The Stevenson-Wydler Technology Innovation Act of 1980

U. S. Department of Commerce

Tip Parker
Joe Allen

NORMAN J. LATKER
Director, Federal Technology Management Policy
Office of Productivity, Technology and Innovation

14th and Constitution, N.W.
Washington, DC 20230

(202) 377-0659

Report to the President and the Congress from the Secretary of Commerce

DEPARTMENT OF COMMERCE
REPORT ON THE ACTIVITIES CONDUCTED PURSUANT TO SECTIONS 5, 6, 8, 11, 12 AND 13 OF THE STEVENSON-WYDLER TECHNOLOGY INNOVATION ACT OF 1980 (PUBLIC LAW 96-480)

Table of Contents

Table of Contents

DEPARTMENT OF COMMERCE
REPORT ON THE ACTIVITIES CONDUCTED
PURSUANT TO SECTIONS 5, 6, 8, 11, 12 AND 13 OF
THE STEVENSON-WYDLER TECHNOLOGY INNOVATION ACT
OF 1980 (PUBLIC LAW 96-480)

Chapter 1: Introduction

The Report

Section 5(d) of the Stevenson-Wydler Act requires that the Secretary of Commerce prepare and submit to the President and Congress, within three years after the date of enactment of this Act, a report on the progress, findings, and conclusions of activities conducted pursuant to sections 5, 6, 8, 11, 12, and 13 of this Act and recommendations for possible modifications thereof.

This is in response to the requirements of Section 5(d).

The Purpose of the Act and the Means for Meeting That Purpose.

The purpose of the Stevenson-Wydler Act as set forth in Section 3 is "to improve the economic, environmental, and social well-being of the United States". Section 3 provides that this purpose is to be achieved by the following means:

- (1) establishing organizations in the executive branch to study and stimulate technology;
- (2) promoting technology development through the establishment of centers for industrial technology;
- (3) stimulating improved utilization of Federally funded technology developments by state and local governments and the private sector;
- (4) providing encouragement for the development of technology through the recognition of individuals and companies which have made outstanding contributions in technology; and
- (5) encouraging the exchange of scientific and technical personnel among academia, industry, and Federal laboratories.

The Act's purpose and the means to achieve it are driven by the Act's finding that increased industrial innovation will follow from cooperation among academia, Federal laboratories, labor, and industry, in such forms as technology transfer, personnel exchange and joint research projects. While the Act finds that industrial innovation is affected significantly by Government antitrust, economic, trade, patent, procurement, regulatory, R&D and tax policies, these policies are not addressed in achieving the purpose of the Act. It is clear, however, that the Act intended these policies to be examined and modified, if appropriate, under the Act's broad mandate "to study and stimulate technology".

Programs Established by the Act to Meet Its Purpose.

The operative sections of the Act authorize activities to support each of the means as follows:

- Section 5 of the Act is intended to implement (1) above by establishing an Office of Industrial Technology to undertake a number of duties including studies and policy experiments. The studies and policy experiments are to be aimed generally at heightening the world position of the United States in generating new technology. The Act authorizes up to $5 million to undertake these studies and policy experiments in fiscal year 1981. Authorizations increase to $9 million in fiscal year 1982 and $14 million for fiscal years 1983, 1984 and 1985;

- Sections 6 and 8 of the Act are intended to implement (2) above through Department of Commerce and National Science Foundation funding of centers for industrial technology. These centers would be affiliated with university or other nonprofit institutions for the primary purpose of fostering technology development through cooperative R&D efforts with industry. It is also intended that the centers undertake generic research projects. The Act authorizes up to $19 million for the funding of centers in fiscal year 1981. Authorizations increase to $40 million in fiscal year 1982, $50 million in fiscal year 1983 and $60 million for fiscal years 1984 and 1985;

Section 11 of the Act is intended to implement (3) above by establishing dedicated offices in the Federal laboratories and a central focus in the Department of Commerce for the purpose of intensifying the transfer of Federally owned or originated technology.

Section 12 of the Act is intended to implement (4) above by establishing a National Technology Medal; and

Section 13 of the Act is intended to implement (5) above through a joint personnel exchange program established by the Department of Commerce and the National Science Foundation.

Chapter II: Summary and Recommendations

Summary

The Department of Commerce and the Administration have made substantial progress in carrying out the intent of Stevenson-Wydler Act to increase cooperative R&D, technology transfer and industrial innovation. The law was designed to stimulate productivity, technology and innovation in the private sector with the intent of regaining or maintaining U. S. technical and industrial leadership in global markets. The comprehensive Administration strategy to do this focuses on the multi-faceted process of innovation itself rather than selected end-products of the process. Weak points in the innovation process have been identified, options for remedial action have been analyzed, and a series of initiatives have been undertaken as described below. These initiatives can be categorized as removing barriers to innovation, providing incentives for private sector initiatives, and increasing awareness of these initiatives in noninterventionist ways. For the most part, this has involved specific use or modification of Government antitrust, patent, procurement, regulatory, R&D, and tax policies.

Examples of initiatives that have been taken include the following:

- An R&D Limited Partnership (RDLP) concept has been articulated as a new method of financing innovation that is equally available and useful both to declining and growth industries. It minimizes direct Government intervention in the private sector. This approach is designed to achieve the objectives of Stevenson-Wydler, but to a much greater degree and over a much broader spectrum of industries than originally envisioned.

- The transfer of Federally funded technology in the private sector is being pursued through patent policy changes that "automatically" transfer new technology to the organizations that develop it and that have the incentive to commercialize it, rather than continuing the current process of "warehousing" and licensing it at a later time.

- Private sector cooperative R&D is being promoted through the removal or reduction of antitrust and other barriers to procompetitive arrangements.

- Federal research funding is being reallocated toward basic research, where commercial incentives are weak or do not exist, and away from development and demonstration of commercial technologies, which are more appropriately undertaken with private funding.

- Basic research performers are being encouraged to be involved in shepherding their new ideas farther along the innovation process toward commercialization.

- The role of the Federal laboratories is being broadened to include more cooperation with universities, other nonprofit organizations and industry.

- Protection of intellectual property held by developers of new technologies is being increased and ambiguities in current laws are being clarified.

As a result of the many policy changes introduced by the Administration along with an improving economic climate, we have already seen:

- An increase in private R&D spending, which has recently surpassed Federal R&D spending. (Industry is forecasted to increase its R&D spending for 1983 by 9.7 percent for a total of $41.7 billion. If the forecast holds true, industry will contribute 49.8 percent of total R&D funding. The Federal Government will contribute 46.4 percent, with academia and others making up the balance.)

- A sharp increase in university/industry/state and local government R&D cooperation. (Corporate contributions are estimated to have increased to about 6-7 percent of total academic R&D, or about $400-500 million annually.)

- Major new private sector cooperative R&D ventures. (The Semiconductor Research Corporation, the Microelectronics and Computer Technology Corporation, the American Welding Technology Applications Center and Control Data's CDC Research Limited Partnership are four examples. Many others are in process of formation.)

Within this improved environment the Administration's Stevenson-Wydler initiatives have led to results such as the following:

- o A sharp increase in patenting and licensing of technology by universities and the Federal agencies. (University sources indicate that approximately 33 percent of the growing university patent portfolio is being licensed. Further, the Department's Center for the Utilization of Federal Technology has quadrupled its rate of licensing of Federally owned inventions assigned to the Department since fiscal year 1980.)

- o An upsurge in private sector activity in R&D limited partnerships.

- o Issuance of a Presidential Memorandum on patent policy extending contractor ownership of Federally funded inventions under P. L. 96-517 to performers not covered by that Act as permitted by law.

- o The creation of new roles and organizational structures to intensify the development and utilization of university, nonprofit and Federal laboratory research results.

It is the Department's view that the primary importance of the Stevenson-Wydler Act is in its early anticipation and articulation of the need for increased cooperative R&D and technology transfer as a means of strengthening industrial innovation. The Department has taken action to increase cooperative R&D and technology transfer, but in ways consistent with the policies of this Administration and existing economic circumstances. The Department and the Administration have focused on Government antitrust, patent, procurement, regulatory, research and development and tax policies as the primary means of increasing industrial innovation. By doing so, the Department has implemented the spirit and intent of Stevenson-Wydler and accelerated the rate of achievement of its intended result.

The Department has <u>not</u> implemented the Centers for Industrial Technology authorized by Section 6 or the personnel exchange program envisioned by Section 13. Given the economic environment at the time that these programs were to be initiated, the Department chose to use alternative means of achieving the goals of these sections without the expenditure of the funds authorized. This is discussed in greater detail in the parts of the report covering Section 6 and 13.

Recommendations

The Department now has no specific recommendations for modification of sections 5, 6, 8, 11, 12 and 13 of Stevenson-Wydler, as invited by the Act. The Department's view is that the following actions will increase industrial innovation as the Act intended:

- Passage of the Administration's proposed antitrust legislation removing barriers to cooperative R&D ventures and the procompetitive exercise of intellectual property rights.

- Passage of legislation increasing intellectual property protection for software and microchips.

- Passage of legislation to extend contractor ownership of federally funded inventions, as specified under P.L. 96-517, to Federally funded research and development performers not now covered by that Act.

In addition, the Department is considering the following actions (and the methods for achieving them) as means of heightening cooperative R&D, technology transfer and industrial innovation:

- To the extent not impowered, extending the authority of the Federal agencies' Offices of Research and Technology Applications (ORTAs) to:

  - Enter into cooperative research projects with industry, universities and other nonprofit organizations, including the use of limited partnerships.

