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Technology-Based Economic Development: A Study of State and Federal Technical Extension Services

Robert E. Chapman, Marianne K. Clark, and Eric Dobson

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EXECUTIVE SUMMARY

The National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards, conducted a study of state and federal technology extension services. The study was requested in the Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418), to capture information on the various programs the states are using to promote technological innovation. Interest in the various state programs is based both on the number of programs and the variety of services they provide. Furthermore, many state programs benefit from federal technology transfer programs and financial support as well as private sources of funding.

The study was carried out in cooperation with the National Governors' Association (NGA). NIST and NGA worked through the Governors' Offices, primarily their Science and Technology Advisors, to collect information on their state's key programs.

To date, no study of state economic development - technological innovation activities has focused on identifying those programs which reach out to provide technological assistance to businesses at the local level, or on the degree to which such programs make use of federal programs and activities in carrying out their missions. This study serves to document these activities as well as identify potential sources of synergism between the states and federal technology transfer programs. In addition to satisfying a Congressional mandate, this study provides a unique opportunity to inventory the level of state-funded activities involved in technological innovation and assistance, and will provide the basis for establishing a Department of Commerce Clearinghouse for State and Local Initiatives on Productivity, Technology, and Innovation which is also required under the Act.

The purpose of this report is to summarize the study's major findings and to provide recommendations on the future federal role in technology extension. A two-pronged approach was used in carrying out the study. The first part of the study focused on an in-depth review of the literature on technology transfer and technology extension services. Special emphasis was placed on federal technology transfer efforts and on identifying and documenting state technical outreach and economic development activities. Emphasis was also placed on analyzing what the states are doing in the key areas of program implementation (e.g., strategic plans) and program evaluation (e.g., self-assessment issues). The second part of the study involved a nationwide survey of state and federal extension services. Among the major findings of the survey, are the following.

The present system for delivering services to small and medium-sized businesses is decentralized. There are a large number of organizations, supported by both the federal and state governments, working directly with businesses - the survey identified over 200 organizations providing assistance to businesses. The services offered by these organizations vary greatly as does the extent to which these programs provide assistance on technological issues. Total funding for all federal and state programs included in the survey was $620 million in fiscal year 1988. Forty-eight percent of the funding for these programs comes from state government, with

the federal government contributing approximately 26 percent. The remainder is contributed by industry (12 percent) and universities (9 percent). Local governments contributed approximately one percent.

All regions of the country are served by organizations providing direct assistance to businesses, although the type of organizations providing services and the services provided may differ greatly. The largest number of responses were received from the Midwest. The South accounted for the largest amount of total dollars, 35 percent of total 1988 expenditures. The North and the Midwest accounted for 29 and 24 percent of spending, respectively, while the West accounted for 12 percent. An examination of source of funds by region shows that the distribution of funds by source differs significantly. In the North, 26 percent of total funding is provided by industry, compared with only 4 to 7 percent in the other three regions, and state funding matches federal funding at a rate of 2.8:1. In the South and Midwest, the ratio of state to federal dollars is 1.8:1, while in the West the ratio is 1.4:1.

The firms being assisted by federal and state-supported organizations are overwhelmingly small businesses. This is true regardless of the type of service being provided. A breakdown by size of firm shows that 60 percent of the firms being assisted have fewer than 50 employees. Another 23 percent have between 50 and 500 employees. Furthermore, these businesses need access primarily to existing off-the-shelf technology rather than advanced state-of-the art technology. The survey respondents reported that for those businesses receiving technology assistance 64 percent require access to established technologies while 35 percent require access to new technologies. Figures for firms participating in other program areas were similar to those receiving technology assistance.

Of the $620 million total funding for all federal and state programs included in the survey, 84 percent or $519 million is earmarked for specific program categories. Technology assistance services accounted for $121 million or 23 percent of the earmarked funds. Another 23 percent is allocated to technology research centers and 17 percent to business assistance. Twenty-four percent of total funds are allocated to other activities (i.e., activities not covered by the survey questionnaire). A majority of these funds are probably allocated to research and development grant programs. Technology assistance services are being provided at a fairly even rate to manufacturing and non-manufacturing firms. Approximately two-thirds of the firms receiving business assistance, however, are non-manufacturing firms.

While 167 state and federally-supported organizations reported providing technology assistance services (e.g., technical information, invention evaluation, technical counseling and patent information), the number of "technology extension services" - as defined to be those programs whose primary purpose is to provide direct consultation to manufacturers for technology deployment - is much smaller. The study identified 13 state-supported organizations in nine states that fit this more limited definition. Both the state and federally-supported organizations providing primarily business assistance services (e.g., Small Business Development Centers and state business assistance programs) serve on average a much

higher number of clients per year than do those organizations that provide primarily technology assistance services. Business assistance services include financial analysis, management assistance and business plan preparation.

The federal program cited as being of greatest assistance in promoting technological innovation is the Small Business Innovation Research (SBIR) Program. Sixty-nine percent of the respondents reported using the SBIR Program and 74 percent gave the program a rating of good. The SBIR Program was established by Congress in 1982 to provide the opportunity for small firms to participate in federal research and development. The states have found the program to be an important source of seed capital for small technology-based businesses. Over a dozen states have established state programs to complement and build on the federal SBIR Program. Other highly rated but less frequently used programs included the Economic Development Administration's University Centers, the Agricultural Extension Service, NSF's Industry/University Cooperative Research Centers, the Department of Commerce's Office of Productivity, Technology and Innovation (now the Office of Technology Policy), and NASA's Commercial Use of Space Program.

State and federal program managers agreed that they would place greatest emphasis on cooperating actively with federal agencies in their technology transfer programs and establishing a training program at the state and local level focused on federal technology transfer and cooperation. The state respondents placed greater emphasis on cosponsoring demonstration projects as compared to drawing on a federal clearinghouse to disseminate information on federal research and development while the federal respondents favored the clearinghouse over demonstration projects.

The Omnibus Trade and Competitiveness Act of 1988 directs NIST to provide technical assistance to state technology programs throughout the United States, to help those programs help businesses - particularly small and medium-sized businesses - enhance their competitiveness through the application of science and technology. The Act directs that such assistance include, but not be limited to: (1) technical information and advice from NIST personnel; (2) workshops and seminars for state officials interested in transferring federal technology to businesses; and (3) entering into cooperative agreements as authorized under the Act.

ACKNOWLEDGEMENTS

The authors wish to thank the many individuals who contributed time and information for the development of this report. First and foremost, thanks are due to the managers of the state and federal programs who responded to the survey.

Thanks are also due to those individuals who reviewed the manuscript and provided advice and guidance. Special thanks are due to Ms. Beverly Jones for her pioneering work on state technology programs while at the Minnesota Department of Trade and Economic Development. Special thanks are also due to Dr. Donald R. Johnson and Messrs. David Edgerly and Joseph Berke, National Institute of Standards and Technology, Mr. DeWitt John and Ms. Kristen Gooch, National Governors' Association, and Dr. Philip Shapira, West Virginia University.

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1. INTRODUCTION

1.1 BACKGROUND

The rapid loss of competitiveness of U.S. industry in international markets is an extremely serious problem with wide-ranging consequences for our material well-being, our security, and our political influence. Its causes are many, but among them certainly are the slow rate at which new technology[1] is embodied in commercial products and processes, and the lack of attention paid to manufacturing. We need to compete in world markets with high-value-added products, incorporating the latest innovations, manufactured in short runs with flexible manufacturing methods. We need research, management, and manufacturing methods that support change and innovation.

Many ideas originating in the American scientific and technical community are being commercially exploited in other parts of the world. We, as a nation, have been slow to capitalize on new technology developed from our own intellectual capability and to improve our manufacturing capability. In the past, small and medium-sized firms have led U.S. industry in innovation. We must now determine the extent to which the federal government can support such companies in the development of improved manufacturing capabilities and the marketing of new, competitive products.

The Omnibus Trade and Competitiveness Act (Public Law 100-418) was signed into law on August 23, 1988. Two issues raised in the competitiveness portion of the Act are of central importance to this study. First, the Act created the National Institute of Standards and Technology (NIST) from the National Bureau of Standards (NBS), the nation's central laboratory for developing and disseminating measurement standards and scientific data. In addition to the name change, NIST was assigned new responsibilities which augment and build on the technical expertise of NBS. NIST is the only federal laboratory with a specific mission to support U.S. industry. Basically, NIST is charged to "assist industry in the development of technology and procedures needed to improve quality, to modernize manufacturing processes, to ensure product reliability, manufacturability, functionality, and cost-effectiveness, and to facilitate the more rapid commercialization ... of products based on new scientific discoveries."

Second, the Act requires the Secretary of Commerce to conduct a nationwide study of state technology extension services and to report findings and recommendations to Congress on an appropriate federal role in encouraging such programs. The Act requires that the study include the following items:

A. A thorough description of each state program, including its duration, annual budget, and the number and types of businesses it has aided;

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[1] Technology is defined as technical information applicable to products and processes.

B. A description of any anticipated expansion of each state program and its associated costs;

C. An evaluation of the success of the programs in transferring technology,[2] modernizing manufacturing processes, and improving the productivity and profitability of businesses;

D. An assessment of the degree to which state programs make use of federal programs, including the Small Business Innovation Research program and the programs of the Federal Laboratory Consortium, the National Technical Information Service, the National Science Foundation, the Office of Productivity, Technology, and Innovation (now the Office of Technology Policy), and the Small Business Administration;

E. A survey of what additional federal information and technical assistance the programs could utilize; and

F. An assessment of how the services could be more effective agents for the transfer of federal scientific and technical information, including the results and application of federal and federally-funded research.

In addition to satisfying a Congressional mandate, this study provides a unique opportunity to inventory the level of state-funded activities involved in technological innovation and assistance, and will provide the basis for establishing a Department of Commerce Clearinghouse for State and Local Initiatives on Productivity, Technology and Innovation which is also required under the Act.

The study was carried out by NIST in cooperation with the National Governors' Association (NGA). NIST and NGA worked through the Governors' Offices, primarily their Science and Technology Advisers, to collect information on their state's key programs. Appendix A contains a list of the economic/ technical outreach programs that provided detailed information.

Two separate questionnaires were used to capture the study data. The first (see Appendix B) is of a summary nature and is designed for use by State Coordinators (e.g., a Governor's Science and Technology Advisor). The Second (see Appendix C) is designed for use by the individual Program Managers.

1.2 PURPOSE

The purpose of this report is twofold. First, it summarizes the recent literature on technology transfer and technology extension. Included in the

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[2] Technology transfer is defined here as the process by which technology, knowledge, or information developed in one organization, in one area, or for one purpose is applied and utilized in another organization, in another area, or for another purpose.

literature survey is a review of selected federal technology transfer programs, a review of state technical outreach and economic development activities, and an analysis of state efforts in the key areas of program implementation and program evaluation. Second, it summarizes the results of a nationwide survey of state and federal technology extension services. The survey was carried out in cooperation with NGA. It represents the first comprehensive study of how these programs reach out to provide technological assistance to businesses at the local level and the degree to which such programs make use of federal programs and activities in carrying out their missions.

1.3 SCOPE AND APPROACH

The report is divided into two parts. Part I focuses on summarizing some of the recent work in the areas of technology transfer and technology extension carried out by the federal government, associations and individual states. Part I consists of Chapters 2 and 3. Part II summarizes the major findings of a nationwide survey of state and federal technology extension services. Part II consists of Chapters 4, 5 and 6.

Chapter 2 traces the history of federal technology transfer activities from its emphasis on agriculture in the early 1900s to the new missions outlined in the Omnibus Trade and Competitiveness Act of 1988.

Chapter 3 discusses results from several recent surveys concerned with incentives and programs designed to promote technology-oriented development. The chapter concludes with a discussion of state-based strategic planning activities and the issue of program evaluation.

Chapter 4 begins with a description of the cooperative effort between NIST and NGA, with special emphasis placed on the data collection strategy. The key findings of the survey are then presented. Results are analyzed by type of program and type of service provided.

Chapter 5 is an in-depth analysis of a small set of technology extension programs. The purpose of these "micro-studies" is to provide a series of snapshots illustrating the way in which the state-based and federal-affiliated programs operate.

Chapter 6 focuses on how the states are using a wide variety of federal technology transfer programs. The chapter includes recommendations provided by program managers on ways in which they can more effectively promote the transfer of federal technology.

Chapter 7 provides a brief summary of the study's major findings.

PART I

FEDERAL-STATE INITIATIVES:

A REVIEW OF THE LITERATURE

2. FEDERAL INITIATIVES TO PROMOTE TECHNOLOGY TRANSFER

2.1 AGRICULTURAL EXTENSION

Among the oldest federal programs for technology transfer is the U.S. Department of Agriculture's (USDA) Cooperative Extension Service. The origins of the system date back to the first federal appropriations for agricultural research. Early activities included: the establishment of the Department of Agriculture and the land-grant universities in 1862 under the Morrill Act; and the funding of state agricultural experiment stations in 1887 under the Hatch Act. The current program began in the early 1900s. The program became nationwide with the passage of the Smith-Lever Act of 1914. The Smith-Lever Act provided for a cooperative system of agricultural extension to be developed between the federal government, land-grant universities, and county extension boards.

