o **Fiber sensing** (sensor networks and imbedded sensors for materials evaluation in commercial shipbuilding applications).

Budget Information: Received about \$150,000 in CIT grants in FY86 and a \$508,000, 5-year grant from CIT in April 1987. Goal is for Center is to be self-supporting after 5 years.

d. Center for Power Electronics

Dr. Fred Lee
Director
Center for Power Electronics
Department of Electrical Engineering
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061
(703)961-7716

Originally a component of the CIT Institute of Information Technology (below).

Budget Information: 5-year commitment of up to \$450,000 from CIT announced in late 1987. Goal is to be self-supporting after 5 years.

e. Center for Bioprocess/Product Development

Dr. Donald Kirwan
Director
Center for Bioprocess/Product Design
Department of Chemical Engineering
Thornton Hall
University of Virginia
Charlottesville, VA 22901
(804)924-6278

Originally a component of the CIT Institute of Biotechnology (below).

Budget Information: 5-year commitment of up to \$450,000 from CIT announced in late 1987. Goal is to be self-supporting after 5 years.



3. Other Research Centers

a. Institute of Biotechnology

Dr. Frank L. Macrina
Director
CIT Institute of Biotechnology
Virginia Commonwealth University
Box 126, MCV Station
Richmond, VA 23298
(804)786-8595

The Institute also involves researchers from the Departments of Microbiology and Chemical Engineering of the University of Virginia. CIT's TDC for Bioprocess and Product Development (above) began as a component of this Institute.

Research Focus:

- o *Agricultural and food biotechnology* (e.g. plant genetic engineering for disease- and stress-resistance);
- o *Bioprocess/product development* (e.g. biocatalysts, enzyme reagents, and continuous-process bioreactors);
- o *Toxicant assessment*;
- o *Macromolecular engineering* (e.g. protein engineering leading to synthetic vaccine for hepatitis B;
- o *Marine biotechnology* (seafood, drugs);
- o *Microbial biotechnology* (emphasis on anaerobes for waste treatment and fermentation);
- o *Molecular diagnostics*;
- o *Therapeutics* (emphasis on mammalian cell receptors).

Established: 1984.

Budget Information: Biotechnology projects received 22.6 percent of CIT research funding, or about \$1.68 million in FY86.

Industrial Participation: The Institute serves as a focal point for jointly sponsored industry/CIT projects throughout the Commonwealth. Its scientific advisory board includes both industry and academic members. Industrial sponsors match CIT funding 1:1 and monitor research to ensure technology transfer.

Companies:

- o Abbott Laboratories;
- o Merck, Sharp & Dohme Corp.



b. Institute of Computer-Aided Engineering

Dr. Ira D. Jacobson
Director
CIT Institute of Computer-Aided Engineering
School of Engineering & Applied Science
Albert H. Small Building
University of Virginia
Charlottesville, VA 22901
(804)924-3759

The Institute also involves researchers from the Departments of Electrical, Industrial and Mechanical Engineering at VPI. CIT's Technology Development Centers for Semicustom Integrated Systems and Fiber and Electro-Optics (above) began and remain essentially components of this Institute.

Research Focus:

- o **Knowledge-based design** (e.g. design parameters and software for magnetic bearing system);
- o **Robotics and automated manufacturing** (e.g. decision systems for industrial applications);
- o **Automation of low and medium tech industries** (upgrading facilities and operations to enhance competitiveness);
- o **Vision applications in CAE** (e.g. optical fibers as sensors and tachometers in robot applications);
- o **Magnetic bearing research** (applications in pumps, turbines, compressors, and jet engines);
- o **Structural Analysis Consortium** (software development);
- o **Telecommunications** (network design and protocols).

Established: 1984.

Budget Information: CAE received 23.8 percent of CIT research funding, or about \$1.77 million in FY86.

Industrial Participation: The Institute serves as a focal point for jointly sponsored industry/CIT projects throughout the Commonwealth. Its scientific advisory board includes both industry and academic members. Industrial sponsors match CIT funding 1:1 and monitor research to ensure technology transfer.