  - Administer an incentive program for laboratory inventors, including royalty sharing.

  - Grant patent licenses or assign future invention ownership rights to industry, university or other nonprofit organizations in order to encourage cooperation in Federal laboratory research efforts.

- Developing techniques for use by the ORTAs to aid in determining the commercial potential of new technologies generated in performance of Federal laboratory research.

- Establishing a new category of Federal professional employees to undertake the extended authorities of ORTAs recommended above.

- Developing a training course to increase the invention awareness of research performers and to communicate the essentials of commercialization options which are available to the ORTAs in the Federal agencies and the technology management offices of universities and other nonprofit organizations.

- Developing organizational incentives (including financial) for Federal laboratories, which will strengthen their support of technology transfer and commercialization of laboratory research results.

- Strengthening means by which U. S. industry can participate in determining the Nation's basic research agenda.

- Investigating the advantages of extending the 25 percent R&D incremental tax credit to those that need it most, including new start-up ventures.

Chapter III: Report On Section 5, Commerce and Technological Innovation

Section 5 provides for the establishment of an Office of Industrial Technology and a Director who is required to undertake a number of duties, including studies and policy experiments aimed at strengthening the world position of the United States in generating new technology.

In implementing Section 5, the Secretary of Commerce established the Office of the Assistant Secretary for Productivity, Technology and Innovation (PTI), appointed an Assistant Secretary to head that Office, and charged him with the responsibility for carrying out Commerce's responsibilities under P. L. 96-480. Section 5 activities undertaken by PTI include:

General Policy Initiatives

A series of noninterventionist initiatives taken to remove barriers to innovation and provide incentives for private sector innovation have resulted in:

- Proposed legislation designed to modify the antitrust laws to encourage cooperative R&D by U. S. companies.
- A Memorandum of Understanding with the Federal Laboratory Consortium designed to make easier commercialization of Federally funded technology.
- A Presidential Memorandum requiring all agencies, within their statutory limitations, to grant back to contractors exclusive rights to Government funded technology.
- A major conference that highlighted key issues involving taxes, antitrust barriers and mechanisms for financing the innovation process.
- A President's Commission on Industrial Competitiveness to make specific recommendations on increasing industrial innovation.

- A National Technology Medal to be awarded annually by the President.

- Proposed legislation designed to strengthen intellectual property rights held by developers of software and microchips.

In addition, other initiatives currently being pursued include:

- Review of national manpower shortages of scientists and engineers, and investigation of methods for developing videodisc-computer interactive teaching systems to improve the quality and productivity of education in these areas.

- Analysis of management methods and organizational structures required for greater adaptability to change and for better integration of R&D into the strategic planning process of industrial concerns.

- Strengthening the in-house capabilities of Federal Laboratories to identify technology that has commercial potential and to disseminate it in useful formats to the private sector.

- Integrating and coordinating DOC productivity programs that are now fragmented and sometimes redundant.

- Developing legislation to extend further contractor ownership of Federally funded inventions not now covered under P. L. 96-517.

Industrial Technology Partnerships Program (ITP)

As part of its program to encourage private sector R&D, the Department of Commerce has launched the Industrial Technology Partnership (ITP) program. The principal element in this program is promotion of the use of R&D Limited Partnerships to finance later stage R&D for new products and processes without direct Government funding.

The Research and Development Limited Partnership is a method of financing R&D which is an alternative to direct in-house funding, borrowing, or venture capital funding. The advantages include the following:

- It draws on previously untapped venture capital--rather than more traditional retained earnings or borrowing by corporations--into the financing of R&D.
- It is available to all companies regardless of their cash or competitive position.
- It reduces the risk for producers or other users of process or product innovations by transferring that risk to a large number of limited partners.
- No loss of equity ownership is necessary.
- It allows a scale of effort beyond the risk or cash-floor threshold of the individual companies involved.

The Department of Commerce is encouraging the use of this concept through a number of initiatives, including:

- Preparing and disseminating detailed guidelines for forming RDLPs by large and small companies.
- Sponsoring educational forums for industry associations, universities, research institutes, Government laboratories and individual entrepreneurs. Four regional workshops are being scheduled.
- Clarifying ambiguities in present tax laws with the Treasury Department.
- Conducting competitive assessments of industry trends, of sensitive factors in manufacturing, and of the impact of new technologies on existing businesses, for use by private sector firms and public policy makers.
- Implementing a search and analysis process that packages Federally funded technology for licensing to the private sector.

There is evidence of widespread interest in RDLPs, and a growing number are forming in the 25 million to 100 million dollar range. Financial institutions such as E. F. Hutton and Merrill-Lynch have syndicated open RDLPs without designating specific programs in advance.

Industry Competitiveness Assessments

The Office of the Assistant Secretary of Productivity, Technology and Innovation has carried out six in-depth and thirteen preliminary assessments of selected industries. Eight additional in-depth studies are being scheduled. Results of these sophisticated analyses will be communicated to interested Government agencies and to companies involved in each industry. RDLP consortia are expected to find these studies important for their strategic planning.

Much of the data needed for these assessments is not available in Government data bases and must be gathered from the private sector. A cooperative agreement to develop the required information has been worked out with a nonprofit private sector organization that has access to such data.

National Technical Information Service (NTIS)

NTIS operates the world's largest data base and is the only organization that catalogs in accessible form much of the Federally funded technology that otherwise would be lost to commercial interests. NTIS is now being organized to conduct selective searches of industry-specific technology for licensing by the private sector. The information will be categorized in business portfolio format. It is anticipated that this portfolio can be used routinely to provide a world scan of new developments for use by technology ventures (including RDLPs). NTIS has also reached agreements with many foreign nations to access technical developments in those countries. Translations from foreign languages are performed by NTIS or contractors.

Small Business Innovation Resources Program

This is a new PTI initiative to develop strategies for assisting high technology small business firms to become more competitive by gaining access to information regarding:

- Technologies available for licensing from the Federal Government.
- Financing for innovation and productivity improvement.
- Markets for innovation and new technologies.

- Existing services to aid innovation, such as "business incubators" and technical evaluation of inventions.

- Policy affecting smaller firms involved in innovation and/or technology transfer.

A support network will be developed for small high technology firms. The network will include public and private organizations and resource services that can assist such firms in the innovation process.

Government Patent Policy

On February 18, 1983, the President signed a memorandum directing Federal agencies to extend the policy of contractor ownership of inventions that P. L. 96-517 established for small business and nonprofit organizations to all research and development contractors. This new policy is a major step in ensuring that Government funded technology is available to the private sector for commercial use. In most cases, the inventing contractor is most likely to have the knowledge and motivation to commercialize new technology. The statutes of a few agencies still restrict this policy to some degree, and legislative efforts are under way to remove these last barriers to a uniform Government patent policy.

Chapter IV: Report On Section 6, Centers for Industrial Technology and Section 7, Grants and Cooperative Agreements

Sections 6 and 7 were designed to encourage cooperative R&D by providing seed money to Centers for Industrial Technology (CITs) that are affiliated with a university or other nonprofit institutions.

Initiatives To Establish Cooperative R&D Arrangements

The CITs and accompanying grants envisioned in sections 6 and 7 have not been established. As part of Government-wide budget recisions proposed by President Reagan in fiscal year 1981, the Department proposed and the Congress agreed to rescind the DOC funding for CITs. Instead, the Department decided to attack the key impediment to cooperative R&D arrangements--concerns about antitrust.

The Administration's proposed antitrust legislation, The National Productivity and Innovation Act of 1983, will greatly ease the antitrust constraints on cooperative R&D programs. Once free of the "chilling effect" of antitrust uncertainty, the private sector will be able to design many organizational vehicles for the accomplishment of cooperative R&D without direct Federal Government participation.

Joint ventures often may be necessary to lower the risk and cost associated with R&D. Under the Administration's proposal, so long as ventures do not aid price fixing (through, for example, exchange of information on prices or production levels), or reduce innovation (by, for example, a tacit agreement to underinvest in R&D), the ventures do not violate the antitrust laws. Title II of the bill provides that the courts may not find a joint R&D venture to be illegal in and of itself. Specifically, it will prevent courts from finding that any joint R&D venture violates the antitrust laws without first finding that it actually has anticompetitive effects that outweigh its procompetitive effects.

A second provision of Title II provides that firms operating a joint R&D venture that has been fully disclosed to the Department of Justice and the Federal Trade Commission may be sued only for the amount of the actual damage caused by any anticompetitive conduct, plus prejudgment interest. Currently, an injured private party who wins an antitrust damage suit is automatically entitled to treble damages. The threat of such suits may inhibit the formation of joint R&D. The Administration's proposed changes should encourage the formation of procompetitive joint R&D ventures, and, unlike some other proposals currently before Congress, they will do so with minimal administrative requirements.

The Administration's proposal deliberately excludes restrictive clauses, such as compulsory licensing of research results of the cooperative venture after a certain period, as proposed in other legislation. While compulsory licensing may not be unreasonable for the electronics industry, where the average life cycle of a new product is now three to five years, for pharmaceuticals or specialty chemicals it might create a substantial disincentive to cooperative R&D, because the FDA or other regulatory clearance process may take five to ten years.

Even prior to passage of this new legislation, the private sector has formed unique cooperative research organizations such as the Microelectronic Computer Corporation and the Semiconductor Research Corporation. After the passage of the new legislation, cooperative R&D activity should increase sharply, mobilizing large gains in private funding. More importantly, the projects undertaken will likely include those beyond the financial or technical capability of even the largest firms alone, i.e., those that otherwise would probably never be undertaken at all.