The system aims to integrate agricultural research, education and technology transfer. New agricultural technology is produced by researchers located at universities, experimental stations and USDA laboratories. USDA's own agricultural research occurs in 148 locations around the country, taking about three-quarters of USDA research funds. The remaining research funds go mainly to universities. Total federal spending on agricultural research was $822 million in 1987. Private industry, university, state, and foundation funds also support agricultural research.

The Cooperative Extension Service takes the results of this research effort and seeks to transfer the technology to farmers as well as provide a feedback loop between farmers and researchers. The Cooperative Extension Service maintains an office in almost every county in the 50 states, in the District of Columbia and in affiliated U.S. territories. In 1987, funding for the extension system totaled more than $1.1 billion ($339 million from the federal government and $801 million from state and local sources). During that same period, more than 16,000 staff were engaged in providing technical services.

2.2 STATE TECHNICAL SERVICES PROGRAM

With the passage of the State Technical Services Act of 1965 (Public Law 89-182), the federal government initiated the State Technical Services (STS) Program. The objective of the STS was to help states accelerate the adoption of new scientific and technological advances by industry. The Act sought the involvement of states, universities, and industries in a cooperative effort to use advanced technology to upgrade industry, increase employment, and enhance the competitive position of U.S. products in world markets. States were asked to designate a qualified agency to develop plans and programs which were then submitted to an Office of State Technical Services in the Department of Commerce for review and funding.

The Act classified technical services as "activities or programs designed to enable business, commerce and industrial establishments to acquire and use scientific information more effectively." Program activities falling within the meaning of the Act included: (1) preparing and disseminating technical

information (e.g., through state technical information centers); (2) sponsoring seminars, industrial workshops and training programs; (3) identifying and making referrals to sources of engineering and other scientific expertise; (4) person-to-person contacts to identify problems and find or adapt technologies to solve them; and (5) demonstrations of new technologies to encourage their application in industry.

Between 1965 and 1969, the STS gave $10.9 million in grants to states. The states used these funds in a variety of ways. New York established a science and technology agency patterned after the National Science Foundation. North Carolina and Pennsylvania set up industrial extension services, somewhat akin to an agricultural extension. Pennsylvania's program (the Pennsylvania Technical Assistance Program (PENNTAP)) is still in existence; it provides technical services to firms through the state university system.

An evaluation of the STS Program by Arthur D. Little in 1969[3] indicated that the program was resulting in technological and economic benefits. Arthur D. Little reported that the program was "most helpful to small and medium-sized firms which do not have broad technical and research capabilities ... and provided useful technical services to firms who would not or could not pay for such services." It was recommended that the STS Program should concentrate its resources on such firms. Recommendations were made to improve federal coordination and increase communication between the states about useful resources and techniques. Unfortunately, when federal funding for the STS Program was terminated in 1969, only a few states continued to support the agencies and programs which STS helped to establish.

2.3 FEDERALLY-SPONSORED INDUSTRY/TECHNOLOGY-ASSISTANCE PROGRAMS

Except for the few instances where industrial development is regarded as a national security concern, the federal government most directly stimulates technological innovation in private industry through technology transfer programs. These programs make available the results of federally-funded research and development (R & D) efforts or support their application. The amount spent on disseminating knowledge gained through federal R & D efforts is considerably smaller than the expenditures required to gain that information.

Although no estimates of the economic benefits of federal technology transfer programs to the nation's businesses are available, there is clear evidence that these activities are beneficial to the national economy. For example, a 1984 study by the Office of Technology Assessment (OTA)[4] concluded that federal technology transfer programs are more likely to contribute to regional high-technology development than are federal R & D programs. The OTA study cited two reasons. First, the more than 700 federal laboratories

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[3] Arthur D. Little, Inc., Program Evaluation of the Office of State Technical Services, Cambridge, MA, October 1969.

[4] Technology, Innovation and Regional Economic Development, Washington, DC: U.S. Congress, Office of Technology Assessment, OTA-STI-238, July 1984.

and technology development centers are located throughout the nation. To the extent that technology transfer takes place on a decentralized basis, federal laboratories can become a vital component in the technological infrastructure of the areas in which they are located. Second, many of the high-technology development initiatives launched by state and local governments and universities focus on technology transfer and improved linkages between academic research and industrial application. As a result, these state and local mechanisms are in a better position to provide local businesses with information about federal technologies and access to federal technical specialists.

The recognition that the federal laboratory system has extensive science and technology resources, developed as a consequence of meeting mission requirements of the federal departments and agencies, has prompted legislation to promote the transfer of federal technology to the private sector where commercialization activities can be undertaken. The key legislation affording access to the federal laboratory system is the Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480), as amended by the Federal Technology Transfer Act of 1986 (P.L. 99-502). Table 2.1 provides brief descriptions of both Acts, as well as legislation affecting the ownership of patents derived from research performed under federal funding, and Executive Order 12591 regarding facilitating access to federally-funded technology.

Inter-Agency Programs and Activities

Federal technology transfer activities are of two basic types, those which are agency specific and those which cut across several agencies. The purpose of this section is to provide a brief description of three key programs which cut across most of the federal agencies participating in research and development. These programs are: (1) the creation of Offices of Research and Technology Applications (ORTAs) within the federal laboratories; (2) the Federal Laboratory Consortium for Technology Transfer (FLC); and (3) The Small Business Innovation Research (SBIR) Program.

Office of Research and Technology Applications (ORTA)

The Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480) and the Technology Transfer Act of 1986 (P.L. 99-502) state that it is the responsibility of the federal government to ensure full use of the results of the nation's federal R & D investment and mandates that, where appropriate, technology be transferred to state and local governments and the private sector. These Acts created an organizational structure within the federal laboratory system to meet this mandate. Each federal agency with one or more laboratories must make available not less than 0.5 percent of its R & D budget for technology transfer activities (this requirement can, and has, been waived if the agency can demonstrate that it is in compliance with the intent of the law). To assist the flow of technology and expertise from the system, each laboratory is required to create an Office of Research and Technology Applications (ORTA); laboratories with 200 or more full-time equivalent scientific, engineering, and related technical positions must have one or more full-time equivalent professionals staffing the ORTA.

Table 2.1 Relevant Legislation and Policy Guidance Governing Federal Technology Transfer Activities

P.L. 96-480 The Stevenson-Wydler Technology Innovation Act
P.L. 96-480 specifically states that it is the responsibility of the federal government to ensure "... full use of the results of the Nation's federal investment in research and development" and to share, and where appropriate, to transfer federally-owned or originated technology to state and local governments and the private sector. The law also created an Office of Research and Technology Applications (ORTA) in each major federal laboratory and the Center for the Utilization of Federal Technology, which is currently located within the National Technical Information Service (NTIS).
P.L. 99-502 The Federal Technology Transfer Act
P.L. 99-502 amends the Stevenson-Wydler Technology Innovation Act to promote technology transfer by authorizing government-operated laboratories to enter into cooperative research and development agreements (CRDAs). It allows companies, regardless of size, to retain title to inventions resulting from research performed under CRDAs with the federal laboratories. The government retains a royalty-free license to use these patents.
P.L. 96-517 The University and Small Business Patent Procedure Act
P.L. 96-517 provides, in part, for title to federally-funded inventions to be vested in a contractor if it is a small business, a university, or a not-for-profit institution, subject to the government receiving a royalty-free license to use the discovery.

Table 2.1 Relevant Legislation and Policy Guidance Governing Federal Technology Transfer Activities (Continued)[5]

P.L. 98-620 Amendments to the Patent and Trademark Laws
P.L. 98-620 affects the transfer of technology from federal laboratories to the private sector. The amendments authorize government-owned, contractor-operated (GOCO) laboratories run by small business, universities, or not-for-profit institutions to elect to retain title to inventions resulting from federally-funded research. The law also authorizes federal agencies to negotiate with federal contractors regardless of size, as to the disposition of rights in federally-funded inventions.
Executive Order 12591 Facilitating Access to Science and Technology
Executive Order 12591, signed April 10, 1987, directs the head of each executive department and agency, to the extent permitted by law, to promote cooperative research and development efforts between the federal laboratories, State and local governments, universities, and the private sector "... to assist in the transfer of technology to the marketplace." This also includes granting title to the results of federally-funded research and development to all contractors, regardless of size, in exchange for royalty-free use by, or on behalf of, the federal government. In addition, the Executive Order calls for the establishment of a Technology Share Program for selected federal laboratories to work with private industry consortia in areas of research and technology with potential long-term national benefits and convenes a Task Force on Technology Transfer from Federal Laboratories under the auspices of the Office of Science and Technology Policy.

[5]Wendy H. Schact, Commercialization of Federally-Funded R & D: A Guide to Technology Transfer from Federal Laboratories, Washington, DC: Congressional Research Service, Library of Congress, September 1988.

Federal Laboratory Consortium for Technology Transfer (FLC)

The FLC was originally established under the auspices of the Department of Defense in 1971 to assist in transferring defense technology to industry. Several years later it was expanded to include other federal agencies in a voluntary organization of approximately 300 federal laboratories. The Federal Technology Transfer Act of 1986 provided the FLC with a legislative mandate to operate and required the membership of most federal laboratories.

The primary purpose of the FLC is to promote the effective utilization of technical knowledge developed within the federal laboratory system by linking these facilities with other federal entities, state, local and regional governments, and the private sector. The FLC assists in identifying, structuring, and addressing user needs in light of the increasing demands placed on state and local jurisdictions for technical solutions to problems. It also establishes a means by which federal technology and expertise can be publicized and made available through individual laboratories to private industry for further development and commercialization. Access to the resources of the full federal laboratory system can be made through any laboratory representative (e.g., an ORTA staff member), the FLC regional coordinators, the Washington area representative located at the National Institute of Standards and Technology, or by contacting the Chairman or Executive Director.

The FLC, itself, does not transfer technology; it assists and improves the technology transfer efforts of the laboratories where the work is performed The legislation requires that the FLC perform various functions including the development of material, techniques, and training methods on how to transfer technology from the federal laboratories and to further advise and assist the agencies and laboratories in their technology transfer programs. The FLC will serve as a clearinghouse for requests for assistance and will either refer requesters to the National Technical Information Service for written information or to the appropriate federal laboratory or agency. When requested, the FLC can: (1) assist the private sector, universities, and state, local and regional jurisdictions in creating technology transfer programs; (2) facilitate appropriate technology transfer mechanisms (including personnel exchange) within the laboratories; (3) help establish transfer programs using volunteers; and (4) seek advice outside the laboratories as to the effectiveness of the technology transfer program.

The work of the FLC is funded by a set-aside of 0.008 percent of the portion of each agency's R & D budget used for the laboratories. This money is transferred to the National Institute of Standards and Technology which, in turn, provides it to the FLC to cover its various activities. The FLC uses 5 percent of its funding for a technology transfer demonstration program. This effort involves grants, awards, or cooperative agreements with state, local, or non-profit organizations to develop programs and mechanisms which may be utilized by the states to transfer technology from the federal laboratories and which will enhance on-going federal, state, and local technology transfer activities.

The Small Business Innovation Research (SBIR) Program

Research by the National Science Foundation (NSF) on the barriers to small firm participation in federal R & D procurement formed the basis for the design of a Small Business Innovation Research (SBIR) Program at the NSF. The NSF program was the predecessor of the current SBIR Program created by the Small Business Innovation Development Act of 1982 (Public Law 97-219). One of the major benefits of the SBIR Program is that it brings new technological vendors to federal science and engineering research programs.

The 12 government agencies with extramural research and development obligations over $100 million annually participate in the SBIR Program. Each agency sets aside a small percentage of its external research and development budget for the program. At present, the required set aside is 1.25 percent. Section 8008 of the Omnibus Trade and Competitiveness Act requires an investigation into the SBIR Program to consider increasing each agency's set aside by 0.25 percent a year until the amount represents 3 percent of the total extramural research and development funds. There are other suggested amendments to the SBIR Program being proposed that are required to be addressed in the Comptroller General's Study.[6]

Agencies issue solicitations on subjects related to their missions. The SBIR projects are funded in two phases. Phase I awards funds for feasibility studies, usually for 6 months and less than $50,000. Successful projects enter Phase II which generally lasts 2 years with up to $500,000 in funding. Where two or more proposals for a Phase II project are evaluated as being of approximately equal scientific and technical merit and feasibility, special consideration is given to those proposals with non-federal capital commitments to commercialize the research. Once Phase II work is finished, the firm is expected to find Phase III funding from the private sector to bring the innovation into the marketplace. If a federal agency has continued interest and need for the innovation, acquisition may proceed with non-SBIR funds.

About $1.5 billion has been awarded to SBIR Phase I and II projects from the program's inception up through fiscal year 1988. In fiscal year 1985, 39 percent of the SBIR Program's $199 million funding was spent by the Department of Defense, 23 percent by the Department of Health and Human Services, 15 percent by NASA, and 13 percent by the Department of Energy. By fiscal year 1988, the SBIR Program's funding level had risen to $360 million of which 58 percent was spent by the Department of Defense, 15 percent by the Department of Health and Human Services, 9 percent by the Department of Energy, and 8.5 percent by NASA

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[6] Federal Research: Assessment of Small Business Innovation Research Programs, Washington, DC: General Accounting Office, GAO/RCED-89-39, January 1989.