Companies:

- o AAR Technical Center
- o American Research Corp. of Virginia;
- o American Standard;
- o AMFOX;
- o AMP Inc.;
- o Applied Computer Technology & Engineers Inc.;
- o AT&T Bell Laboratories;
- o Babcock & Wilcox;



- o Braxton Manufacturing Co.;
- o Buehler;
- o Burroughs Corp.;
- o CASA/Gifts Inc.;
- o Celwave;
- o CIT Alcatel;
- o Control Data Corp.;
- o Corning Glass Works;
- o Digital Equipment Corp.;
- o Electronic Warfare Associates Inc.;
- o EM Industries;
- o Exxon Education Foundation;
- o FiberCom Inc.;
- o General Electric (several divisions);
- o Harris Corp.;
- o Hercules Aerospace/Advanced Materials;
- o Hermle Black Forest Clock Co.;
- o Hitachi Ltd.;
- o Hi-Test X Inc.;
- o Hoya Optics Inc.;
- o IBM Federal Systems Division;
- o Ingalls Shipbuilding;
- o Ingersoll-Rand Turboproducs;
- o Inland Motors;
- o ITT Corp.;
- o Jonathan Corp.;
- o KDI-Electro-tec Inc.;
- o Kingsbury Inc.;
- o Litton-Polyscientific;
- o Lord Corp.--Industrial Automation Division;
- o MacNeal-Schwendler Corp.;
- o Magnetic Bearings Inc.;
- o Mitsubishi Heavy Industries Ltd.;
- o Morrison Knudson Co.;
- o Mr. Electron TV;
- o Newport News Shipbuilding & Drydock Co.;
- o Noika Machinery;
- o Norfolk International Terminals;
- o Norfolk Southern Corp.;
- o PDA Engineering;
- o Photon Kinetics;
- o Raychem Ltd.;
- o Research Triangle Institute;
- o Reston Publishing Co. Inc. (Prentice Hall);
- o Ryland Group;
- o Salamone Turbo Engineering Inc.;
- o SAMS--Division of Macmillan Inc.;
- o Seicor Corp.;
- o Simmonds Precision--Division of Hercules;
- o Southeastern Technologies Inc.;
- o Stewart Sandwiches Inc.;
- o Swanson Analysis Systems Inc.;
- o Tektronix;
- o Texas Instruments;



- o Transamerica Delaval
- o TRW Inc.;
- o Turbodyne--Division of Dresser Industries;
- o University Science Books;
- o Valpey-Fisher Inc.;
- o Vatell Corp.;
- o Waterford Specialties;
- o John Wiley & Sons Inc.

c. Institute of Information Technology

Dr. Roger W. Ehrich
 Director
 CIT Institute of Information Technology
 133 McBryde Hall
 Virginia Polytechnic Institute and State University
 Blacksburg, VA 24061
 (703)961-7539

The Institute also involves the UVA's Departments of Computer Science, Electrical Engineering and Systems Engineering, as well as George Mason University's program in Information Sciences and Technology. CIT's TDC for Power Electronics (above) began as a component of this Institute.

Research Focus:

- o *Power electronics and power management;*
- o *Computing systems* (e.g. automated LAN performance measurement);
- o *Human-computer interaction* (e.g. voice-recognition software and eyegaze-response applications for the disabled); and
- o *Communications systems* (e.g. microwave antenna);
- o *Intelligent systems and decision systems* (e.g. computer simulation of manufacturing processes, expert systems for fault diagnosis);
- o *Software engineering.*

Established: 1984.

Budget Information:

- o \$0.97 million FY85;
- o \$1.39 million FY86 (18.7 percent of CIT research funding);
- o \$0.60 million FY87.

Industrial Participation: The Institute serves as a focal point for jointly sponsored industry/CIT projects throughout the Commonwealth. Its scientific advisory board includes both industry and academic members. Industrial sponsors match CIT funding 1:1 and monitor research to ensure technology transfer.



Companies:

- o General Electric Co.;
- o Intel Corp.;
- o Philip Morris Corp.

d. Institute of Materials Science and Engineering

Dr. Chester W. Spencer
Director
CIT Institute of Materials Science and Engineering
100 Holden Hall
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061
(703)961-6351

Institute research is also being carried out on the campuses of the University of Virginia, the College of William and Mary, and the Virginia Military Institute.

Research Focus:

- o **Adhesion** (modeling and synthesis of adhesives and adhered surfaces, e.g. surface analysis and bonding of sheet-molded composite materials);
- o **Advanced composites** (e.g. modeling, characterization, and fabrication processes);
- o **Electronic materials** (semiconductor and dielectric materials, e.g. metal organic vapor deposition, gallium arsenide for high frequency applications);
- o **Metals and ceramics** (structure and fracture analysis, environmental effects, tests to predict service lifetimes); and
- o **Polymers** (characterization, synthesis and behavior of polymers, e.g. crystallization behavior of thermoplastics in fiber and film matrix applications).