In addition to the antitrust initiative, the tax incentives in the Economic Recovery Tax Act (ERTA) of 1981, which include the incremental R&D tax credit and the tax credits for contributions of equipment to universities, have been created to encourage increased R&D. Using the tax system rather than direct funding, the Administration believes it can stimulate industrial growth in an even-handed way and avoid a direct role in private sector decision-making, including avoidance of the Government choosing winning technologies.

Taken together, the tax and antitrust initiatives, along with the Industrial Technology Partnership program (RDLP) for later-stage R&D, represent a package which implements the overall objectives of Sections 6 and 7 of P. L. 96-480.

Centers for Industrial Technology are forming without direct Government funding. Many universities are developing Technology Management Offices that have undertaken many of the activities intended for CITs. The pace of developing these offices has accelerated since enactment of P.L. 96-517 in response to the requirement to manage and license inventions resulting from Federal R&D funding that the university chooses to own in accordance with the Act. Preliminary reports indicate a significant surge of disclosures of such inventions since enactment of P.L. 96-517. In addition to patent licensing, many of these offices have become involved in other aspects of industry/university cooperation similar to those anticipated by Section 6. This is due, in part, to their authority to consummate cooperative R&D ventures with industry that involve the transfer of future invention rights on an exclusive basis. Once accepted as a communications path, these offices are being asked by industry and university investigators to help develop more complex arrangements, e.g., the Monsanto-Washington University (St. Louis) agreement.

Based on the activities of the more successful university Technology Management Offices, it appears that an ideal office has the authority and ability to at least:

- Identify, evaluate, protect and disseminate information on new university technologies.
- Promote commercial use of and respond to industry inquiries concerning new technologies produced by the university, which may lead to new business ventures.
- Alert university research management to industrial needs, particularly those of small business.
- Fund research from royalty receipts.
- Seek venture capital.
- Enter into cooperative research projects, including limited partnerships.

- o Establish policies encouraging employee-inventor start-ups and follow-on participation.
- o Share royalties with inventors and the research organization.
- o Conduct training on invention, entrepreneurship and industrial innovation.
- o Assess potential conflicts of interest.
- o Grant patent licenses or assign future invention ownership rights as an incentive for industry cooperation in developing, participating in, or contributing resources for further laboratory research efforts.

This range of activities is much like the expanded role that the Department of Commerce foresees for the Federal laboratory Offices of Research and Technology Applications (ORTAs) created under Section 11 of Stevenson-Wydler Act.

Relatively few of the hundreds of university Technology Management Offices presently have this full range of authorities and abilities. The Department's view is that the Government has a significant opportunity to support the intent of Section 6 by providing technical assistance for the Technology Management Offices of universities and other nonprofit organizations that request it. Accordingly, the Department is examining techniques that may take the form of training courses to teach invention awareness to research performers and convey commercialization techniques to university and nonprofit Technology Management Offices.

Chapter V: Report On Section 8, National Science Foundation Centers For Industrial Technology

Section 8 Provides for NSF Centers for Industrial Technology.

The following charts summarize NSF's activities in supporting Centers for Industrial Technology. NSF funding in this area was at the $2.0M level in FY 1983 and is projected to be $3.0M in FY 1984.

NATIONAL SCIENCE FOUNDATION UNIVERSITY/INDUSTRY CENTERS.

LOCATION	SCIENCE AREA	DEGREE OF SELF SUFFICIENCY (% of Funding By Industry - Balance is Funded By NSF)
Massachusetts Institute of Technology	Polymers (Processing)	100
	Computer Graphics	80
Rensselaer Polytechnic		
Case-Western Reserve University	Polymers (applied)	70
Ohio State University	Welding	70
University of Massachusetts	Polymers (properties)	75
University of Rhode Island	Robotics	75
North Carolina State University	Telecommunications	70
Rutgers University	Ceramics	70
Georgia Institute of Technology	Materials Handling	80
Worchester Polytechnic Institute	Automation Technology	50
Texas A&M University	Hydrogen Technology	50
Pennsylvania State University	Dielectrics	60

(NOTE) ANNUAL INDUSTRY FUNDING FOR EACH CENTER IS USUALLY BETWEEN $500,000 and $1,000,000, WITH BETWEEN 5 AND 30 INDUSTRIAL PARTICIPANTS.

NSF CENTERS BEING PLANNED

LOCATION	SCIENCE AREA
West Virginia University	Fluidized Beds
University of Cincinnati	Digital Processing
University of Wisconsin	Biotechnology
Northwestern University	Tribology
University of Arizona	Microcontamination Control
Duke University and University of North Carolina	Biotechnology

Chapter VI: Report On Section 11, Use of Federal Technology

Section 11 provides for a central focus in the Department of Commerce and for the establishment of offices in the Federal laboratories to transfer Federally owned or originated technology to state and local governments and to the private sector.

X Center for the Utilization of Federal Technology (CUFT)

CUFT was established within the National Technical Information Service of the U. S. Department of Commerce in June 1981. It received appropriated funding in January 1983. The CUFT program is directed to:

- Encourage agency technology evaluation efforts;
- Improve the public's online access to technology furnished to CUFT by the Federal laboratories;
- Promote private sector and local government awareness of Federal laboratory technology;
- Encourage the licensing of Federally owned inventions through the patent licensing function attached to CUFT;
- Highlight Federal laboratory technology having significant potential for commercialization;
- Maintain a directory of Government technology transfer personnel.

A variety of products and services have been planned and developed to improve industry access to Federal laboratory technology, including:

- Tech Notes: A monthly subscription service alerting readers to the latest technology from the Federal laboratories through one or two page fact sheets describing new processes, equipment, materials, and techniques with potential commercial or other practical application.
- Federal Technology Catalog: An index of more than 1,200 new technologies identified by Federal laboratories.

- Catalogs of Government Patents: A listing of Federally owned and patented inventions available for licensing.

- Government Inventions for Licensing Abstract Newsletter: A weekly subscription newsletter summarizing Federally owned inventions divided into 11 categories. When appropriate, a drawing of the invention is also provided.

- Directory of Federal Technology Resources: This directory, available in early 1984, will describe special technical resources provided by the Federal agencies and their laboratories. It will include equipment for sharing, technical information centers, laboratory contacts available for technology interchange, software sources, information analysis centers, and other services.

- Federal Technology Transfer-Online. A Reference Guide: A free service provided to online computer searchers interested in Tech Notes or information on Federally owned inventions. This service explains how to receive this information by computer.

CUFT personnel are involved in a number of other projects, including:

- Cooperation with the Federal Laboratory Consortium in order to develop working relationships with agency technology transfer personnel.

- Contacting small business associations, state innovation groups and trade journals, to emphasize the availability of Federal laboratories technology.

Research and Technology Application Offices

Section 11 requires each laboratory to establish an Office of Research and Technology Applications (ORTA) to assist the laboratory in the transfer of its technology. The Appendix to this report summarizes information provided by the agencies on the technology transfer activities undertaken by their ORTAs.

A major function of the ORTAs is to prepare application assessments of R&D projects that have potential for application to state and local government or industry. Notwithstanding the ORTA's assignment, the lack of uniform guidelines, criteria, and processes in preparing application assessments appears to have produced difficulty in determining and communicating a new technology's commercial potential. This may be particularly true when the process involves finding secondary uses for technology developed primarily to meet a unique Government need.

A second function of the ORTAs is actual transfer of technology. Technology can be transferred in two basic forms:

- Information--which includes advice, technical assistance, reports, and other forms of aid. This is usually provided at minimal or no cost and is based on work already performed in the laboratory system.

- Intellectual Property--which includes patents, copyrights, technical data, rights to future inventions, and other forms of technology that can be owned, protected, assigned, or otherwise controlled.

Information

A review of the agency activities outlined in the Appendix indicates that most ORTAs have concentrated on information transfers. These are less formal, easier to arrange, and appear more consistent with the wording of Section 11.

Intellectual Property

Though the ORTAs have performed valuable services regarding the information form of technology transfer, they have been less involved in intellectual property transfer. Yet opportunities to help create new products, large numbers of new jobs, and even new industries are likely to come primarily from intellectual property transfers because investment recovery and profits often depend on ownership or control of the technology being developed.

Patent licensing is the type of intellectual property transfer most used at the Federal agency level as a private sector incentive for development of Federal laboratory inventions. This is done primarily on a centralized basis, either by the patent staffs at agency headquarters or the patent licensing function attached to the Center for Utilization of Federal Technology.

Successful promotion of some inventions may require the resources of centralized licensing organizations with access to potential nationwide and international users. For example, centralized licensing offices can target advertising of specific technologies for ORTAs (which could handle other aspects of the transfer), as well as provide advice and training to the ORTAs.

The following problems, however, have been observed:

- o There have been misinterpretations that the licensing provisions of P. L. 96-517 require nonexclusive licensing if more than one firm applies for a license.
- o Centralized licensing offices tend to concentrate on inventions that meet a known commercial need and are the easiest to sell. These offices may do less well than decentralized operations at the laboratory level in becoming advocates and market creators for technologies that were not developed to meet a specific private sector need or are more suitable for development by start-up companies.