Agency-Specific Programs and Activities

The focus of this section is on agency-specific technology transfer activities. These activities may be classified into four basic modes of operation: (1) technical information; (2) technology brokering; (3) cooperative research and development; and (4) technical extension services. Technical information is usually provided in the form of newsletters, directories, or computer data bases that list federal technologies available for licensing and use by private firms. Technology brokering by agency staff involves seeking out potential users of federally-owned technologies, or providing referral services for inventors seeking technical or financial resources. Cooperative research and development involves partnering with industry, generally in the early stages of research and development, to transfer technology or know-how. Technical extension services provide consultants to assist firms in solving technical problems in a certain field of specialization.

NASA

NASA's Technology Utilization Program was initiated in 1962 to bring new aerospace technologies to the attention of American industry. The program's first efforts were in the publishing and distribution of NASA R&D results. By the mid-1960s, program staffers had found that the availability of technical information alone would not transfer technologies effectively, so they began a process of matching potential users to information and skills at NASA installations. In 1971, NASA became even more active in technology brokering through technology adaptation, the re-engineering of NASA technology for other uses, such as a fire-fighter breathing system based on spacesuit technology.

Another part of the Technology Utilization Program with particular relevance here is NASA's 10 Industrial Applications Centers (IACs). All are located at universities, where they offer information services, workshops, and technical assistance to industrial clients.

Two types of literature searches are offered. The first, retrospective searches, identify published or unpublished literature. Results are screened and documents are identified according to a client's interest profile. Results are tailored to specific needs. Backup reports identified in a search usually are available upon request. The second, current awareness searches, provide selected weekly, monthly, or quarterly abstracts on new developments in any selected area of interest. Companies receive printouts automatically.

Technical assistance is also available. IAC engineers will help industrial clients evaluate the results of a literature search. They can find answers to technical problems and put clients in touch with scientists and engineers at appropriate NASA Field Centers.

The Computer Software and Management Information Center (COSMIC) serves as NASA's software dissemination center. COSMIC makes available to business and industry over 1400 computer programs covering all areas of NASA project

involvement. Source code is supplied for each program along with detailed user documentation.

Department of Commerce

The Department of Commerce (DoC) operates a variety of programs which provide technology-oriented assistance to the private sector. Among the DoC programs reviewed by this study are: (1) The Center for the Utilization of Federal Technology (CUFT) within the National Technical Information Service (NTIS); (2) the University Centers Program operated by the Economic Development Administration (EDA); (3) the Trade Adjustment Assistance Centers Program (TAAC) operated by the International Trade Administration; (4) the Office of Productivity, Technology and Innovation (now the Office of Technology Policy); and (5) the National Institute of Standards and Technology (NIST).

CUFT was created by the Stevenson-Wydler Technology Innovation Act of 1980 to serve as the collection point for the information generated by the ORTAs. Acting as a special information resource for all agencies, CUFT offers businesses a series of special information products linking them with federal technology and resources. These products include: (1) Tech Notes; (2) Government Inventions for Licensing; and (3) Directory of Federal Laboratory and Technology Resources.

Tech Notes is a monthly alerting service. Tech Notes provide one-page monthly fact sheets, often illustrated, of new processes and new products developed by federal agencies and their contractors. Each fact sheet details a specific invention, process, software, material, instrument or technique selected for application. Tech Notes are available by subscription in any of 10 categories. Annual collections of all 10 categories of Tech Notes are also bound in single, soft-cover volumes.

Government Inventions for Licensing is a weekly newsletter. The newsletter presents summaries of new patent filings and issuances on government-sponsored inventions. All inventions are available for licensing (often exclusive). The newsletter describes some 1200 new inventions annually. All inventions are presented in a single annual publication, the Catalog of Government Patents. This catalog arranges descriptions of these 1200 inventions under 41 subject areas for easy reference.

The Directory of Federal Laboratory and Technology Resources is a unique single-source guide to hundreds of federal agencies, laboratories, engineering centers, and some 90 Technical Information Centers. The special expertise, facilities and services of each resource are described and the name of a personal contact is provided.

EDA operates three technical assistance programs; they are designed to promote economic development and alleviate underemployment and unemployment in distressed areas. The National Program supports demonstrations, information dissemination and studies of economic development issues of national significance. The Local Program supports feasibility studies and other projects leading to local economic development. The University Centers Program provides funds to involve the resources of universities in economic

development in their areas. Currently, there are 57 University Centers, 11 new ones having been established in 1988 with 4 scheduled for 1989. DoC funding for the program during fiscal year 1988 was $4.79 million. The Pennsylvania Technical Assistance Program (PENNTAP) is one such University Center.

ITA's Trade Adjustment Assistance Program provides trade-impacted small and medium-sized manufacturers with in-depth technical help, including advice on engineering design, production, marketing, and finance. Twelve regional Trade Adjustment Assistance Centers (TAACs) deliver the program's services. DoC funding for the 12 TAACs during fiscal year 1987 was $16 million. The TAACs operate either as independent non-profit corporations or as affiliates of universities.

The Office of Technology Policy operates a Shared Flexible Manufacturing Systems Program. This program provides basic data on concepts related to financing methods and organizational structures that can make automation a realistic option for small and medium-sized manufacturers. Information is provided on computer-integrated manufacturing, and especially on automated, flexible manufacturing systems. The Office of Technology Policy also operates programs designed to help companies to learn about improved productivity, quality and competitiveness techniques and to provide training on the innovation process.

NIST operates a variety of technology transfer programs. These programs include the exchange of technical information and data as well as in-depth personal assistance relating to research activities.

The Office of Energy-Related Inventions encourages innovation in non-nuclear technology by helping individual inventors and businesses develop promising energy-related inventions. A description of any new concept, device, product, material or industrial process may be submitted for evaluation. The invention need not be patented. The office evaluates all submitted inventions and recommends those that are promising to the Department of Energy (DoE). DoE then reviews the recommended inventions and determines the next reasonable step for the invention. The most promising inventions receive a grant from DoE to further their development.

The Research Associate Program offers a unique opportunity for business, industry and academia to work with NIST professionals of recognized stature and makes available the extensive laboratory facilities at NIST. This is an effective way to transfer NIST technology and a means of communicating industrial views and needs directly to NIST. The Research Associate remains the employee of the sponsoring organization, which pays the salary, fringe benefits, travel and relocation. NIST provides, at no cost to the sponsor, technical supervision, office and laboratory space, routine supplies and services and the use of research equipment not normally subjected to time and usage charges. NIST also encourages the use of its unique facilities for the conduct of proprietary research on a cost recovery basis when equal or superior facilities are not otherwise readily available.

Small Business Administration

Under the provisions of the Small Business Innovation Development Act, the Small Business Administration (SBA) surveys and monitors SBIR programs in participating agencies. SBA's Office of Innovation, Research and Technology formulates and issues policy directives for government-wide operation of SBIR programs, operates an SBIR information program, develops a source file of qualified small firms wishing to participate, publishes advance announcements of all SBIR solicitations from participating agencies, and coordinates with the private sector on commercialization of SBIR innovations.

SBA also supports a network of Small Business Development Centers (SBDCs). Each SBDC receives a grant from SBA based on a population formula. SBDCs have a legislative mandate (P.L. 96-302) to assist in technology transfer, make use of federal laboratories and equipment, and coordinate and conduct research they deem worthwhile. Currently, there are 53 lead SBDCs. The lead SBDCs serve a coordinating function, two states Texas and New York, have more than one lead agency. The lead SBDCs oversee more than 500 sub-center SBDCs across the country. During fiscal year 1988, federal appropriations totaled $40 million; federal appropriations were raised to $45 million in fiscal year 1989.

Department of Defense

The Defense Technical Information Center (DTIC) is the central point within the Department of Defense for acquiring, storing, retrieving, and disseminating scientific and technical information to support the management and conduct of defense-related R & D activities. DTIC's main facility is located in Alexandria, VA; other DTIC sites are: (1) Boston, MA; (2) Los Angeles, CA; and (3) San Diego, CA. All sites are equipped with dedicated terminals and staffed with information specialists.

The Strategic Defense Initiative Organization (SDIO) has initiated a program to accelerate the transfer of SDI-developed technologies to the private sector, federal agencies, state and local governments, and universities. SDIO's role in this technology transfer process is to act as a bridge between those who have a need for the technology developed with SDI research funds and the inventors and developers of that technology. SDIO does this by identifying potential private and public sector applications for emerging SDI technologies and then providing information about these technologies to individuals and organizations within the private and public sectors that can use the SDI technologies as a source for other research and development efforts.

Department of Energy

DoE's National Appropriate Technology Assistance Service (NATAS) helps entrepreneurs develop the business side of energy-related appropriate technology by providing business information and direct business assistance. NATAS can assist with such activities as acquiring financing, marketing, business planning, and business organization development. NATAS works

closely with federal, state and local programs to coordinate technical assistance activities.

In addition, DoE operates an extensive system of laboratories with an annual budget of $6.5 billion. The system includes nine multi-program, nine major single program, and numerous other smaller laboratories. Some of the major laboratories (e.g., Oak Ridge National Laboratory) are quite progressive in their technology transfer efforts. In the areas of licensing technology and software DoE has embarked on a program through which: (1) intellectual property policy is being streamlined and simplified; (2) all non-profit laboratory contractors can retain patent rights and license the technology in all technical areas except defense and other sensitive areas; (3) for-profit laboratory contractors may soon have similar capability (presently, these contractors operate via case-by-case patent waivers); (4) all laboratory contractors can copyright and license computer software to realize its technology transfer value; (5) each laboratory does its own licensing; and (6) government-owned patents are licensed from DoE Headquarters.[7]

National Science Foundation

NSF supports scientific and engineering research. NSF provides most of its support in the form of grants to assist in the conduct of specific projects.[8] By-and-large, most of NSF's funding is directed at individual research projects performed at U.S. universities. However, as part of the federal government initiative to improve the competitiveness of U.S. manufacturers, NSF has created a series of Engineering Research Centers (ERCs) to promote multidisciplinary engineering research. The ERCs are located at academic research institutions across the country.

The ERCs were created as a response to changing patterns of industrial competitiveness. NSF views technology and the training of scientists and engineers through cross-disciplinary research and development critical to U.S. manufacturing competitiveness. The ERCs are the most recent attempt to promote cross-disciplinary research through university/industry cooperation and technology transfer from universities to the private sector. The 11 Materials Research Laboratories, which focus on interdisciplinary materials research, came under NSF control in 1972. NSF also supports the Industry/ University Cooperative Research Centers which link industry and universities through joint R & D projects in the manufacturing sciences.[9]

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[7] Claire H. Sink, "Opportunities to Work with Department of Energy Laboratories," Proceedings of Tech-Link 89: Roles for the States in Technology Transfer from DoE to Industry, Los Alamos, NM: Los Alamos National Laboratory, June 1989.

[8] Small Business Guide to Federal R & D Funding Opportunities, Washington, DC: National Science Foundation, March 1986.

[9] John S. Wilson, Productivity and Competitiveness: Industrial Extension Services and Technology Transfer Programs in the United States, Washington, DC: The World Bank, (in press).

2.4 INITIATIVES UNDER THE OMNIBUS TRADE AND COMPETITIVENESS ACT OF 1988

With the passage of the Omnibus Trade and Competitiveness Act, federal technology transfer activities took on a new and expanded role. The Act assigned new roles for the Department of Education, the Small Business Administration, and the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS). Central to the competitiveness portion of the Act was the expanded mission of NIST. The Institute's new responsibilities augment and build on the technical expertise of NBS. NIST will maintain the traditional functions of NBS and will continue to offer the full array of measurement and quality assurance services that were provided by NBS. These services include calibration services, standard reference materials, standard reference data, and measurement assurance programs.

NIST is a relatively small agency and its resources are quite modest when compared to research and development expenditures by industry and the federal government, or with the $620 million expenditure by the various state programs for technology development and commercialization. The new programs being developed by NIST will be collaborative, highly leveraged, and can serve as examples to be followed by others with greater resources.

The Act establishes four new major programs aimed at the rapid and effective transfer of technology to U.S. industry to enhance the country's technological competitiveness. The four programs are:

(1) the Regional Centers for the Transfer of Manufacturing Technology;

(2) the Industrial Extension Services Program;

(3) the Advanced Technology Program; and

(4) the Clearinghouse for State and Local Initiatives on Productivity, Technology, and Innovation.

These expanded responsibilities will cast NIST in a new and different role working with new constituencies such as state and local economic development organizations and such federal agencies as the Small Business Administration, the Economic Development Administration, the International Trade Administration, and the National Science Foundation. Short descriptions of the four new programs follow.

Regional Centers for the Transfer of Manufacturing Technology

The aim of the regional centers is to bring modern automated manufacturing technology to small and medium-sized manufacturing firms that cannot compete in the international markets because their resources for research or technological improvement are insufficient. The program focuses on technologies appropriate to small businesses (e.g., automation of existing facilities with off-the-shelf equipment within the reach of the personnel, finance, and engineering capability of such companies).