Established: 1984.

Budget Information: Materials science and engineering received 31.0 percent of CIT research funding, or about \$2.31 million in FY86.

Industrial Participation: The Institute serves as a focal point for jointly sponsored industry/CIT projects throughout the Commonwealth. Its scientific advisory board includes both industry and academic members. Industrial sponsors match CIT funding 1:1 and monitor research to ensure technology transfer.

Companies:

- o Ashland Chemical Corp.;
- o General Motors Corp.;
- o ITT-Roanoke;
- o Texas Instruments.



WASHINGTON

1. Statewide Policy and Coordination

William T. Bakamis
Policy and Program Coordinator
Department of Trade and Economic Development
101 Grenard Administration Building
Olympia, WA 98504
(206)753-5634

The Washington High Technology Coordination Board worked from 1983 to 1986 to identify a strategic plan for high technology, to provide a link between R&D resources and the needs of high technology industry, and to coordinate higher education issues. In 1987 its functions were assumed by the Department of Trade and Economic Development and the Higher Education Coordinating Board.

3. Other Research Centers

a. Washington Technology Center

Dr. Edward Stear
Director
Washington Technology Center
University of Washington
Seattle, WA

WTC focuses the State's research initiatives on the creation of commercially promising technology and on the needs of technology-based industry. Its activities include both research and training, as well as technology transfer, business development, and management assistance to high-tech startups.

Research Focus:

- o *advanced materials;*
- o *computer systems and software;*
- o *biotechnology;*
- o *integrated optics;*
- o *microsensors.*

Established: Since 1983.

Budget Information: \$3.6 million FY76-87 biennium, from State general funds.



WEST VIRGINIA

1. Statewide Policy and Coordination

Lysander Dudley, Sr.
Director
Department of Industrial Development
State Capitol M-146
Charleston, WV 25305
(304)348-0400

3. Other Research Centers

a. Center for Education and Research with Industry

Director
Center for Education and Research with Industry
Marshall University
Huntington, WV 25701
(304)696-2309

CERI is a consortium of 26 public and private colleges and universities, created to promote university-industry-government partnership and to mobilize university resources for economic development. It has four principal activities:

- o Training. -- Demand analysis and course development for on-site and off-site training and retraining programs.
- o Management and professional development. -- Continuing education and credit and noncredit courses for supervisory and professional personnel.
- o Consulting. -- Inventory faculty and staff expertise in technical, scientific and management fields that can be tapped to solve specific business problems or help new firms get started.
- o Research. -- CERI serves as a clearinghouse for contractual arrangements or collaborative joint ventures in research and development. It also sponsors research conferences.

Established: 1983; statewide office opened 1985.

Budget Information: \$100,000 per year from Board of Regents.



WISCONSIN

1. Statewide Policy and Coordination

Rolf Wegenke
Department of Development
State Justice Building
P.O. Box 7970
123 W. Washington Avenue
Madison, WI 53707
(608)266-1018

3. Other Research Centers

a. Centers of Excellence at the University of Wisconsin

Chandler L. McKelvey
Executive Director
Wisconsin for Research, Inc.
201 Waubesa Street
P.O. Box 3037
Madison, WI 53704
(608)244-3511

The University of Wisconsin system supports a large Centers of Excellence program, supporting approximately 20 Centers doing basic and applied research. A University-Industry Research Program has been in place for 10 years, and the College of Engineering has established formal research relationships with industry through seven industrial consortia. WFR and its for-profit subsidiary, the Research Development Corp., help to arrange for contractual and collaborative research and assist the Wisconsin Alumni Research Foundation in commercializing the results of University Research.

Research Focus:

- o Microelectronics --
 - * Center for Applied Microelectronics;
 - * Wisconsin Electric Machines and Power Electronic Consortium;
 - * Instrumentation Systems Center.
- o Biotechnology.
- o Materials --
 - * Cast Metals Program;
 - * Wisconsin Polymer Processing Industrial Consortium;
 - * Materials Science Program;
 - * Superconductivity.
- o Manufacturing systems --
 - * Tactile Sensing and Robotic Technology Consortium;
 - * Mechanism Design Research Program;



*** *Thermal Systems Engineering Laboratory
Industrial Consortium.***

Budget Information: Centers of Excellence received \$2 million per year from State general funds in 1986 and 1987.