ORTAs (and licensing offices) which are decentralized have natural advantages for some types of technology transfer because of their immediate proximity to the laboratories. Laboratory research could be more effectively transferred to industry by a "full service" ORTA performing the following functions:

- Identifying, evaluating, and arranging for protection of new technologies.
- Promoting commercial use of the new technologies produced by the laboratory which may lead to new business ventures.
- Coordinating with ORTAs of other laboratories, when necessary, to meet the needs of industry for Federal technologies from more than one source.
- Recommending research to meet market needs.
- Seeking venture capital to help start-up ventures.
- Entering into collaborative research projects with industry, including limited partnerships.
- Administering policies that encourage employee-inventor start-ups and follow-on participation.
- Administering a royalty sharing program with laboratory inventors and with any part of the laboratory deemed to have contributed to the invention which generates the royalties.
- Training and instructing on invention, entrepreneurship and industrial innovation.
- Assessing and advising on potential conflicts of interest.
- Granting patent licenses or assigning future invention ownership rights as an incentive for industry cooperation in developing, participating in, or contributing resources for further laboratory research efforts.

These functions are much like those performed by the ORTA counterpart offices in universities.

It appears to be no accident that technology complexes such as Silicon Valley, Route 128, Research Triangle, and Princeton's Forrestal Center have evolved around major universities. Direct access to the university and the university's right to transfer the results of its research on an exclusive basis is an important incentive for business to invest in the further

development and commercialization of new technologies. In contrast, Federal laboratories generally have not served as nuclei for similar arrangements. They often perceive themselves as unable to enter into cooperative development arrangements because of organizational and legal restraints. This is one reason why national reviews of Federal laboratories have concluded that too little of the results of laboratory research is used in the private sector.

The present authorities of most ORTAs are limited and unclear. In order to perform the full range of desirable functions discussed above, consideration should be given to augmenting the ORTA role as follows:

- Authority to negotiate the assignment or licensing of Government-owned inventions.
- Authority to negotiate arrangements that include disposition of future research results on an exclusive basis, acceptance of private sector funding, and formation of Government/private sector research teams.
- Authority to administer incentives to Federal employee inventors, including royalty sharing and the right of employees to own inventions that neither the Government nor a participating private sector organization plans to commercialize.
- Authority (with appropriate limits) to arrange for Federal employee inventors to participate in the future development of an invention outside of the lab when this is necessary for successful commercialization.

In addition, it may be useful to establish a system of organizational incentives that encourages the laboratories to support technology transfer and commercialization. One element could be retention by the laboratories, (e.g. the Director's Office) of part of the royalties to use for future research. Care must be exercised to ensure that budgetary controls are not weakened and that a proper balance is maintained between Federal research missions and commercialization efforts.

Further, techniques should be developed and made available to the ORTAs to help evaluate the commercial potential of new technologies. These are particularly necessary to evaluate ideas that were not developed to meet a known private sector need.

Finally, in order for the ORTAs to achieve their full potential, trained professionals will be needed to engage in technology transfer. The Department recommends consideration of a new category of professional employees, entitled, "Federal Technology Managers" (or another appropriate title) to implement the new authorities outlined above. The Department suggests that previous legal, engineering, technology transfer and product development experience be taken into full account when filling positions and making promotions in this new category of professional employees. These ORTA officials would work directly in the laboratories to stimulate collaboration with the private sector and would be key elements in spinning off important discoveries to industry. The "Federal Technology Managers" would function as a critical liaison between the research professionals employed in the laboratories and the private sector.

Chapter VII: Report On Section 12, National Technology Medal

Section 12 provides for the establishment of a National Technology medal which is to be awarded periodically by the President to individuals or companies for outstanding contributions to the promotion of technology or technological manpower.

Procedures for the selection of recipients of the Medal are in effect. A Steering Committee, chaired by the Assistant Secretary for Productivity,Technology and Innovation, solicits nominations and refers them to an Evaluation Committee, currently being chartered under the Federal Advisory Committee Act. Recommendations for awards are forwarded to the Secretary through the Steering Committee.

A Press Release soliciting nominations for the Medals was released August 17, 1983, with nominations to be received between September 1 and November 30, 1983, and between May 1 and July 31 of succeeding years.

The first Medals are expected to be awarded in the Spring of 1984.

Chapter VIII: Report On Section 13, Personnel Exchanges

Section 13 provides that the Secretary of Commerce and the National Science Foundation (NSF) jointly shall establish a program to foster exchange of scientific and technical personnel among academia, industry, and Federal laboratories. In light of similar programs already being run independently by Commerce and NSF, no action has been taken to implement this Section.

APPENDIX: SUMMARY OF AGENCY REPORTS ON OFFICE OF RESEARCH AND TECHNOLOGY APPLICATION (ORTA) ACTIVITIES

Introduction

In addition to the reporting requirements for the Department of Commerce under Section 5(d), agencies are required by Section 11(e) to report as follows:

> "Each Federal agency which operates or directs one or more Federal laboratories shall prepare biennially a report summarizing the activities performed by that agency and its Federal laboratories pursuant to the provisions of this section. The report shall be transmitted to the Center for the Utilization of Federal Technology by November 1 of each year in which it is due."

The Secretary of Commerce requested that relevant Federal agencies submit the report required by Section 11 of the Act for the two-year period October 1, 1980, to September 30, 1982. Summaries of these reports, which include brief descriptions of each program and some achievements, are provided in this Appendix.

Section 11 requires that each Federal laboratory establish an Office of Research and Technology Applications (ORTA). Further, each laboratory with a total annual budget in excess of $20 million shall provide at least one professional full-time individual to staff the ORTA; and beginning in FY 1982, each Federal agency directing a laboratory shall make available not less than 0.5 percent of the agency research and development budget to support technology transfer, including operation of the ORTA. The Act assigns the following four functions to an ORTA:

1. Assess each R&D project which has potential for successful application in state or local government, or in private industry;

2. Provide and disseminate information on Federally owned/originated products, processes, or services having potential for application in state or local government, or in private industry;

3. Cooperate with the Center for the Utilization of Federal Technology and other appropriate organizations to link Federal R&D as a whole to potential users; and

4. Provide technical assistance when requested by state and local government officials.

Because this is a relatively new effort for many laboratories, there is insufficient information to develop any type of Government wide evaluation measure of technology transfer effectiveness. It is clear, however, that within Federal agencies there is a wide range of definitions and anticipated results for the technology transfer process. Most agencies have a technology transfer program for the movement of mission-oriented research to mission-oriented application. But, there are very few agencies that look for "spin-off" applications and attempt to seek application of their research beyond the original mission.

The greatest effort being exerted by many agencies is in the processing and dissemination of written information. Much of the dissemination is done through publications/communications groups unique to the agency and directed to an agency mission-targeted audience. Also, there is some evidence that information dissemination is believed to be sufficient, in and of itself, to effect technology transfer.

The primary examples of cooperative efforts with industry are participation by laboratory representatives at workshops and meetings. In addition, although there are references to the performance of the technology application assessment function of the ORTA, there seems to be some uncertainty regarding the appropriate method to produce the assessment and its ultimate use.

Finally, many agencies reported dedication of major resources--both budget dollars and personnel time--to the technology transfer function. Few agencies reported active, long range planning and/or evaluation efforts directed toward achieving a satisfactory level of performance or developing the most cost effective program.

Summaries of the agency reports are provided below:

U. S. DEPARTMENT OF AGRICULTURE (USDA)

Two agencies of the U. S. Department of Agriculture (the Agricultural Research Service and the Forest Service) operate Federal laboratories. For many years the USDA has utilized the Federal-State Cooperative Extension Service and State and Private Forestry System to transfer technology rapidly and successfully. Additional steps have been taken to implement the requirements of the Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480) as follows:

Agricultural Research Service (ARS)

Since the passage of P.L. 96-480, the ARS has appointed an Assistant Director from the Northern Regional Research Center to coordinate the technology transfer activities in the four large Regional Research Centers. Recently, a Science and Technology Applications Coordinator was appointed to plan, oversee and coordinate the ARS technology transfer activities at the Headquarters level. A plan to achieve full compliance with P.L. 96-480 has been drafted and will be incorporated into the new ARS organizational structure.

Achievements Reported

- A safer and more effective vaccine for foot and mouth disease (FMD) has been made possible by breakthrough research in genetic engineering. The vaccines resulting from this technology will help the U.S. stockpile vaccine, produce an annual savings of billions of dollars in countries with FMD, reduce barriers to international trade, and increase the world supply of meat.

- Caseous lumphadenitis abscesses caused by the bacteria Corynebacterium ovis is one of the most important worldwide diseases of sheep and goats. ARS developed an antibody test that indicates past or present infection. The test, which uses an enzyme as an indicator, is simple, economic, fast and nonhazardous.

- Fast-food merchandising and salad bars have greatly increased demand for mild-flavored onions. Unfortunately, such onions neither store well nor are adapted to northern producing areas. ARS scientists produced a new nonpungent, high-yielding hybrid with good storage quality. Wide-scale testing has generated enthusiastic response, and export potential may be significant.

- Of the 32 ARS patents transferred to NTIS, four exclusive and 28 non-exclusive licenses have been granted. The patents include "Anti-Feedant for Boll Weevils," "Preparation of Frozen Quick Cooking Legumes," and "Tool for Welding Plastics." The patents have been licensed to such companies as Pennwalt Corp., Metal Recovery System, and Amity Soyfoods, Inc.