The regional centers program emphasizes "hands-on" experience. Senior managers from business and industry will be invited to the centers to observe and participate in demonstrations of automatic equipment that will be advantageous to their companies. They will be assisted in choosing the proper equipment, in selecting a reputable supplier, and in acquiring and training the staff that will operate the equipment. The program will encourage a partnership with academic institutions, with special focus on training of workers that could be provided by community colleges or vocational schools.

NIST will create these centers in partnership with non-profit organizations established by state and local governments, academic institutions, or companies. Three organizations have been selected to become the first NIST Regional Manufacturing Technology Centers: (1) the Manufacturing Technology Center at the Cleveland Advanced Manufacturing Program in Cleveland, Ohio; (2) the Northeast Manufacturing Technology Center at Rensselaer Polytechnic Institute in Troy, New York; and (3) the South Carolina Technology Transfer Cooperative based at the University of South Carolina in Columbia, South Carolina. NIST has now established cooperative working arrangements with each of these organizations.

Industrial Extension Services Program

The objective of the extension services program is to improve the use of technology, particularly federal technology, by small and medium-sized businesses by working through existing state and local extension activities. A number of federal agencies now sponsor extension programs of various kinds.

The role of NIST will be to work through existing state and local extension activities to assist in the identification, retrieval and dissemination of federal technology. In addition, NIST will provide technology assistance to extension services as appropriate, develop workshops and seminars on technological issues, and provide increased access and utilization of available NIST services. A pilot effort to network local biotechnology companies and supporting firms has been operating successfully at NIST for more than a year. Experience gained from this pilot program will benefit the NIST efforts in other technologies.

Another part of this program will be the technical evaluation of promising inventions that are not energy-related - a program that is modelled after a successful 12-year-old program for energy-related inventions managed by NIST for the Department of Energy.

Advanced Technology Program

The objective of this program is to accelerate the commercialization of scientific discoveries and manufacturing technologies. The focus of the program is on small entrepreneurial firms. This program will provide limited federal funding to encourage and leverage private sources of support for developing generic technology, developing new products from specific projects, and improving existing manufacturing processes.

NIST has developed a preliminary program plan that calls for the initiation of several operating program components that together would: (1) encourage U.S. business to look to the future and to improve their competitive positions through technological innovation; (2) capture greater civilian market potential from existing federal investment on basic research: and (3) systematically couple different aspects of federal research investment to additional sources of funding from state and local governments.

Clearinghouse for State and Local Initiatives on Productivity, Technology, and Innovation

This is a shared assignment with the Department of Commerce. The Clearinghouse will gather and analyze information on the many state and local technology development programs across the nation. NIST will offer technical and analytical support to the Clearinghouse. The objective of this program is to develop a central base of information on what programs are available, what has been tried, and what the results have been. The information will be shared through workshops and other mechanisms.

The Clearinghouse will be a resource for state and local governments when deciding on new technology policies. This will be accomplished in part through the development of a network of technical contacts within the state and local policy level staff, and through the collection of information on current programs. The Clearinghouse will provide the type of information needed at the state and local level by governors, county executives, mayors, and other decision makers as they plan new programs and make policy decisions. The total investment at the state level is large and the influence on the overall direction of U.S. high technology industries and, hence, the impact on the nation's balance of trade could be substantial. Consequently, the availability of a quality database on state technology programs is an essential resource for decision makers.

3. STATE INITIATIVES DESIGNED TO STIMULATE TECHNOLOGY-ORIENTED INVESTMENT AND DEVELOPMENT

3.1 HISTORICAL PERSPECTIVE

In the past 10 to 20 years, several regions of the United States have developed strong local economies based on fast-growing, technology-oriented industries. Encouraged by these successes, state and local governments, universities and private sector groups are launching initiatives to promote similar technology-oriented development in their regions. They are optimistic because technology-oriented industries are spreading beyond their original strongholds. While technology-oriented industries represent less than one quarter of the total U.S. employment, they play a major role in many local economies and could be a force in the revival of distressed regions and cities, especially in the Midwest.

The intense competition for technology-oriented development has generated literally hundreds of state and local initiatives. State and local organizations are beginning to take a number of actions to encourage technological innovation and economic activity. Generally speaking, the three common goals of these initiatives are: (1) job creation; (2) business development; and (3) economic diversification.

Virtually every state has some form of incentive to either attract firms to locate within its boundaries or to keep new or established firms from moving. A recent survey published by the National Association of State Development Agencies (NASDA) provides a perspective from which to select a small set of incentives directed at technology-oriented economic development[10]. These incentives are summarized in table 3.1. We begin with a discussion of the single nonfinancial incentive shown in table 3.1, customized industrial training. Each of the financial incentives appearing in table 3.1 will then be discussed.

Trained labor increasingly is being viewed as an essential element in development, growth, and redevelopment efforts. Private industry realizes that training can make a difference in reducing manpower costs, increasing productivity, and even making certain operations possible when they rely on particular manpower skills. Many states have already discovered the strong relation between developing labor resources and developing business. In their traditional role of attracting industry, states found that a suitable labor force was essential, and that training programs were a big help in upgrading the work force. In fact, the mere existence of such a training program acts as a powerful incentive to business. Consequently, most states have developed training programs customized to particular industries or even to specific company needs. The emphasis has been on training workers for

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[10] Directory of Incentives for Business Investment and Development in the United States: A State-by-State Guide, Washington, DC: National Association of State Development Agencies, 2nd Edition, 1986.

Table 3.1 Mechanisms Used by States to Stimulate Business Investment and Development

Type of incentive (column headings for Table 3.1):

1. Customized Industrial Training
2. Direct Loan Programs
3. Enterprise Zones
4. Grant Programs
5. Industrial Development Bond Guarantees
6. Tax Incentives
7. Umbrella Bonds

State	Incentive Provided (* = yes)						
	1	2	3	4	5	6	7
Alabama	*			*			
Alaska						*	*
Arizona							
Arkansas	*		*		*	*	
California	*	*	*				
Colorado	*					*	
Connecticut	*	*	*				*
Delaware	*		*			*	
Florida	*	*	*			*	
Georgia	*		*				
Hawaii	*	*					
Idaho	*						
Illinois	*	*	*	*			*
Indiana	*	*	*	*		*	
Iowa	*					*	*
Kansas	*		*				
Kentucky	*	*	*				*
Louisiana	*	*	*			*	
Maine					*	*	*
Maryland	*	*	*	*	*		*
Massachusetts	*				*		
Michigan	*	*	*	*		*	
Minnesota		*	*			*	
Mississippi	*	*	*	*		*	
Missouri	*	*	*	*	*	*	*

Table 3.1 Mechanisms Used by States to Stimulate Business Investment and Development (Continued)

Type of incentive (column headings for Table 3.1):

1. Customized Industrial Training
2. Direct Loan Programs
3. Enterprise Zones
4. Grant Programs
5. Industrial Development Bond Guarantees
6. Tax Incentives
7. Umbrella Bonds

State	Incentive Provided (* = yes)						
	1	2	3	4	5	6	7
Montana	*	*					*
Nebraska	*						*
Nevada	*	*	*			*	
New Hampshire							
New Jersey	*	*	*	*	*	*	
New Mexico	*						
New York	*	*			*	*	*
North Carolina	*			*		*	
North Dakota	*				*	*	
Ohio	*	*	*	*		*	
Oklahoma	*	*	*			*	
Oregon		*		*		*	*
Pennsylvania	*	*	*	*		*	
Rhode Island	*	*		*	*	*	
South Carolina	*	*				*	*
South Dakota	*						
Tennessee	*						
Texas	*	*					
Utah						*	
Vermont	*	*					
Virginia	*		*			*	*
Washington						*	
West Virginia	*	*				*	
Wisconsin	*			*		*	
Wyoming							*

real jobs, in real companies, which were likely to be available to them. The programs have been designed to reflect local economic realities and private corporate needs, with the latter a major factor. The private sector plays a central role in the design and implementation of these training programs. More than 40 states have formal customized training programs.

Financial incentives are a major component of virtually all state programs. States depend on outreach activities and investment incentives to bring companies and investment into their jurisdictions. States provide a range of technical services such as demographic data on communities and the work force, as well as information on available sites and buildings. These services, along with the growing number of direct financial incentives, provide powerful follow-up to state advertising outreach efforts.

Direct financial incentives include direct state loans, grants, industrial development bonds (IDBs), and loan guarantees. States also provide various tax exemptions, deductions, and credits as incentives to businesses and investors.

One or more direct loan programs are reported in more than half the states. Many loan programs are established as revolving funds in order to make the most of limited capitalization. These loan programs are utilized predominately by small and medium-sized businesses because maximum loan amounts are often less than $1 million. Generally, a state provides less than 100 percent of the total project costs. In many instances, the state's loan is provided as part of an overall package that includes a commercial loan. State direct loans usually carry a below-market interest rate.

Enterprise zone programs could be classified as advanced tax incentive programs. The initial concept embodies a basic premise of economic development: to leverage investment by reducing the cost of doing business. Enterprise zones carry with them the idea of targeting assistance to specified "distressed" areas within the state. Businesses locating or expanding in these designated areas are eligible for a variety of incentives, which vary by state. Currently nearly half the states have an enterprise zone program.

Grants are the most direct and heavily subsidized form of state assistance. Because of the high cost, nonretrievability, and legal constitutional constraints on such assistance, direct state grants to businesses are rare. States do, however, give grants to help underwrite various costs of economic development. Examples include grants to build or improve the physical infrastructure; grants to support R & D activities, support local economic development activities, and help subsidize and implement specific development projects.

The most common tool used for economic development financing is the industrial development bond (IDB) program. All 50 states allow for the issuance of such bonds; some actually issue the bonds at the state level. The interest on IDBs is federally tax exempt, and the lower rates that can be paid on such bonds are then passed on to the companies by the public issuer.

Most commonly, IDBs are used to subsidize the financing of land and site development or of other fixed assets.

Two of the more innovative uses of IDBs, industrial development bond guarantees and umbrella bond issues, are designed to make IDB financing available to small businesses. IDB guarantees are similar in principle to loan guarantees. The additional security provided by the guarantee improves the marketability of the bonds. Thus, these programs seek to improve the financing terms for sound companies with projects too small to attract investors. Currently, a little less than 20 percent of the states utilize IDB guarantees.

Umbrella bond issues are used by states to market several individual bond issues of $1 million or less in one package. This reduces the credit risk to the bond purchasers and lowers the costs of bond financing to the small businesses. Under most umbrella or pooled IDB programs, eligible loans are bundled as a package and bonds are sold when a certain minimum limit is reached. In general, umbrella bond programs provide financing for projects too small to qualify for the normal revenue bond program. With these programs, borrowers pay below-market interest rates for long-term loans. The pooled risk and economies of scale in costs permit the companies and private lenders to participate in deals that might otherwise be too risky or not sufficiently profitable. Roughly one third of the states have some form of pooling program, and the number is expected to grow.

Tax incentives can promote economic development in a variety of ways. These include reduction of the overall level of taxation, both personal and business taxes, revision of the tax structure, and use of tax credits to encourage particular types of investments. A recent survey by the National Governors' Association[11] indicated that 15 states have recently enacted tax cuts to stimulate economic activity. Twelve states reported decreases in business taxes, and five reported decreases in personal income tax rates. Two states repealed unitary tax measures and three revised their unitary tax system, adopting the alternative "water's edge" concept. The unitary tax method allows states to tax corporations based on the ratio of their state profits to their worldwide profits. Under a water's edge system, companies are taxed on earnings based on the ratio of their in-state profits to their profits within the United States. Profits earned in foreign countries are excluded from the calculation.

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[11]Marianne K. Clarke, Revitalizing State Economies: A Review of State Economic Development Policies and Programs, Washington, DC: National Governors' Association, 1986.

3.2 ORGANIZATION OF STATE EFFORTS[12]

Currently, 43 states have at least one program that specifically encourages technological innovation. Programs range from business assistance to comprehensive, multi-million dollar programs. Some states invest in only one type of technology program, while others approach technological development by investing in a number of areas simultaneously.

Table 3.2 summarizes information on those states which have boards, commissions, authorities, or offices that oversee or coordinate state technology initiatives. The most common type of structure is a public/private partnership comprised of representatives from private firms, academia, and state government. Technology offices may operate as independent public agencies or private nonprofit corporations. States without a technology office may have a science and technology policy advisor. The duties and responsibilities of technology offices range from the administration of multi-million dollar technology centers to providing information dissemination and advisory services.

Information on six general classes of state technology programs is provided in the table 3.3. A seventh class, Other, is also included in the table to indicate the importance of highly-focused programs which have a local or regional flavor. The following is a brief description of the six classes of state technology programs summarized in table 3.3:

Business Assistance: Business assistance focuses on providing general business management information such as personnel, accounting and legal advice.

Incubators: Incubator facilities provide office and lab space for start-up companies at below-market rates. Shared support services such as clerical, reception and data processing are often made available.

Research Parks: Research parks are planned groupings of technology companies that encourage university/private relationships.

Seed Capital: Money is provided for projects that are at an early stage of development or that offer job creation potential but may not have the return on investment expected by commercial venture capitalists. Includes research grant and product development programs.

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[12]The material presented in this section is based on information from: State Technology Programs in the United States, St. Paul, MN: Office of Science and Technology, Minnesota Department of Trade and Economic Development, July 1988.