Forest Service (FS)

In 1978, the Forest Service (FS) established an organizational unit similar to that called for in P.L. 96-480. Following passage of P.L. 96-480, the unit was designed as the FS Office of Research and Technology Application (ORTA). Located in the Area Planning Development Staff of the State and Private Forestry branch in the Washington Office, the ORTA is responsible for FS-wide technology transfer activities. The ORTA is staffed by one full-time professional and a staff technician.

Achievements Reported

- Builders in 27 states are using or have expressed interest in a Truss-Framed Building System developed by the FS Forest Products Laboratory. More than 1,300 homes have been constructed using this system, which provides savings in the use of wood and wood base materials.

- The Forest Products Laboratory developed the concept of press drying paper which will permit paper manufacturers to use 100 percent hardwood pulp for linerboard for the first time. Several commercial laboratories have built press dryers to test research concepts to demonstrate the research. Black and Clawson, a paper machine manufacturer, is developing a press dryer for the commercial market.

- The states of Maryland and Minnesota are using the Timber Inventory/Management Information Planning System which was developed by Forest Service researchers to assist landowners of small private forests. Five other states are considering the use of this system.

U. S. DEPARTMENT OF COMMERCE

Four agencies of the United States Department of Commerce are covered by the requirements of the Stevenson-Wydler Technology Innovation Act of 1980. These agenices are the National Bureau of Standards, the National Oceanic and Atmospheric Administration, the National Telecommunications and Information Administration, and the National Technical Information Service. Except for the National Technical Information Service, the other three have laboratory facilities.

National Bureau of Standards

The National Bureau of Standards (NBS) established the Office of Research and Technology Applications (ORTA) on March 1, 1981. The intent was to augment and exploit NBS activities to make Federal technology readily accessible to private industry and state and local governments.

The FY 1982 direct budget of the office was $.25M, excluding the cost of administering the Visiting Committee and the Evaluation Panels. In FY 1982, $16M within NBS was dedicated to implementing technology transfer under the functions of the ORTA.

Achievements Reported

- The ORTA staff addressed each NBS R&D project and found 216 projects with potential value to U.S. industry. These projects were disclosed to members of the Industrial Research Institute and many other U.S. firms at meetings of their respective industry associations.

- NBS reports that inquiries about Federal technology are at an all-time high, particularly regarding the NBS Industrial Research Associate Program. During FY 1981, NBS had 41 Research Associate programs with 124 Research Associates. During FY 1982, there were 44 programs with 121 Research Associates from such U.S. firms as Allen-Bradley, Structural Dynamics Research Corporation, Mobil Research and Development Corporation, Rheology Research, Hardinge Brothers, Johnson Controls, Exxon Chemical Company, and General Electric.

- To further assist industry and state and local governments to acquire Federal technology, the NBS ORTA aided the Federal Laboratory Consortium in developing a "Tools of the Trade" primer and prepared a "Directory of Federal

Laboratories". ORTA supported the Model Interstate Information Clearinghouse (MISTIC) of the National Conference of State Legislatures, arranged for computer conferencing between NBS and state legislatures through Legitech, and provided numerous responses to inquiries from local officials. Finally, the ORTA assisted Pennsylvania, Ohio, and Maryland officials in arranging regional meetings on the availability of technology from various Federal laboratories which might be useful to local businesses.

National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) conducts a wide range of research and development activities. Five NOAA Line Organizations (LOs) contribute to the total NOAA R&D effort, each concentrating in its area of mission responsibility. The five LOs are:

- Office of Oceanic and Atmospheric Research (OAR)
- National Weather Service (NWS)
- National Ocean Service (NOS)
- National Marine Fisheries Service (NMFS)
- National Environmental Satellite, Data, and Information Service (NESDIS)

To ensure an integrated and coordinated agency response to P.L. 96-480, NOAA has established a Technology Transfer Working Group consisting of a representative from each of the LOs.

Assessment of the potential for nonFederal application of NOAA R&D and technology is done at the source, (i.e., at the laboratories, centers, and R&D project offices). A designated ORTA contact at each NOAA R&D facility is responsible for the routine assessment of R&D projects at the facility and for the preparation of application assessment abstracts for dissemination.

Achievements

NOAA has established a technology transfer program to ensure the agency's compliance with both the spirit and letter of P.L. 96-480. Listed below in chronological order are the events which led to the implementation of the program:

- In April 1982 the Deputy Administrator of NOAA assigned responsibility for the development of a NOAA program to the Environmental Data and Information Service and directed the formation of a Working Group to coordinate program planning.

- During the summer and fall of 1982, the Working Group developed interim plans and conducted a pilot program to test them. All NOAA R&D activities were assessed to determine the potential for nonFederal application of the research, and over 130 Application Assessment Abstracts were submitted to the Working Group by NOAA's laboratories, centers, and R&D project offices.

- In January 1983, a full-time ORTA was established in the NESDIS Office of External Relations. A long-term NOAA Technology Transfer Program Plan was completed in May and approved in June 1983.

- In July 1983, a full-time Technology Transfer Specialist was added to the NOAA ORTA staff.

- NOAA joined the Federal Laboratory Consortium in July 1983. NOAA also established contacts with other Federal and state technology transfer organizations.

National Telecommunications and Information Administration

The Institute for Telecommunication Sciences (ITS) is the chief research and engineering arm of the National Telecommunications and Information Administration (NTIA).

ITS allocated approximately $15,000 per year to assure dissemination of research reports through its Technical Publications Office. In addition, ITS has allocated approximately $100,000 over FY 1981 and FY 1982 to make available computer programs to aid the private sector in planning and operating various communications systems.

Achievements Reported

- During 1981, ITS efforts facilitated approval by the Federal Communications Commission (FCC) of applications to offer direct broadcast satellite service. The deployment of direct broadcast satellite systems in the U.S. could result in very substantial new demand for satellite earth terminals and related equipment.

- Beginning in 1980, and continuing to the present, ITS has worked to develop technically feasible means by which the hours of operation of small daytime-only radio broadcasting stations could be significantly improved and their numbers increased. ITS technical expertise and research also played an important role in U.S. preparation for the 1982 World Administrative Radio Plenipotentiary Conference.

National Technical Information Services (NTIS)

The National Technical Information Service (NTIS) plays a major role in the development of advanced information products and services for the achievement of U.S. productivity and innovation goals in the 1980's. NTIS is the central source for the public sale of U.S. Government-sponsored research, development, and engineering reports, software, and other analyses prepared by Federal agencies, their contractors or grantees. Its program supplements technology transfer activities of all Government agencies.

Since NTIS is not a laboratory and funds no research, it does not have an Office of Research and Technology Application (ORTA). The NTIS budget involved in technology transfer was approximately $16.7M in FY 1982. This included the functions of the Center for the Utilization of Federal Technology (CUFT) and the Office of Government Inventions and Patents.

Achievements Reported

- In its interagency patent licensing program, NTIS negotiated and granted over 40 patent licenses in FY 1983 on behalf of HHS, Commerce, USDA, and Interior, which represents a 50 percent increase over FY 1982. Royalty revenue increased five-fold to the $800,000 level, making the program self-supporting. This includes costs of creating and maintaining a large foreign patent portfolio for licensing to U.S. industry. Proposed development plans submitted with applications for 49 of the licenses granted in the last two years committed $139.8 million in further private sector R&D to commercialize these Government inventions. New CUFT information products introduced in 1983 included:

- The Federal Technology Catalog,
- Federal Technology Transfer-On line, and
- Directory of Agency and Laboratory Technology Transfer Contacts.

NTIS PATENT LICENSES GRANTED FY 1981 - FY 1992

(Title)	
Department of Agriculture	
Nematocide	Pennwalt
Particle Board	Purdue Research Foundation
Pueromone Insecticide	Albany International
Insect Maturation Inhibitors	Stauffer Chemical
Boll Weevil Antifeedant	Bio-Systems Research
Department of Army	
Cellulase Producing Microorganism	IFP
Department of Commerce	
Clear Air Turbulence Detector	Bendix Corporation
Laser Wavelength Meter	Lasertechnics Inc.
Ultrablack Coating	Ball Corporation
Frequency Stablization	Efratom Systems Inc.
Cryptographic Key Notorization	P.E. Systems Inc.
Rotating Tool Wear Monitor	Valeron Corporation
Echometric Remote Temperature Measurement	Radian Corporation
Contrast Resolution Ultra Sound Testing	Nuclear Associates
Department of Health & Human Services	
Fecalator	Marion Scientific
Assay for Benzodiazapines	Neuobiological Sciences
Interferon Inducer	Behringwerke
Chromatographic Instruments	Buechi Laboratories Knots

HHS (cont'd)

(Title)	
Fiber Optic Probe	Advanced Technical Labs
Zwitterionic Detergent	Calbiochem Pierce Chemical Poly Sciences
Clot Lysing Timer	Beecher Co.
Oral Acne Drug (13 - cis retinoic acid)	Ortho Pharmaceutical Westwood Pharmaceutical McNeil Pharmaceutical Dermik Pharmaceutical
Toluidine Blue Rinse (Oral Cancer Detector)	Block Drug
Non-A, Non-B Hepatitis Detection	North American Biologicals Abbott Laboratories
Large Unilamellar Vesicles	Abbott Laboratories
Monclonal Antibodies against Herpes Virus	Abbott Lab. Cooper Biomedical
Blood Cell Separator	IBM Corp.
Countercurrent Extraction Apparatus	P.C. Inc.
Insulin Infusion Apparatus	Nordisk
Silver Stains for Protein	Electro-Nucleonics
N-Acetyl Cysteine Prevention of Cardiac Damage in Cancer Therapy	Mead Johnson

Department of Interior

Modified Sulfur Cement	Chevron Research FB Coatings JA Reece Inc. Sulcon. Inc. Chemical Enterprises

Veterans Administration

PALA Platinum Antineoplastics Drug	Adria Lab. Behringwerke, AG.

U. S. DEPARTMENT OF DEFENSE (DOD)

The Department of Defense (DOD) is the Federal agency responsible for the management control of the three Military Services. In fulfilling the requirements of the Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480), the DOD has waived the full-time staffing and monetary set-aside requirements for the Military Services, but has directed them to individually establish mechanisms to comply with the law, including establishment of Offices of Research and Technology Applications (ORTA).

Department of the Navy

The Navy has had a formal technology transfer program for over ten years and had been transferring technology to the civilian sector on an ad hoc basis for many years before that. Following passage of P.L. 96-480, ORTAs were created for the ten major R&D activities to ensure compliance with the law. Further, a series of major policy statements has been issued regarding the Navy domestic technology transfer program.

An estimate of the FY 1982 cost of performing the ORTA function at each major R&D activity is shown in the table below, including cost estimates for coordinating the program and funding domestic technology transfer demonstration projects. These costs are expected to increase as awareness of the program increases.

Department of Navy
FY 82 ($ K)

Laboratory	ORTA Cost
Naval Air Development Center	80
Naval Coastal Systems Center	5
Naval Ocean Systems Center	40
Naval Personnel Research and Development Center	40
David Taylor Naval Ship Research and Development Center	80
Naval Surface Weapons Center	20
Naval Underwater Systems Center	80

Naval Weapons Center	30
Naval Research Laboratory	120
Naval Ocean Research and Development Activity	2
	$ 497

Navy-Wide Technology Transfer

Publications and Exhibits	160
Demonstration Projects	70
Industry Information	300
	$ 530
TOTAL	$1,027

The publication of thousands of in-house Navy and Navy-sponsored technical reports is the largest and most significant technique used by the Navy. Many Navy activities publish annual listings of their technical output.

Achievements Reported

- The Naval Underwater Center (NUSC) initiated the Technical Volunteer Service (TVS) whereby nearly 400 volunteers provide information, assistance and advice to local Governments. Two other Navy laboratories will initiate TVS programs in FY 1983 and several other Federal laboratories are exploring the concept.

- The Navy Personnel R&D Center (NPRDC), which is developing more effective methods and procedures for teaching Basic Skills, produced a computer software package for the teaching of vocabulary and reading comprehension. In response to a request from the San Diego Community College, technical assistance from NPRDC resulted in competency-based adult education classes in the Community College District.

- The Navy performs manufacturing technology projects to demonstrate production feasibility by industry of critically needed items. Successful transfer projects during FY 1981 and FY 1982 include:

  - Naval Research Laboratory -- laser welding, ion beam milling, ion implanation;

- Naval Surface Weapons Center -- graphite-aluminum tape and tooling, laser hardening of cams; and

- Naval Ocean Systems Center -- fiber optic digital receiver modules, high radiance light emitting diodes, automate layout of circuits.

o Patented Navy inventions are licensed on both a limited and nonexclusive basis. Two examples of limited exclusive licenses include:

  - Naval Ocean Systems Center developed a decompression computer which can be worn on a diver's wrist to provide the diver with both his current depth and safe-ascent depth; and

  - Naval Surface Weapons Center developed a pyrotechnic chemical composition which can be used in an underwater incendiary cutting torch.

Department of Army

The Director of Army Research in the Office of the Deputy Chief of Staff for Research, Development and Acquisition is responsible for managing the technology transfer function. Management actions during the reporting period include:

o Army Regulation 70-57, which mandates the technology transfer activity and was revised in August 1982 to emphasize provisions of the Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480);

o Meetings in May and November of 1982 to coordinate technology transfer functions;

o Identification of thirty-five Army laboratories as requiring Offices of Research and Technology Applications (ORTA). These laboratories have been notified of the Army's support of the fulfillment of P.L. 96-480 and informed that beginning in 1983 each laboratory organization chart must show the ORTA and a direct point of contact; and

o Establishment and funding of two tasks (beginning in November 1982) to support the central management of the technology transfer function.

Achievements Reported

- Pattern recognition techniques were applied to epidemiological analysis of patterns in Sudden-Infant-Death syndrome.

- An instrument developed to provide a rapid, more effective means of presurgical hand and arm scrub by operatory personnel is now commercially available.

- A Toxic Corridor Prediction (TOXCOP) Program developed to graphically depict downwind hazards resulting from accidental release of toxic chemicals has been used by a California city to design evacuation plans in event of major fires or chemical spills.

Department of the Air Force

In August 1981, the U.S. Air Force established an ORTA at each of its ten laboratories. All four of the ORTA technology transfer functions given in the Stevenson-Wydler Technology Innovation Act of 1980 are vested in the established ORTA. There are no ORTA personnel devoted exclusively to technology transfer. Since technology transfer is part of the overall mission of the laboratory, it is difficult to estimate either the amount of time or money dedicated to this activity.

In March 1982, Air Force Systems Command Regulation 80-25, "Technology Management Reviews", was revised to require that the Program Manager at each laboratory perform the technology application assessment mandated in P.L. 96-480. The Program Manager, after preparing the assessment, works with the ORTA to devise a plan to transfer the technology.

Achievements Reported

- The Aerospace Medical Division (AMD) has developed the Subjective Workload Assessment Technique (SWAT), a computer program made available to several private and educational institutions. The program focuses on behavioral workload assessment. To date, AMD has transferred the program to Hughes Aircraft, Douglas Aircraft, Lockheed, Boeing, BDM Corporation and Arizona State University.

- The AMD Integrated Sizing System and drawing board mannequins have been used by several clothing merchandising companies, e.g., Sears, Roebuck and Company, in establishing sizing data for military as well as civilian use.

- The AlLiMo thermal battery concept, formulated at the Frank J. Seiler Research Laboratory, was put out on developmental contract to Eureka Corporation of Illinois. The thermal batteries could be used on any system having short-term high power requirements with extremely high reliability.

- At least one small business has been started using an instrument developed at the Rome Air Development Center for the measurement of moisture content in integrated circuit packages.

- The Air Force Engineering and Services Center has provided technical consultations to the cities of Phoenix, Arizona; Natchez, Mississippi; Rockville, Maryland; Jacksonville, Florida; Madison, Wisconsin; North Miami Beach, Florida; and Escambia County, Florida; Broward County, Florida; Land of Sky Regions Council, North Carolina; the University of Kentucky; Ridgeways Chemicals, Inc.; and numerous other agencies.

U. S. DEPARTMENT OF ENERGY (DOE)

The Department of Energy (DOE) is organized to implement technology transfer through the 37 national multiprogram and program dedicated laboratories. The Office of Energy Research is responsible for Headquarters oversight and management of the program.

On March 25, 1982, DOE order 5800.1 "Research and Development Laboratory Technology Transfer Program", was issued to ensure that technology transfer is integrated into the operations of each R&D laboratory. The order details the objectives of the program and incorporates the technology transfer program into the existing laboratory planning and oversight process.

Each laboratory has an Office of Research and Technology Applications (ORTA) or equivalent. Those laboratories with an annual budget in excess of $20 million have a full-time professional devoted to the management of the program.

Achievements Reported

- An ultrathinning technique developed by the Pacific Northwest Laboratory was transferred to the Medical College of Georgia to aid in examination of calicified tissues.

- Sandia National Laboratories designed an electronically controlled pump, derived from weapon technology, that has provided reliable insulin delivery when implanted in diabetic patients. Design and know-how is being transferred to medical equipment manufacturers.

- A geothermal power plant simulation computer program "GEOTHM" has been developed by Lawrence Berkeley Laboratory. It includes models of the properties of geothermal and geopressured brines at high temperatures. Bechtel has used the program in designing two geothermal power plants, one of which is now under construction in the Imperial Valley of California.

- The Morgantown Energy Technology Center has helped the transfer to private industry of state-of-the-art simulation technology for large coal conversion process plants by the completion and delivery of the Advanced System for Process Engineering (ASPEN) software package. Developed by MIT under contract to Morgantown, the package is available through the National Energy Software Center and from the National Technical Information Service.

- Ames National Laboratory estimates an annual sales level of $100 million over 1,500 installations for the Inductively and Coupled Plasma-Atomic Emission Spectrograph developed at the laboratory.

- Los Alamos National Laboratory estimates over $800,000 in business by six instrument manufacturers from laboratory invented technology.

- Oak Ridge National Laboratory estimates that over $200 million has been invested by industry since 1978 in the uranium extraction process developed at the laboratory.

U. S. DEPARTMENT OF HEALTH AND HUMAN SERVICES (DHHS)

Within the Department of Health and Human Services (DHHS), the Public Health Service (PHS) is the only component that funds Federal laboratories for research and development as defined by the Stevenson-Wydler Technology Innovation Act. The PHS supports biomedical technology-related activities which include the conduct and support of basic, applied and developmental research.

The Public Health Service Act requires that the Secretary of Health and Human Services coordinates all research, evaluations, and demonstrations relating to the assessment of health care technology undertaken and supported through DHHS. The Technology Coordinating Committee is the mechanism for achieving this coordination. With representatives from DHHS, committee activities include research studies, special initiatives and plans, and conferences, workshops and symposia pertinent to health care technology.

In FY 1981, 17 percent of the R&D budget was devoted to technology transfer; in FY 1982, it was 16 percent. A summary follows of each agency's approach to technology assessment and transfer, and includes highlights of achievements.