Technology Assistance: Technology assistance focuses on providing specialized services such as technical information, invention evaluation, technical counseling and patent information. Technology assistance includes both information exchange and active out-reach programs to provide access to newly-created technologies and to promote innovative applications of established technologies.

Technology/Research Centers: These centers generally concentrate their studies in a particular field which is usually based on the strengths of the university and/or the major industries in the state.

The Minnesota study found that individual state expenditures for science and technology programs varied widely. In general, those states that have invested most intensely in technology programs are the traditional manufacturing states of the Northeast and Midwest. Rural and Western states tend to provide the fewest programs and the least money. Reference to table 3.3 reveals that 30 states offered business assistance, 18 had incubators, 11 had research parks, 31 provided seed capital, 40 offered technology assistance, 30 funded technology/research centers and 37 operated one or more special-purpose programs.

Most of the financial resources for these programs come from state general funds. Other sources include bond issues, state lottery funds, pari-mutuel gambling receipts, and state employee pension funds. Iowa and Oregon use lottery funds in addition to state general funds. Kansas allocates both state general funds and gaming funds. Alabama's general funds are complemented by the State Trust Fund Income. South Dakota's Future Funds are residuals from its unemployment compensation reserve.

Table 3.2 State Offices for Promoting Initiatives in Science and Technology

State	Office
Alabama	Alabama Department of Economic and Community Affairs
Alaska	Science and Engineering Advisory Commission
Arkansas	Arkansas Science and Technology Authority
Colorado	Colorado Advanced Technology Institute
Connecticut	Governor's Technology Advisory Board
Delaware	High Technology Task Force
Florida	Florida High Technology and Industry Council
Georgia	Advanced Technology Development Center
Hawaii	High Technology Development Corporation
Illinois	Governor's Commission on Science and Technology
Indiana	Corporation for Science and Technology
Iowa	Iowa High Technology Council
Kansas	Kansas Technology Enterprise Corporation
Kentucky	Office of Business and Technology
Maine	Maine Science and Technology Board
Maryland	Science Advisory Council
Massachusetts	Massachusetts Office of Science and Technology
Michigan	Michigan High Technology Task Force
Minnesota	Office of Science and Technology
Missouri	Missouri Corporation for Science and Technology
Montana	Montana Science and Technology Alliance
Nebraska	Nebraska Research and Development Authority
New Jersey	New Jersey Commission on Science and Technology
New Mexico	New Mexico Science and Technology Commission
New York	New York Science and Technology Foundation
North Carolina	North Carolina Board of Science and Technology
Ohio	Thomas Edison Program
Oklahoma	Oklahoma Center for the Advancement of Science and Technology
Oregon	Oregon Resource and Technology Development Corporation
Pennsylvania	Ben Franklin Partnership Program
Rhode Island	Rhode Island Partnership for Science and Technology
South Carolina	South Carolina Research Authority
Tennessee	Tennessee Technology Foundation
Virginia	Center for Innovative Technology
Washington	Washington High Technology Coordination Board
Wyoming	Wyoming Science, Technology, and Energy Authority

Table 3.3 Selected Science and Technology Programs by State

Type of program (column headings for Table 3.3):

1. Business Assistance
2. Incubators
3. Research Parks
4. Seed Capital
5. Technology Assistance
6. Technology/Research Centers
7. Other

State	Type of Program (* = provided)						
	1	2	3	4	5	6	7
Alabama	*	*		*	*		*
Alaska	*						*
Arizona	*		*			*	
Arkansas	*	*		*	*		*
California				*			
Colorado					*	*	*
Connecticut		*	*	*	*		*
Delaware	*		*		*	*	*
Florida				*	*		*
Georgia	*	*			*	*	*
Hawaii	*	*	*	*	*	*	*
Idaho	*					*	
Illinois		*	*	*	*		*
Indiana	*			*	*		*
Iowa	*	*	*	*	*	*	*
Kansas	*			*	*	*	*
Kentucky	*	*	*	*	*	*	*
Louisiana							
Maine				*	*		*
Maryland	*	*			*	*	*
Massachusetts					*	*	*
Michigan	*			*	*	*	*
Minnesota	*		*	*	*	*	*
Mississippi	*				*		
Missouri		*	*		*	*	*

Table 3.3 Selected Science and Technology Programs by State (Continued)

Type of program (column headings for Table 3.3):

1. Business Assistance
2. Incubators
3. Research Parks
4. Seed Capital
5. Technology Assistance
6. Technology/Research Centers
7. Other

State	Type of Program (* = provided)						
	1	2	3	4	5	6	7
Montana	*			*	*		*
Nebraska	*			*	*	*	*
Nevada							
New Hampshire	*	*					
New Jersey	*	*		*	*	*	*
New Mexico				*	*	*	*
New York	*			*	*	*	*
North Carolina	*	*		*	*	*	*
North Dakota	*				*	*	*
Ohio		*		*	*	*	*
Oklahoma				*	*	*	*
Oregon	*			*	*		*
Pennsylvania	*	*		*	*	*	*
Rhode Island				*	*	*	*
South Carolina	*		*				*
South Dakota				*			
Tennessee	*		*	*	*	*	*
Texas	*			*	*		
Utah					*	*	
Vermont		*		*	*		
Virginia	*	*		*	*	*	*
Washington	*	*			*	*	*
West Virginia					*	*	
Wisconsin				*	*	*	
Wyoming							*

3.3 TECHNOLOGIES TARGETED[13]

Many state programs target one or more particular technologies that states hope to develop. In fact, states have targeted over 64 different technologies. These include technologies as diverse as biomedical, energy, food processing, lasers, robotics, superconductivity, and welding.

Grouping similar technologies into categories, table 3.4 provides a convenient state-by-state summary. As might be expected, biotechnology and information technologies have been targeted by many of the states. Reference to the table shows that 23 states targeted biotechnology and the life sciences and 22 targeted information technologies. Similarly, materials sciences were targeted by 22 of the states.

Many states target technologies which hold promise for being spun off and enhancing the state's existing economic base. For example, while Michigan targets such emerging technologies as biotechnology and materials sciences, it also is placing a major emphasis on developing advanced manufacturing process technologies, including robotics and flexible manufacturing systems. In fact, at least 13 states are targeting manufacturing technologies.

Other states have targeted technologies for development which, while not making up a large part of their current industrial structure, are hoped to contribute to new forms of development in the future. For example, the Microelectronics Center of North Carolina is a major research effort designed to both attract microelectronics firms to the state and to support the microelectronic firms currently in the state. Similarly, Colorado is targeting, among other technologies, computers and artificial intelligence.

3.4 PROGRAM IMPLEMENTATION AND EVALUATION

As a means of stimulating technology-based economic development, a number of states have prepared strategic plans. Strategic planning is an exercise borrowed from the private sector. Its key elements at the state level are the establishment of long-term economic goals that may realistically be met, an audit and analysis of internal strengths and weaknesses, and an assessment of opportunities that may be exploited by the state's particular mix of economic resources and capabilities.[14] The plan is designed to focus resources over the long term on a state's comparative advantages and to prevent the effort from becoming fragmented. A crucial aspect of state strategic planning is the identification of certain industries likely both

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[13] The material presented in this section is based on information from: Robert D. Atkinson, State Programs for Technology Development, Washington, DC: National Association of State Development Agencies, April 1988; and Paul B. Phelps, Centers of Excellence: A Catalogue, St. Paul, MN: Office of Science and Technology, Minnesota Department of Energy and Economic Development, January 1988.

[14] Peter K. Eisinger, The Rise of the Entrepreneurial State, Madison, WI: University of Wisconsin Press, 1988.

Table 3.4 Technologies Targeted by State

Type of technology targeted (column headings for Table 3.4):

1. Aerospace
2. Biotechnology and Life Sciences
3. Earth Sciences
4. Information Technologies
5. Manufacturing Technologies
6. Materials Sciences
7. Other

State	Technology Targeted (* = yes)						
	1	2	3	4	5	6	7
Alabama							
Alaska							
Arizona				*			*
Arkansas		*					
California							
Colorado	*			*		*	
Connecticut							
Delaware							
Florida		*		*		*	
Georgia		*		*	*	*	*
Hawaii		*	*	*			*
Idaho							
Illinois		*		*	*	*	*
Indiana							
Iowa							
Kansas	*	*		*	*	*	*
Kentucky						*	
Louisiana							
Maine							
Maryland		*					*
Massachusetts		*	*		*	*	*
Michigan		*		*	*	*	*
Minnesota		*	*	*		*	*
Mississippi	*	*		*		*	
Missouri					*		*

Table 3.4 Technologies Targeted by State (Continued)

Type of technology targeted (column headings for Table 3.4):

1. Aerospace
2. Biotechnology and Life Sciences
3. Earth Sciences
4. Information Technologies
5. Manufacturing Technologies
6. Materials Sciences
7. Other

State	Technology Targeted (* = yes)						
	1	2	3	4	5	6	7
Montana							
Nebraska		*					*
Nevada							
New Hampshire							
New Jersey		*		*	*	*	*
New Mexico		*		*		*	*
New York		*		*		*	*
North Carolina		*		*		*	
North Dakota							
Ohio		*		*	*	*	*
Oklahoma							
Oregon							
Pennsylvania	*	*		*	*	*	
Rhode Island							
South Carolina							
South Dakota							
Tennessee	*	*	*	*	*	*	*
Texas				*		*	
Utah	*	*	*	*	*	*	
Vermont							
Virginia		*		*	*	*	*
Washington		*		*		*	
West Virginia							*
Wisconsin		*		*	*	*	
Wyoming							

to provide high economic development benefits and to flourish in the state's business environment.

The emphasis in strategic planning is on specific feasible goals attained according to a timetable. By 1986, at least 17 states had written some sort of strategic plan designed to focus state resources on certain targeted industries of special interest to the state.[15] The growing interest in strategic planning has risen from a need to use public resources in a more focused way in a highly competitive environment. As states compete with each other, as local producers compete abroad, and as entrepreneurs compete with one another, state decision makers have concentrated on those economic sectors and businesses most likely to produce job growth. Strategic planning provides the guidelines for such efforts.

One critical and complicated element in all long-term planning activities is the assessment process. Complications arise because any assessment process needs to take into account that economic development is unlikely to occur in the short run. Two concerns are at the heart of this issue.[16] The first concern is the extent to which officials feel they can correlate economic growth within the state to the impact of their specific programs either in the short-term or in the long-term. The second concern centers on the fact that there are two different audiences within the state that judge how the program is doing: (1) the individual program managers; and (2) the officials responsible for allocating resources.

One useful mechanism for assessment, given that program outcomes may not exist or may be difficult to assess in the short-term, is to focus on the process of establishing the structure of the program. Rather than measuring program effects, states can determine the degree to which the program is developing according to the state's original plans (e.g., where it fits into the state's strategic plan). Two measures of program structure are the composition of the clientele and the type of services offered by the program. If the original intent of the program clearly identifies which industries it wishes to serve, what size and type of businesses it wishes to assist (e.g., small manufacturers), and what services it wants to provide, then assessing how well the program's expectations are being met will be a helpful measure in determining how closely the development of the program has followed its original plans.

Several states are developing formal mechanisms and measurement techniques that will provide data which they feel are accurate and representative of how their program contributes to economic development. Pennsylvania uses such quantitative measurements and estimates in its assessment process. Among the numbers that officials from Pennsylvania have been collecting are: (1) the number of new jobs that the program has assisted in creating; (2) the number

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[15] Ibid, p.28.

[16] State Government Strategies for Self-Assessment of Science and Technology Programs for Economic Development, Washington, DC: National Academy Press, 1987, p.4.

of relocated firms where the program played a significant role; (3) the number of start-up firms established; and (4) the amount of venture capital attracted to firms related to the program. For each of these estimates the program provides explicit definitions, details for presenting results, and their role in the assessment process.

One program which has been in existence long enough to generate a body of quantitative information, is the Pennsylvania Technical Assistance Program (PENNTAP). PENNTAP began operation in 1965. At regular intervals, PENNTAP has asked the businesses which use its services to evaluate what they accomplished and what PENNTAP's services meant to them. Based on results reported in the most recent survey, PENNTAP's clients estimated cumulative benefits in excess of $123 million; the benefits for 1988 alone were nearly $8 million. The benefits have been tabulated since 1971 when PENNTAP began emphasizing the one-to-one assistance of its professional staff. During the same 17-year period, expenses to operate the statewide service network totalled approximately $7 million.[17]

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[17]H. LeRoy Marlow, PENNTAP: 1988 Update, mimeo, 1989, p. 13.

PART II

RESULTS FROM A NATIONWIDE SURVEY OF STATE TECHNICAL EXTENSION AND ECONOMIC DEVELOPMENT SERVICES

4. SURVEY-RELATED ISSUES: DATA COLLECTION AND ANALYSIS

To develop the list of programs which constitute the survey population, NIST conducted extensive reviews of past studies covering state-supported economic development programs, as well as site visits and interviews with state economic development officials. Approximately 400 economic development/technical outreach programs were identified as the survey population.