PHS Funding for Research and Development and Technology Transfer Activities, FY 1981 and FY 1982, by Laboratory

	FY 1981 ($ in millions)		FY 1982 ($ in millions)	
	Total R&D Budget	Technology Transfer Budget	Total R&D Budget	Technology Transfer Budget
ADAMHA	$ 239	$ 35	$ 248	$ 38
CDC	71	28	69	26
FDA	71	3	73	3
NIH	3,320	571	3,419	560
Total	$3,701	$637	$3,809	$627

National Institutes of Health (NIH)

By supporting basic and applied research, the NIH provides a strong foundation for discovery of new knowledge and translation of that knowledge into medical technology. Once the assessment process indicates the safety and efficacy of new technology, individual groups promote widespread application through demonstration projects.

The Office of Medical Applications of Research (OMAR), which was established in the office of the Director, NIH, in 1977, has been designated as the Office of Research and Technology Applications (ORTA) for NIH. OMAR's staff consists of seven full-time professionals and three full-time support members. In FY 1981 and FY 1982, the funding allocated to OMAR's assessment and transfer activities was $1.5 million and $2.1 million, respectively.

Achievements Reported

- Seven conferences were held between 1980-1982 on various subjects including "Diagnosis and Treatment of Reye's Syndrome" (March 1981) and "Clinical Application of Biomaterials" (November 1982). Eight such conferences are scheduled for 1983-1984. In an effort to strengthen this effort, OMAR has undertaken three evaluation studies. The results show that although current dissemination reaches one-third of the target population, efforts should be expanded. The second study basically validated the current process but recommended that methods for directing data synthesis and selecting conference panelists could be improved. The final study, now in progress, is expected to produce recommendations for future activities to strengthen the dissemination process and enhance diffusion.

- Within the patent programs, our evaluation study revealed that patent applications have been filed for 40 percent of all inventions, approximately 70 percent of the filings have been awarded patents, and nearly 50 percent of the patented inventions have been commercially licensed. Approximately 14 percent of all NIH inventions have, at one time, been commercially licensed.

Food and Drug Administration (FDA)

As a regulatory agency, the FDA employs a strategy which is anticipatory rather than reactionary, and preventive rather than corrective. In implementing this strategy, FDA conducts applied research and development directed to the safety of the

Nation's food, cosmetics, drugs, medical devices, biologic and radiological products. Within the Office of the Commissioner, FDA, the Office of Scientific Coordination is responsible for overseeing the applied R&D conducted by all FDA components. The Office of Scientific Coordination has been designed as the ORTA at FDA.

Achievements Reported

The FDA's National Center for Devices and Radiological Health has effected two interesting transfers:

- The first was a collaborative effort with Johns Hopkins, SIEMENS Corporation, and Terminal Computers, Inc., to develop an electronic video report which transmits information instantaneously from radiologists to physicians. To promote its transfers, FDA produced a 16-minute documentary. Users have reported time savings, reduction in costs, and improved patient care.

- The same FDA Center established a consortium of hospitals to test the use of laser high-density storage discs for x-ray information. Through FDA, Phillips has loaned a storage system to a hospital in St. Louis and RCA has loaned a system to the University of Pennsylvania for similar testing.

- FDA also has developed a portable neutron spectrometer to measure neutron radiation being emitted during high-energy dose applications from linear accelerators. Thus far, two patents have been issued and are available for use by the private sector.

Center for Disease Control (CDC)

CDC programs are administered through: the centers for prevention services, environmental health, health promotion and education, professional development and training, and infectious diseases; the National Institute for Occupational Safety and Health; and program offices addressing the areas of epidemiology, international health; and laboratory improvement.

As the group responsible for coordinating the provision of reference laboratory services to Federal, state and local health department laboratories, the Laboratory Improvement Program Office (LIOP) has been designated as the CDC ORTA. Its primary function is liaison between LIPO and the functional laboratory offices and staff as they conduct their individual technology transfer activities.

Achievements Reported

- During FY 1980 and FY 1981, CDC engaged in two related activities to be used by state and private laboratories and private industry. In the first effort, CDC developed sensitive and selective analytical methodologies for PBB's (polybaominated biphenyls) that were transferred to the Michigan Department of Public Health; subsequently, CDC developed simultaneous measurement of both PBB's and PCB's (polychlorinated biphenyls) and prepared, dispensed, assigned values and made available serum samples containing PCB's and commonly occurring chlorinated pesticides for use by state and private laboratories.

- In a related area, CDC investigators completed control technology assessments for industrial processes including primary aluminum, pesticide manufacturing and formulating, raw cotton processing, secondary nonferrous smelters, dry cleaning, tire manufacturing, spray painting and coating, and coal gasification and liquefaction. Altogether, 47 industry-wide studies concerned with occupational safety and health were conducted and 13 educational resources centers were supported.

- CDC also participated in cardiovascular intervention trails, assisted in the formation of standarized quality control reference materials, set up training clinics, and was responsible for operating 23 WHO collaborating centers.

Alcohol, Drug Abuse, and Mental Health Administration

The Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) provides the Federal focus to increase knowledge and promote effective strategies to deal with health problems associated with the use and abuse of alcohol and drugs and with mental health and mental illness. The ADAMHA Office of the Administration (OA) is responsible for interpretation of requirements, policy guidance, and recommendations on improvements and augmentation of the knowledge transfer program and has been designated as an ORTA. Three full-time professionals are assigned to the ORTA functions.

ADAMHA has determined that each of its three institutes functions as a "laboratory" and so has designated an ORTA within each institute.

Achievements Reported

- Workshops on occupational alcoholism programs were conducted for labor and management in both public and private agencies and industries.

- In responding to an increasing number of requests, NIDA has developed effective treatment programs for specific populations with drug abuse problems; established school-based drug prevention programs; and distributed special information products.

- The National Institute of Mental Health responded to a state mental health program director who needed an appropriate patients rights program for the state. Based partly on an R&D project that developed and tested a model state program on the topic, NIMH consultants were able to help plan the program.

U. S. DEPARTMENT OF THE INTERIOR (DOI)

Two units within the Department of the Interior operate laboratories, as defined in the Stevenson-Wydler Technology Innovation Act of 1980. A summary follows of the technology transfer activities conducted by the Bureau of Mines and the Fish and Wildlife Service.

Bureau of Mines (BOM)

For several years, the Bureau of Mines has conducted a technology transfer program through the Branch of Technology Transfer (BTT) in the Office of Technical Information. With passage of the Stevenson-Wydler Technology Innovation Act, the BTT assumed the ORTA functions.

The BTT has a total of four professional and two clerical positions and an annual budget of $250,000 which is derived from assessments against authorized BOM programs. In addition, the BTT is assisted by the Technology Transfer Liaison Officers (TTLO) stationed at each of the Bureau's 10 Research Centers. Although technology transfer is a collateral duty for each TTLO, the costs (essentially for salary and occasional travel) are supported by the research centers.

Achievements Reported

- During FY 1981 and FY 1982, the BTT was responsible for the conduct of 14 seminars on 7 technology developments, 5 industry briefings, 4 workshops, 2 demonstrations, 12 exhibits and 74 issues of the Technology News. In cooperation with the Federal Laboratory Consortium, the BTT completed twenty-seven technology assessments describing specific research projects.

  As a result of the BTT's efforts, a number of research developments have been commercially adopted. They include technologies that have:

  - substantially lowered respirable dust concentrations in underground coal mines;
  - improved visibility for operators of large surface mine haulage equipment;
  - provided automatic systems for the suppression of mine fires;
  - helped control acid mine drainage; and
  - enabled minerals recycling and recovery plants to reclaim valuable minerals from wastes or from low-grade ores.

Fish and Wildlife Service

All research activities of the Fish and Wildlife Service are centrally managed by the Associate Director-Research. Although the Fish and Wildlife Service has not assigned any full-time personnel to the functions of an Office of Research and Technology Applications (ORTA), each R&D facility has a designated official whose functions also include responsibility for ORTA activities. In addition, an ORTA representative in Washington, D.C. was named as a national coordinator. During FY 1982 an estimated $3.3 million was spent on technology transfer efforts.

In FY 1983, the Fish and Wildlife Service anticipates a major reorganization merging Research, the Office of Extension Education and most of the Office of Biological Services into one R&D organization. As part of this merger an Office of Information Management will be established in Fort Collins, Colorado and will include an Office of Research and Technology Application.

Achievements Reported

- One of the most significant discoveries was the determination of the life cycle of an obscure organism known to cause whirling disease in salmonid fish. Enthusiastically received by state fisheries and state and private fish hatcheries, it is expected that cultural methods will be developed to control the organism, thereby resulting in measurable savings for fish producers.

- The Fish and Wildlife Service demonstrated that fat soybean meal can be used to replace nearly all fishmeal in pelletized fish food. The soybean substitute will result in cost reductions of approximately 15 percent for the manufacturers of prepared fish foods.

- In support of the 4-H fish and wildlife programs, the Fish and Wildlife Service has funded adult volunteer leader training programs and sponsored recognition certificates and awards to outstanding 4-H youths and leaders. The National Wildlife Health Laboratory provided diagnostic services on wildlife specimens for 16 state agencies, 5 universities and 6 zoos, and provided 300 consultations on wildlife health problems.

U. S. DEPARTMENT OF TRANSPORTATON (DOT)

The Department of Transportation manages nine laboratories engaged in R&D activities.

The responsibility for technology transfer rests within each of the operating DOT administrations. Office of Research and Technology Application (ORTA) contacts have been identified for each laboratory. Departmental oversight and coordination is provided by the Technology Sharing Program under the Assistant Secretary for Governmental Affairs within the Office of the Secretary.

The Federal Highway Administration (FHWA) technology transfer activities represent approximately $9.1 million in FY 1981 and $8.3 million in FY 1982. Within the Office of the Secretary, approximately $490,000 and $200,000 were expended on technology sharing efforts in FY 1981 and FY 1982 respectively. Although other operating administrations do not identify technology transfer as a separate budget item, DOT estimates that another $10 to 15 million is directed toward such activities.

Achievements Reported

- The FHWA has been very active in the area of transfer and commercialization of DOT research results. One activity has resulted in savings of over $8 million for the states. One example is the DOT work in the development of the dryer drum mixer for producing hot-mix asphalt. Now nearly all new hot-mix plants sold in the U.S. use this approach because of lower capital and operating costs.

- In another area, the Federal Railroad Administration (FRA) has contracted with the Association of American Railroads (AAR) for the "Care, Custody and Control" of the Transportation Test Center in Pueblo, Colorado. Thus, the FRA will provide the bulk of the funds while the AAR will do the actual testing for its own or member accounts.

- As a cooperative venture, the FHWA selected 10 state highway agencies to establish Technology Transfer Centers to assist local transportation agencies responsible for roads, bridges and public transportation. Working with a local university, the Center activities include quarterly newsletters, technical reports, seminars and training courses.

U. S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

The technology transfer program of the Environmental Protection Agency (EPA) seeks to transfer R&D outputs to Federal and state agencies and private industry. The program is coordinated by the Regional Services Staff, which is part of the research program management reporting to the Assistant Administrator for Research and Development. The Regional Services Staff will plan, broker and network the EPA functions required under Section 11 (c) (3) of the Stevenson-Wydler Technology Innovation Act. The individual laboratories are responsible for the functions specified in Section 11 (c) (2), information provision and dissemination; and 11 (c) (4), technical asssistance to state and local governments. In addition, the 10 Regional Offices of EPA interact directly with states, territories and possessions, and frequently transfer user needs to the appropriate laboratory and/or the Regional Services Staff.

EPA estimates that technology transfer expenditure for FY 1981 were $3 million and FY 1982 were $2.8 million. A breakdown of the EPA spending organizations is shown below.

	Budget ($K)	
Technology Transfer Function	1981	1982
Regional Services Staff (Executive Directorate, ORTA function)	$ 482.9	$ 391.3
Center for Environmental Research Information	1,093.7	1,092.4
Technical Information Product Management	706.8	657.3
Research Laboratories (Estimated)	716.6	700.0
	$3,000.0	$2,841.0

Achievements Reported

- Areas of particular interest during FY 1981 and FY 1982 included acid rain and hazardous waste disposal. EPA developed methodologies for defining susceptability of aquatic systems to acid rain impacts through cooperative research efforts with the States of Minnesota, Michigan and Wisconsin. Efforts to control hazardous waste using land treatment were initiated at the request of the Oklahoma State Health Department, and an innovative mobile incinerator has been provided to New Jersey for the disposal of polychlorinated biphenyls (PCB's) at a land-fill site.

- In support of its efforts to develop the synfuels industry, EPA provided assistance to both states and private industry in the preparation of Environmental Impact Statements, permits, and environmental monitoring plans. A reference manual was developed for synfuel developers that describes streams and pollutants to be monitored and the frequency, cost and procedures for such monitoring.

- EPA has established, by cooperative agreements, eight research centers at competitively selected universities. The focus of the center programs is generally on long-term (3-5 years or longer) research which links basic to applied research as related to EPA's mission.

- A series of ten two-day Emerging Technology Seminars on wastewater control provided the 900 attendees with a rational basis for the consideration of new technologies during the planning and design of waste water treatment facilities.

Other reported achievements include:

- Sodium conditioning to solve problems associated with hot side electrostatic precipitators for electric utilities;
- Waste load allocation guidance document for toxic substances in a computer program for the State of Michigan;
- Biological availability to fish of organics in municipal fly ash conducted cooperatively with Dow Chemical Company for use by industry and states;
- Design and specification guidelines for low pressure sewer systems for the State of Florida; and
- Treatment techniques for controlling trihalomethanes formed in drinking water for water utility managers.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

The National Aeronautics and Space Administration (NASA) conducts no activities directly pursuant to the Stevenson-Wydler Technology Innovation Act, having exercised the waiver and election provided by Section 11(b) and 11(c)(4) of the Act. NASA does conduct a Technology Utilization program, begun in 1962, to enhance national economic growth and productivity through the transfer of new technology resulting from NASA research and development efforts to the nonaerospace segment of the economy.

Achievements Reported

- A safety net was required for personnel working on the Shuttle Orbiter. A sophisticated twisting process was invented which resulted in a supertwine that met the NASA specifications; a net of this twine can sustain a load of 800 pounds falling 25 feet.

  A firm is now manufacturing this net, which has proven attractive to fishing fleets. Japan has almost totally dominated this market, but the net could provide a foundation for American competition in the $500-600 million a year netting industry.

- To improve certain characteristics of composite materials, which are finding increased use in aircraft and other areospace systems, NASA developed an improved impregnating solution known as PMR-15. A company obtained the formula and the procedure for synthesizing PMR-15 and used it in developing new composite materials. These composites have a variety of applications, such as compressor blades for aircraft engines, radar domes, aircraft structures and other components requiring a material with high temperature resistance.

- A portable x-ray instrument developed by NASA and now being produced commercially may soon find further use as a medical system. The instrument is called Lixiscope--Low Intensity X-ray Imaging Scope--a self-contained, battery-powered fluoroscope that produces an instant image through use of a small amount of radioactive isotope. It is designed to use less than one percent of the radiation required by conventional x-ray devices.

  Lixiscope is being produced by a company which has an exclusive NASA license for one version of the device. It has received Food and Drug Administration approval to begin

testing the device for medical applications. Lixiscope's small size and low radiation dosage make it attractive in medical applications, such as emergency room examination of small children.

- A flat conductor cable is being highly praised as the best cost-saving office support system ever developed. Flat conductor cable was developed of necessity as aircraft and spacecraft became increasingly complex. NASA recognized that the cable offered a benefit in design of electrification systems for commercial buildings and undertook its promotion.

- A NASA-developed stress monitor was designed to provide highly precise stress measurement in industrial applications--such as pressure vessels and power plants--where overtighthened or undertightened bolts can fail and cause accidents or costly equipment shutdowns. The monitor is licensed to 12 companies.

- NASA wanted a system for monitoring two different propellants being supplied to a spacecraft rocket thruster. A positive displacement measuring device had to be developed that would not miss any of the propellant flow. The technology thus developed provided a basis for later design of an extremely precise low-flow calibration system now being marketed worldwide.

NATIONAL SCIENCE FOUNDATION (NSF)

The National Science Foundation (NSF) operates only one research center, the National Center for Atmospheric Research (NCAR), which is of sufficient size to require an Office of Research and Technology Applications (ORTA). Because of the special and limited focus and management structure of NCAR, NSF requested a waiver from the ORTA requirement of the Stevenson-Wydler Technology Innovation Act (P.L. 96-480) in March 1982. In lieu thereof, the NSF has implemented a team approach whereby the professional research staff at NCAR support research and technology applications as needed.

In addition, the NSF performs a variety of activities that are concerned with research and technology application. NSF efforts directed toward the objectives of P.L. 96-480 include six national centers for research and eight programs devoted in whole or in part to the transfer and use of science and technology by the private sector and state and local governments.

Each of the Centers has an individual identified as the ORTA contact. Although NSF has not published any regulations or directives to implement P.L. 96-480, it has identified the percentage of employee time and percentage of budget at each center dedicated to research and technology applications. Averaging the six centers, in FY 1981 1.2 percent of employee time and 1.7 percent of budget was expended on such functions. In FY 1982, research and technology applications accounted for 1.4. percent of employee time and 1.8 percent of budget.

Achievements Reported

- The Air Quality Management Study, developed by NCAR, is being used by Federal and State Governments to develop a methodology for assessing the performance of air quality models. The Study includes work on methods for improving statistical analysis of ambient pollutant data and visibility research.

- The Small Business Innovation Research Program made awards to Collaborative Research, Inc. of Lexington, Massachusetts in 1977 and 1978. Announcement of the awards led the Dow Chemical Corporation to contract more than $11 million to that firm in research and investment. The firm's expansion with NSF and Dow funds led to a 1982 public offering which provided an additional $13.5 million. Today, Collaborative Research, Inc. is a well known producer of interferon and related products.

- The Massachusetts Institute of Technology's Polymer Processing Center, an Industry/University Cooperative Research Center, worked with one of the member companies, Martin Marietta, to develop a new time- and cost-saving molding process for the super-lightweight ablator coating used on the external fuel tank of NASA's space shuttle. In conjunction with a gas injection technique, also developed by Martin Marietta, the process is expected to save over $100,000 per launch for an estimated saving of $10 million over the next ten years.

- An Industry/University Cooperative Research Project has linked a faculty member at the Illinois Institute of Technology with an industrial scientist at Bell laboratories to develop an infrared intracavity spectrometer. They are using the spectrometer to study vapor deposition reactions which are important in the manufacture of solid electronics, solar cells and optical fibers for telecommunications.