The survey was designed to capture information on what each state is doing to encourage innovation and increase competitiveness. In order to conduct the survey, it was necessary to develop two separate questionnaires; one for State Coordinators and one for Program Managers. The two questionnaires differ in their focus. The State Coordinator's version establishes a set of control totals against which the individual programs can be measured. The Program Manager's version is fairly detailed and is divided into two parts: (1) background information; and (2) program orientation. Background information (Part 1) relates to the size and objectives of the respondent's organization; funding levels; percentage of resources allocated to six broad-based economic development functions; and the respondent's knowledge of and relationships with key federal programs. Every respondent was asked to complete all of Part 1. Program orientation (Part 2) has six sections, depending upon the orientation of the respondent's organization (e.g., business assistance versus technology assistance). Respondents only completed those sections of Part 2 that related to their program.

4.1 COOPERATION WITH THE NATIONAL GOVERNORS' ASSOCIATION

The nationwide survey was a joint effort between NIST and the National Governors' Association (NGA). This approach was taken because NGA has played a key role in promoting state initiatives to support technological innovation. NIST worked closely with NGA and, through it, with its established network of contacts in the Governors' Offices in assuring a maximum amount of cooperation from respondents and to prevent overlap or possible duplication of effort.

In 1986, NGA's Committee on Economic Development and Technological Innovation appointed Richard Celeste, Governor of Ohio, as the Lead Governor for Science and Technology. Under his direction, a Working Group on State Initiatives in Applied Research has been organized. The members of the Working Group include Governors' Science Advisors and directors of state technology development programs.

To obtain the data requested in the Omnibus Trade and Competitiveness Act of 1988, NGA administered, on behalf of NIST, a survey of state technology extension services. NGA and NIST worked through the Governors' Offices, specifically the members of the Working Group on State Initiatives in Applied Research, to capture the study data. Appendix A contains a list of the state-funded economic development/technical outreach programs which responded to the survey.

In early November, the survey instrument was sent to the Governors via a transmittal letter jointly signed by the Secretary of Commerce and Governor Gerald Baliles of Virginia, the Chairman of the NGA. Accompanying the transmittal letter and survey instrument was a list of organizations involved in economic development and/or technical outreach, with a request that the Governor's Office coordinate the state's response. NIST and NGA worked with each State Coordinator to confirm the list of respondent organizations within the state and to have respondents complete the survey. All survey data was returned to NGA for processing.

As the questionnaires were returned to NGA for processing, they were assigned to one of two categories. Those programs which were state funded were returned through the State Coordinator; these questionnaires tended to arrive on a state-by-state basis. Those programs which were designated as federal affiliates were returned on an individual program basis. This is because each federal affiliate was mailed directly a Program Manager's version of the questionnaire. For example, all Small Business Development Centers (SBDCs), University Centers (UCs), Trade Adjustment Assistance Centers (TAACs), and NASA Industrial Applications Centers (IACs), as federal affiliates, receive a portion of their funds from the Small Business Administration (SBA), the Economic Development Administration (EDA), the International Trade Administration (ITA), and NASA, respectively. Each of these programs was surveyed directly.

As the questionnaires were received at NGA, the data were collated, reviewed and entered into a database. Once the survey data had been entered into the database, it was verified for accuracy and completeness. Summary statistics were then prepared as well as a draft report. These statistics served to highlight differences and similarities between programs due to their geographical location, size and orientation, and their use of federal programs.

Several members of the Working Group on State Initiatives in Applied Research, and other individuals with expertise on the topic of technology extension services, were then asked to review the draft report and participate in a roundtable discussion of the preliminary findings. The purpose of the roundtable was to review our progress, present results, and provide an opportunity for comments and suggestions for alternative methods of analysis. Based on the roundtable, a Final Report was prepared by NGA and submitted to NIST.[18]

The NGA Final Report, which documents the methodology and results of the survey, is being released jointly by NIST and NGA. NGA's Final Report includes descriptions of both state-based programs and federal affiliates as well as summary data from the survey. Much of the material presented in Part II is either abstracted from NGA's Final Report, or derived directly from the survey data.

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[18]Marianne K. Clarke and Eric Dobson, Promoting Technological Development: The Role of State and Federal Extension Activities, Washington, DC: National Governors' Association, 1989.

4.2 SELECTED RESULTS ANALYZED BY TYPE OF PROGRAM AND TYPE OF SERVICE

The present system for delivering services to small and medium-sized businesses is decentralized. There are a large number of organizations, supported by both the federal and state governments, working directly with businesses. The survey identified 231 organizations providing services to businesses, however, the services offered by these organizations vary greatly as does the extent to which these programs provide assistance on technological issues. The types of services for which information was collected are summarized in table 4.1.

Total funding for all federal and state programs included in the survey was $620 million in fiscal year 1988. Forty-eight percent of the funding for these programs comes from state government, with the federal government contributing approximately 26 percent. The remainder is contributed by industry (12 percent) and universities (9 percent). Local governments contributed approximately one percent.

All regions of the country are served by organizations providing direct assistance to businesses, although the type of organizations providing services and the services provided may differ greatly. The largest number of responses were received from the Midwest. The South accounted for the largest amount of total dollars, 35 percent of total 1988 expenditures. The North and the Midwest accounted for 29 and 24 percent of spending, respectively, while the West accounted for 12 percent. An examination of source of funds by region shows that the distribution of funds by source differs significantly. For example, in the North, 26 percent of total funding is provided by industry compared with only 4 to 7 percent in the other three regions. Furthermore, in the North, state funding matches federal funding at a rate of 2.8:1. In the South and Midwest, the ratio of state to federal dollars is 1.8:1 while in the West the ratio is 1.4:1.

Of the $519 million allocated to specific program categories, $121 million or 23 percent is allocated for technology assistance services. Another 23 percent is allocated to technology/research centers and 17 percent to business assistance. Twenty-four percent of total funds are allocated to other activities (i.e., activities not covered by the survey questionnaire). A majority of these funds are probably allocated to research and development grant programs. Technology assistance services are being provided at a fairly even rate to manufacturing and non-manufacturing firms. Approximately two-thirds of the firms receiving business assistance, however, are non-manufacturing firms.

Table 4.1 Types of Services for Which Information Was Collected in the Nationwide Survey

Type of Service	Description of Service Provided
Business Assistance	Business assistance focuses on providing general business management information such as personnel, accounting and legal advice.
Incubators	Incubator facilities provide office and lab space for start-up companies at below-market rates. Shared support services such as clerical, reception and data processing are often made available.
Research Parks	Research parks are planned groupings of technology companies that encourage university/private relationships.
Seed Capital	Money is provided for projects that are at an early stage of development or that offer job creation potential but may not have the return on investment expected by commercial venture capitalists. Includes research grant and product development programs.
Technology Assistance	Technology assistance focuses on providing specialized services such as technical information, invention evaluation, technical counseling and patent information. Technology assistance includes both information exchange and active outreach programs to provide access to newly-created technologies and to promote innovative applications of established technologies.
Technology/ Research Centers	These centers generally concentrate their studies in a particular field which is usually based on the strengths of the university and/or the major industries in the state.

While 167 state and federally-supported organizations reported providing technology assistance services, the number of "technology extension services" - as defined to be those programs whose primary purpose is to provide direct consultation to manufacturers for technology deployment - is much smaller. The study identified 13 state-supported organizations in nine states that fit this more limited definition (see sec. 5.1). Both the state and federally-supported organizations providing primarily business assistance services (e.g., Small Business Development Centers and state business assistance programs) serve on average a much higher number of clients per year than do those organizations that provide primarily technology assistance services. Business assistance services include financial analysis, management assistance and business plan preparation. See table 4.2 for a state-by-state tabulation of programs classified by type of service provided.[19]

State-Based Programs

State governments are actively involved in promoting economic growth within their states. During the 1980s, state economic development policies have begun to focus on ways to improve the productivity and competitiveness of existing firms. Two distinct sets of programs have evolved to achieve this goal. First, almost every state provides management and technical assistance to small and medium-sized businesses. Such assistance may take many forms such as helping a firm locate and secure financing, or providing advice on accounting or inventory controls. Such business assistance programs vary in the extent to which they help businesses with technological issues.

Second, a large majority of the states have adopted policies and programs to promote technology development. Such initiatives encourage the development and application of advanced technology by both existing and new firms. For the purposes of this study, technology development initiatives include the following elements: (a) incubators; (b) research parks; (c) seed capital; (d) technology assistance; and (e) technology/research centers.

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[19]Since some programs may provide more than one type of service, the column totals add up to more than 231, the total number of programs from which detailed information was received. It is important to note that the information on services provided by a particular state recorded in table 4.2 may differ from those in table 3.3. Whereas the information recorded in table 4.2 is based on specific responses to the survey questionnaire, the information in table 3.3 is based solely on previously published studies.

Table 4.2 State-by-State Tabulation of Programs Classified by Type of Service Provided

Type of program (column headings for Table 4.2):

1. Business Assistance
2. Incubators
3. Research Parks
4. Seed Capital
5. Technology Assistance
6. Technology/Research Centers

State	Number of Programs Responding					
	1	2	3	4	5	6
Alabama	3	1			4	
Alaska	5		1		4	1
Arizona						
Arkansas	1	1		1	2	1
California	4			1	5	
Colorado	2	1			2	
Connecticut	3			2	2	
Delaware	1		1	1	1	
Florida	4	2		1	3	
Georgia	4	2			3	1
Hawaii	3	1	2		2	
Idaho	2	2	2	1	2	1
Illinois	14	5	2	5	12	2
Indiana	2			1	3	1
Iowa	5	2		1	3	
Kansas	2	1			6	3
Kentucky	5			1	4	2
Louisiana	1				1	
Maine	2	1			2	2
Maryland		1			1	2
Massachusetts	5	1	1	3	4	1
Michigan	16	4		3	17	5
Minnesota	6	1	1	1	5	2
Mississippi	1	1			1	
Missouri	4	2			4	1

Table 4.2 State-by-State Tabulation of Programs Classified by Type of Service Provided (continued)

Type of program (column headings for Table 4.2):

1. Business Assistance
2. Incubators
3. Research Parks
4. Seed Capital
5. Technology Assistance
6. Technology/Research Centers

State	Number of Programs Responding					
	1	2	3	4	5	6
Montana	3	1		1	5	3
Nebraska	1	1		1	2	
Nevada	1				1	
New Hampshire						
New Jersey	8	2		4	13	4
New Mexico	3			1	4	1
New York	5	2	1	2	4	2
North Carolina	1	2		2	2	1
North Dakota	3	1	1	1	2	1
Ohio	1	1		1	1	
Oklahoma	3	2		1	4	
Oregon	1			2	2	
Pennsylvania	6	4	1	2	7	2
Rhode Island	1				1	
South Carolina	1		1		2	1
South Dakota	1	1		1	1	
Tennessee	6	4	2	2	5	1
Texas	2	1			3	1
Utah	1				1	
Vermont						
Virginia	1	1			1	1
Washington	6	1	1	2	3	2
West Virginia	4	1	1		4	2
Wisconsin	4	2	1	1	7	1
Wyoming	1	1			1	

Funding

Seventy-eight percent of the state-supported programs included in the survey can be categorized as technology development programs. These programs reported total fiscal year 1988 funding of approximately $465 million. Of this amount 28 percent was allocated to technology research/centers, 22 percent to technology assistance, 13 percent to seed capital, 9 percent to business assistance, 4 percent to incubators, and 1 percent to research parks. Twenty-three percent was allocated to "other" activities. The other category includes research and development grant programs.

Fifteen percent of the state respondents operate programs which are primarily business assistance programs. These programs are included in the analysis because they provide some element of technological assistance to businesses. These business assistance programs account for $54 million in fiscal year 1988 funding or 10 percent of total funding for the state-supported programs in the study. Sixty-six percent of total funding was allocated to the "other" category indicating the nontechnical nature of these programs. Included in this category would be the full range of traditional economic development activities. Of the remainder, 26 percent was allocated to business assistance services, 5 percent to technology assistance, 2 percent to incubators, and 1 percent to technology/research centers.

Services Provided

While it is possible to identify programs which concentrate their resources primarily on one activity, the vast majority of the organizations responding to the survey provide some combination of services. For example, one organization may provide business assistance, technology assistance, and seed capital while another may provide technology assistance and operate an incubator. The text which follows provides narrative and descriptive statistics covering the wide range of services being provided by the state-supported programs within each of the following areas: (1) technology assistance; (2) business assistance; (3) incubators; (4) research parks; (5) seed capital; and (6) technology/research centers.

(1) Technology Assistance

Recognizing that the major benefits of technology development will be experienced when new discoveries are introduced into existing firms, states have become increasingly active in providing technology assistance and encouraging technology transfer.

Technology transfer can be accomplished by examining existing research, actively searching for technology that has commercial application, and then assisting in the development of a process or product and associated business. It can also attempt to accelerate the diffusion of advanced off-the-shelf technology to existing industry. The latter is usually accomplished by providing some combination of information and field service. Both types of programs are included in the survey population.

One hundred and twenty-two state-supported organizations, 69 percent of the total responding to the survey, provided detailed information on their technology assistance efforts. The median number of firms assisted by these programs in 1988 was 60, although the number of firms assisted ranged from 20 or less to several thousand. This very large range indicates the varying level of services provided by individual programs. In some cases, a business' request for assistance may be handled by a single phone call. In other programs, a firm may be provided with in-depth, on-site technical assistance as the firm seeks to adopt a new technology. Overall, the number of firms an organization can provide technology assistance to in a year tends to be much smaller than the number of establishments that can be provided with business assistance services.

The respondents were asked to indicate the types of services being provided during the 1985 through 1987 time period and in 1988 and to identify the services to be expanded during the 1988-1989 year. Their responses indicated that, by and large, the organizations are expanding services currently being offered rather than changing the mix of services provided. For example, 85 percent are currently engaged in networking and referrals and 69 percent are planning to expand those services, 81 percent offer seminars and workshops and 66 percent plan to expand, and 77 percent provide technical counseling and 60 percent plan to expand. On the other hand, only 43 percent provide liaison to the nation's system of federal laboratories and only 36 percent plan to expand.

Ninety-four of the respondents provided information on the number and type of businesses served. Of the approximately 35,000 firms receiving technology assistance services, 52 percent were manufacturers and 48 percent were non-manufacturing businesses. The firms receiving technology assistance from these organizations are overwhelmingly small businesses - 63 percent of the firms have fewer than 50 employees and 25 percent have between 50 and 500 employees. Thus only 12 percent of the firms had more than 500 employees. On average, 66 percent of the firms assisted required access to established technology while only 37 percent required access to new technologies.

The program managers indicated that they are assisting firms in the following areas:

(a)	product/process development	33 percent
(b)	product/process commercialization	25 percent
(c)	product/process testing	12 percent
(d)	prototype development	11 percent
(e)	other	19 percent

The types of technologies targeted in 1988 include: manufacturing technologies (35 percent), information sciences (15 percent), biotechnology and life sciences (15 percent), material sciences (10 percent), and aerospace and earth sciences (4 percent each).

(2) Business Assistance

As stated previously, every state provides business assistance services to small and medium-sized firms. The organizations included in the survey represent only a small sample of these programs. The organizations included in the survey, however, in addition to providing business assistance, also operate some type of technology development program.

One hundred and eighteen state-supported organizations (66 percent of the total) provided information on their business assistance activities. Of these, 88 organizations provided information on the number and type of businesses assisted. These organizations assisted over 77,000 firms in 1988. Economic development organizations accounted for approximately 40,000 of these firms with each organization assisting an average of 2,664 firms per year. Organizations responsible for technology development programs assist an average of only 500 businesses per year.

The most common services provided are business plan preparation and evaluation (73 percent), small business consulting (72 percent), management assistance (61 percent), and financial analysis (55 percent). The least commonly provided services include labor analysis (19 percent), business forecasting (26 percent), and site location assistance (42 percent). As was the case for technology assistance, the organizations included in the survey intend to continue to expand existing services rather than change the mix of services offered.

With regard to the size of firms being assisted, the distribution is similar to the businesses receiving technology assistance, 60 percent had fewer than 50 employees, 23 percent had 50 to 500 employees, and 16 percent had greater than 500 employees. Unlike the firms receiving technology assistance where 52 percent were manufacturers, only 34 percent of the firms receiving business assistance were manufacturing firms.

State economic development organizations account for the majority of non-manufacturing firms receiving assistance. These organizations report that 80 percent of the firms receiving business assistance from their organizations are non-manufacturers whereas the technology development organizations report that the firms receiving business assistance from them are evenly divided between manufacturing and non-manufacturing firms.

(3) Incubators

A specific tool used to support new, small business is the incubator. Incubator facilities provide low-rent office and lab space for entrepreneurs or early start-up firms. Additional on-site support services such as office support and computer access are also frequently provided along with on or off-site management and technical services on a referral basis. While incubators can serve a variety of firms, they are often developed to serve technology-based clients.

A 1988 study identified 300 business incubators in the United States. While the first state programs supporting incubators was adopted in 1983, 5 years

later approximately half the states have programs that support the development of incubator facilities.

Thirty-seven state-supported organizations provided detailed information on incubator operations. Of these, seven were economic development organizations, and 30 were technology development organizations. Data was provided on 164 incubators. The number of incubators more than doubled between 1985 and 1988.

A 1985 survey of business incubators - the study was not limited to those targeted to technology-based firms - found that almost twice as many firms survive to move out of an incubator as fail while there. "Thus initial comparisons with the general business environment where roughly four times as many firms fail as succeed during their first 5 years, are favorable."[20] For those incubators covered in the survey, the average number of jobs per incubator was 32. On average, each incubator facility housed 6.5 establishments with an average size of 5 employees per firm. A 1988 survey of incubators conducted by David Allen and Mary Ann Dougherty found a somewhat higher level of job creation. Their survey of 127 incubators yielded an average of 85 jobs per facility and 8.5 jobs per tenant.[21] This difference may be due to the fact that the incubators included in our survey are more likely to be targeted to technology-based businesses.

According to the current survey, the average number of years a firm spends in an incubator is three. Most incubators limit the time a firm can remain in the incubator to 4 years. The incubators reported 367 graduates (i.e., firms that went on to move out of the incubator). Of these, the respondents indicated that 91 percent are still in business.

The respondents indicated that an average of 55 percent of the business located in the incubators require access to established technologies while 45 percent require access to new technologies. As compared to other program areas, the businesses in incubators appear to have a greater need for access to new technologies. This may be a result of the fact that incubators are focusing on new, technology-based firms.

What we are not able to determine from the survey is the exact nature of the services being provided in the incubators, nor the extent to which incubators are targeting technology-based businesses or assisting businesses with

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[20]David N. Allen, Creating Jobs by Creating Businesses: The Role of Business Incubators, Washington, DC: National Council for Urban Economic Development, 1985.

[21]David N. Allen and Mark L. Weinberg, The State's Role in Incubator Planning and Operation, Washington, DC: National Council for Urban Economic Development, February 1989.

technological needs, although it is known that many incubators do. The three major technologies targeted by the incubators in the survey are: (1) information technologies; (2) manufacturing technologies and biotechnology; and (3) life sciences.

(4) Research Parks

Research parks, often affiliated with universities, have been established throughout the country to stimulate the growth of technology-based businesses. Such parks often encompass a broad array of private research firms and, on occasion, light manufacturing facilities. A recent study of research parks reports that there has been nearly a 300 percent increase in the number of parks in the United States since 1982 and the authors suggest that such growth is likely to continue. There are now approximately 130 research parks nationwide.[22]

Although many states participate in the development of research parks, few states have established programs to manage them. One exception is South Carolina where the South Carolina Research Authority (SCRA) is developing a statewide research park system. Established in 1983, the SCRA has acquired and developed land for research parks in three locations throughout the state. Several other state technology programs support one or more research parks.

Sixteen state-supported organizations provided information on 27 research parks. The average number of establishments per park in 1988 was six, with an average of 27 employees per park. In 1988, the program managers reported an average occupancy rate of 41 percent. While care must be taken in drawing conclusions from such a small sample, the data seem to support the contention of Goldstein and Luger that we are perhaps overbuilding research parks. They suggest that regional economic conditions, the presence of major research universities, the cooperation and long-term commitment of local leaders, and good fortune are all factors that determine whether parks become successful.

(5) Seed Capital

States have become increasingly active in providing start-up and early stage financing for new technology-based businesses. Very early stage financing is often referred to as "seed" capital. An entrepreneur who has developed a new process, product, or service often needs such financing to support activities involved in proving a technology concept from a business point of view. Start-up capital is essential for further product development and refinement prior to commercial scale production and marketing and to begin initial market testing.

It is difficult to say definitively how many states support seed capital programs. A recent study of state competitive research grant programs

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[22]Harvey A. Goldstein and Michael I. Luger, "Research Parks: Do They Stimulate Regional Economic Development?" Economic Development Commentary, Spring 1989, pp. 3-8.

prepared by the National Governors' Association identified approximately 50 research grant programs operating in over half of the states. The report notes:

> ...27 percent of the programs [included in the competitive research grant study] identified seed capital as an activity they support; 11 percent of the programs support seed capital activities exclusively. But 71 percent of the programs support activities that would be considered traditional seed capital activities (i.e., business plan development, prototype development, and business operations).[23]

Forty-three program managers provided information on state-supported seed capital programs. Total funding for these programs was reported as $41 million in public funds and $59 million in private funds. These programs assisted approximately 1,300 firms in 1988. One-third were manufacturing firms and two-thirds were non-manufacturing firms. As might be expected, the vast majority of these firms are very small - 88 percent had fewer than 50 employees. What is surprising is that firms with greater than 50 employees also received "seed" capital. While this would seem to be a contradiction in terms, one explanation would be that some of this funding was used to support new product or process development.

The program managers reported that 89 percent of the businesses assisted are still in business. Of the firms receiving seed capital, 55 percent require access to new technologies and 48 percent require access to existing technologies.

The respondents reported that 36 percent of their 1988 funds were used for product and process development, 28 percent for product and process commercialization, 13 percent for prototype development, and 8 percent for product and process testing. Fourteen percent was used for other activities.

Program managers reported targeting 30 percent of their 1988 funds to manufacturing technologies, 20 percent to information technologies and 18 percent to biotechnology and life sciences.

(6) Technology/Research Centers

Technology/research centers, often called centers of excellence or advanced technology centers, are vehicles for conducting research in a specific technological area. Usually, the state identifies those areas in which the university system has expertise or that are particularly pertinent to the state's major industries. A research center is established to focus efforts on these targeted technologies with the state serving as a catalyst to bring the resources of the private sector and the university together.

Technology/research centers can be designed to attract new industry to a state, to encourage the creation of new firms through spin-off of new

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[23]John Forrer, State Competitive Research Grant Programs, Washington, DC: National Governors' Association, June 1989.

products and processes, or to help solve the technological problems of existing industries. A 1988 study commissioned by the State of Minnesota identified approximately 100 state-supported centers of excellence.[24]

Forty-one state-supported organizations provided data on technology/research centers. These organizations supported 137 centers in 1988. The largest concentration of centers is in the Midwest with 53, followed by the South with 34, the West with 29, and the North with 21. The program managers reported that nearly 2,000 firms are participating in these 137 centers. Over half of these firms are small and medium-sized companies, four-fifths of these are manufacturers.

Federal Affiliates

These programs are sponsored by a federal agency to address a specific need for information or assistance. Four program types were analyzed in the survey. Each program receives funds from the federal government which must be matched by funds from other sources (e.g., state or local funds).

The first federal affiliate is the Small Business Development Centers Program. The Small Business Development Centers are partnerships between the Small Business Administration (SBA), state and local government, the educational community and the private sector. Each Small Business Development Center (SBDC) serves as a one-stop assistance center for businesses and provides services ranging from pre-business start-up counseling to technical advice for existing businesses. The SBDC mission is to serve as a vehicle for up-to-date counseling, training and research assistance in small business management. In addition, the SBDCs have a legislative mandate to assist in technology transfer, make use of federal laboratories and equipment, and coordinate and conduct research they deem worthwhile. Survey responses were received from 26 of the 53 lead SBDCs.

The University Centers Program is the second federal affiliate; it is administered by the Department of Commerce's Economic Development Administration (EDA). The University Centers Program provides funds to involve the resources of universities in economic development within the community. Funding is provided to establish or augment centers that provide economic development and/or technical assistance. Each University Center (UC) gives top priority to projects which are addressing the economic distress of an area. Survey responses were received from 14 University Centers.

The NASA Industrial Applications Centers Program is the third federal affiliate. There are currently 10 Industrial Applications Centers (IACs) affiliated with universities across the country; survey responses were received from seven IACs. IACs offer clients access to a national data bank that includes over 100 million documents of accumulated technical knowledge,

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[24] Paul B. Phelps, Centers of Excellence: A Catalogue, St. Paul, MN: Office of Science and Technology, Minnesota Department of Energy and Economic Development, January 1988.

along with their expertise in retrieving information and applying it in support of clients' needs. The IACs are backed by IAC Affiliates, state-sponsored business or technical centers, that provide access to the technology transfer network.

The last type of federal affiliate is the Trade Adjustment Assistance Centers Program. The Trade Adjustment Assistance Centers (TAACs) are administered by the Department of Commerce's International Trade Administration (ITA). Each TAAC provides trade-impacted small and medium-sized manufacturers with in-depth technical assistance. The TAAC assists firms in petitioning the Department of Commerce evidencing their lost sales and production as a result of import competition. Upon approval of the petition, the TAAC does a diagnostic examination of the firm and provides an adjustment plan. Survey responses were received from six of the 12 TAACs.

Funding

The federally-supported programs responding to the survey, received approximately $73 million in fiscal year 1988. Of this amount, 46 percent was from the federal government; 22 percent was from state government; 18 percent was from universities; 7 percent was from industry; 2 percent was from local government and 4 percent was from other sources. The federal and state funds for these federal extension programs account for 66 percent of the total allocated funds (see table 4.3).

Services Provided

The federally-supported programs provided technology assistance to over 13,500 establishments, and business assistance services to over 74,000 establishments in 1988. SBDCs serviced the majority of these firms, accounting for 56 percent of the firms receiving technology assistance and 95 percent of the firms receiving business assistance. The technology assistance services provided by the federal programs concentrate on small business (56 percent), with 21 percent directed to large firms (over 500 employees), and 16 percent to medium-sized firms. The business assistance services provided by the federal programs concentrate on small business (less than 50 employees) (53 percent) and on non-manufacturing firms (80 percent) with only a small portion being provided to manufacturing firms (18 percent). In addition, 56 percent of the services provided were for non-manufacturing establishments and 41 percent to manufacturing establishments.

(1) Technology Assistance

Table 4.4 provides summary statistics on the number of businesses which received technology assistance during fiscal year 1988. The table is divided into two parts. Part A shows the breakdown between manufacturing and non-manufacturing establishments. Part B shows the breakdown between small establishments (i.e., less than 50 employees), medium-sized establishments (i.e., 50 to 500 employees) and large establishments (i.e., more than 500 employees).

Table 4.3 Funds Received by Federal Affiliates during Fiscal Year 1988[25]

Source of Funds	SBDC	UC	IAC	TAAC	TOTAL BY SOURCE
Federal Government	19,173	4,945	5,057	5,807	34,982
State Government	8,152	7,774	95	0	16,021
Local Government	1,477	104	0	100	1,681
University	10,640	826	1,658	160	13,284
Industry	478	2,503	1,483	419	4,883
All Other	1,981	47	904	110	3,042
TOTAL ALL SOURCES	41,901	16,199	9,197	6,596	73,893

[25]Federal affiliates may receive funding from more than one federal program. All estimates of program funding by source of funds are based on the responses of the individual program managers. No estimate has been made for those programs which did not respond to the survey questionnaire.

Table 4.4 Summary Statistics on Establishments Receiving Technology Assistance From Each of the Four Federal Affiliates[26]

Part A: Summary Statistics by Type of Establishment Assisted

Type of Establishment	SBDC	UC	IAC	TAAC
Manufacturing	1,380	2,395	1,722	80
Non-Manufacturing	5,874	369	1,361	0
Unknown	284	37	44	0
TOTAL	7,538	2,801	3,127	80

Part B: Summary Statistics by Size of Establishment Assisted

Size of Establishment	SBDC	UC	IAC	TAAC
Less than 50 employees	3,948	2,150	1,408	19
50 to 500 employees	638	570	913	57
More than 500 employees	2,127	44	722	4
Unknown	825	37	84	0
TOTAL	7,538	2,801	3,127	80

[26]All estimates of firms receiving technology assistance classified by type of establishment and size of establishment are based on the responses of the individual program managers. No estimate has been made for those programs which did not respond to the survey questionnaire.

SBDCs

In 1988, SBDCs provided technology assistance to approximately 7,500 firms. In terms of the breakdown between manufacturing and non-manufacturing clients, SBDCs provided services to four times as many non-manufacturing clients as manufacturing clients. This was true for both technology assistance and business assistance. This is the only federally-supported program which provided more assistance to non-manufacturers than manufacturers. Technology assistance services were provided to over 3,900 small firms, over 600 medium-sized firms, and over 2,100 large firms. In this area, SBDC efforts appear to be more as a facilitator than an active participant. The technology assistance most commonly provided by SBDCs are seminars and workshops (100 percent), networking (96 percent), technical consulting (74 percent), and product design assistance (70 percent). Assistance such as demonstration projects (17 percent), state liaison (39 percent) and technical literature (52 percent), were less frequently provided. The establishments assisted by SBDCs required little access to technology. When technology assistance was provided, on average, 27 percent required access to new technology and 49 percent to established technologies.

University Centers

In 1988, University Centers provided technology assistance to over 2,800 establishments. On average, the centers provided assistance to over 300 clients per year, a much smaller number of clients than are served by SBDCs per year. This may reflect the more technical nature of the services being provided by the University Centers. University Centers also concentrate more on serving manufacturing firms. Eighty-five percent of the firms receiving technology assistance were manufacturers. Seventy-seven percent of the firms receiving technology assistance were small businesses, 20 percent were medium-sized establishments. Over 90 percent of the centers provided technical consulting, networking, and seminars and workshops. In addition, the majority of the centers provide technology assistance in product design, technical data, user requests and technical literature. These services are ones which rely on the resources and expertise available through the university at which the center is located. The establishments assisted by university centers do not need extensive access to new or established technologies. In the provision of technology assistance services, an average of 28 percent required access to new technology and 53 percent to established technology.

NASA Industrial Applications Centers

NASA IACs provided technology assistance to over 3,100 firms. The technology focus of the IACs is evident in that technology assistance was provided five times as often as business assistance (compare the figures in table 4.4 with those in table 4.5). Forty-five percent of the firms receiving technology assistance had less than 50 employees, 29 percent had between 50 and 500 employees and 23 percent of the firms employed more than 500 people. The number of large firms receiving assistance is significantly larger than the

other state and federal programs included in the survey. One-hundred percent of the IACs provide technology assistance. Of the technology assistance services provided, 100 percent of the IACs provide networking, technical data, and technical literature, 86 percent provide seminars/workshops, technical counseling, responding to user requests and serve as state liaison, and 71 percent provide assistance in product design. The most commonly cited technology assistance services appear to be ones requiring specific technical expertise. The establishments receiving technology assistance from IACs required access to technologies more than any of the other federally-supported programs. An average of 36 percent of the firms required access to new technologies while 76 percent required access to established technologies.

Trade Adjustment Assistance Centers

TAACs provided technology assistance services to 80 establishments. The clientele that the TAACs work with are highly specialized and are in industries that have been severely impacted by trade. One-hundred percent of the firms assisted were manufacturing firms. TAACs are the only federally-supported extension program that concentrates solely on manufacturing establishments. Technology assistance was provided primarily to medium-sized firms (71 percent), followed by small firms (24 percent). With regard to technology assistance services, 66 percent of the centers surveyed provide assistance in product design and technical counseling. In addition, at least one-third of the centers provide networking, technical data, technical literature, and user request and response. None of the centers surveyed served as state liaison to the federal labs. Of the TAACs included in the survey, only a few (5) indicated that the businesses they serve required access to new or established technologies. Of those responding, 11 percent of recipients required access to new technologies, 59 percent to established technologies. The lack of responses on this question could indicate that among establishments seeking help from TAACs, need for management and marketing assistance outweighs their need for technology assistance. It is surprising, however, that assisting these companies in modernizing their operations does not appear to be a major component of the TAAC program.

(2) Business Assistance

Table 4.5 provides summary statistics on the number of businesses which received business assistance during fiscal year 1988. The table is divided into two parts. Part A shows the breakdown between manufacturing and non-manufacturing establishments. Part B shows the breakdown between small establishments (i.e., less than 50 employees), medium-sized establishments (i.e., 50 to 500 employees) and large establishments (i.e., more than 500 employees).

SBDCs

In 1988, SBDCs provided business assistance to over 70,000 firms. The large number of clients receiving business assistance from SBDCs, an average of 2,700 clients per year per SBDC, suggests that the majority of requests for

Table 4.5 Summary Statistics on Establishments Receiving Business Assistance From Each of the Four Federal Affiliates[27]

Part A: Summary Statistics by Type of Establishment Assisted

Type of Establishment	SBDC	UC	IAC	TAAC
Manufacturing	11,407	1,486	393	260
Non-Manufacturing	57,985	1,333	169	0
Unknown	1,267	48	0	0
TOTAL	70,659	2,867	673	260

Part B: Summary Statistics by Size of Establishment Assisted

Size of Establishment	SBDC	UC	IAC	TAAC
Less than 50 employees	36,504	2,380	605	94
50 to 500 employees	4,065	471	60	156
More than 500 employees	843	16	•	10
Unknown	29,247	0	•	0
TOTAL	70,659	2,867	673	260

[27]All estimates of firms receiving business assistance classified by type of establishment and size of establishment are based on the responses of the individual program managers. No estimate has been made for those programs which did not respond to the survey questionnaire.

assistance are handled with a minimal amount of staff input. The business assistance efforts of the SBDCs appear to be concentrated on smaller businesses (those with less than 50 employees), but about 40 percent of the businesses assisted are of unknown size. SBDCs provided business assistance services to over 3,600 clients with less than 50 employees, over 400 medium-sized companies (50 to 500 employees) and over 800 large companies (over 500 employees). Management assistance and business plan development are provided by 100 percent of the SBDCs. While marketing surveys, small business consulting and financial analysis are provided by 96 percent of the SBDCs.

University Centers

In 1988, University Centers provided business assistance to over 2,800 establishments. Fifty-one percent of the establishments receiving business assistance in 1988 were manufacturing firms. The efforts of the University Centers are concentrated on assisting smaller businesses (those with under 50 employees). Of the business assistance provided, 83 percent of the firms had less than 50 employees, and 16 percent had between 50 and 500 employees. The services provided by the University Centers are tied to the types of resources the home-university can help provide. Of the centers responding, 100 percent provide management assistance and 91 percent provide small business consulting services. In addition, the majority of the centers provide feasibility studies, financial analysis, market surveys and site location assistance and business plan development.

NASA Industrial Applications Centers

NASA IACs provided business assistance to over 650 establishments. Of the business assistance services provided to IAC clients, approximately 70 percent was provided to manufacturing firms, and 30 percent to non-manufacturing firms. The size of the establishment assisted varied considerably between technology assistance and business assistance. Of those firms provided business assistance, 90 percent had less than 50 employees and 9 percent had between 50 and 500 employees. As was noted above, the firms provided technology assistance tended to be medium-sized. Forty-two percent of the IACs indicated that they provide no business assistance services. Of those that do provide business assistance services, 100 percent provide feasibility studies and small business consulting. In addition to this, 75 percent provide management assistance, market surveys and site location assistance. The rest of the business assistance services are provided by a small percentage of the centers. Based on the types of business assistance services provided, it appears that the IACs business assistance efforts are ones with a more technical focus.

Trade Adjustment Assistance Centers

The TAACs main allocation of funds is towards business assistance services (68 percent). The services provided by TAACs are geared to helping businesses improve their management or processes and therefore the business assistance component is emphasized more than technology assistance. TAACs provided business assistance services to 260 establishments. Business

assistance efforts tended to concentrate on medium-sized firms, those with 50 to 500 employees. Of the business assistance services provided, 36 percent were to small firms, 60 percent to medium-sized firms and 4 percent to large firms. The TAACs consistently provide the most comprehensive services of the federally-supported extension programs. One-hundred percent of the TAACs provide business assistance in the form of business plan development, financial analysis, business management, market surveys and small business consulting. The other business assistance services are provided infrequently reflecting the nature of the TAAC program (i.e., assisting trade-impacted manufacturers).

5. MICRO-STUDIES FOR SELECTED TECHNOLOGY EXTENSION PROGRAMS

5.1 STATE-BASED PROGRAMS

While the state programs described earlier contribute to technology transfer, most of them pursue this objective as only one of several. Frequently, technology transfer is not the primary objective of these organizations. A much smaller subset of state programs have evolved whose primary function is to help small and medium-sized businesses, particularly manufacturers, adopt advanced technologies.

Based on an examination of organizational objectives, 13 state-based programs were identified as candidates for micro-studies. In two cases, the Industrial Extension Service at the Georgia Institute of Technology and Michigan's Industrial Technology Institute, the extension service is housed in an organization with additional responsibilities for technology development. This section discusses the data provided by these programs; a snapshot description of each program is also provided. The 13 program descriptions draw on the survey data, research conducted by Philip Shapira of the University of West Virginia, and information supplied directly by the managers of the individual programs.[28]

The 13 programs discussed below, accounted for only 4 percent ($25 million) of total expenditures on the range of development initiatives covered in the survey. It should be noted, however, that half of this amount ($12.4 million) is accounted for by one organization, the Michigan Industrial Technology Institute. Forty-nine percent of these funds support technology research centers, 47 percent support technology assistance services, 3 percent support business assistance activities, and 1 percent support seed capital programs. If, however, the Industrial Technology Institute is excluded, the amount allocated to technology assistance increases from 47 percent to 75 percent and the amount allocated to technology research centers decreases substantially from 49 to 17 percent. Budget size ranged from $450,000 to $12.4 million annually. With the exception of ITI, most budgets fall within the $500,000 to $1.5 million range.

The programs range in staff size from 1 to 122. For the majority of the programs the staff is small, averaging about 20. Overall, the program managers reported providing assistance to 5,029 firms in 1988. Over three-fourths of these firms, however, are accounted for by two programs, the Ohio Technology Transfer Organization (OTTO) program, and the Pennsylvania Technical Assistance Program (PENNTAP). The remaining programs typically served 150 to 250 clients per year. This wide range in the number of businesses served may reflect the different approaches employed by these programs. Some of the programs act primarily in a broker's role, matching businesses with various sources of expertise, others take a more active role with staff providing one-on-one consulting services.

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[28] Philip Shapira, "Modern Times: Learning from State Initiatives in Industrial Extension and Technology Transfer," Economic Development Quarterly, Vol. 4, No. 3, 1990, pp. 186-202.

Georgia Institute of Technology's Industrial Extension Service

Established in 1956, the Industrial Extension Service (IES) is one of the oldest technology extension programs. Using a network of regional offices and field staff, the service provides manufacturers and local communities with information and technical assistance on new technologies, management tools and techniques, and access to problem solving engineering skills.

A firm interested in securing services through the IES will usually contact a regional office. An initial site visit to the firm is used to collect information about the business, including data describing production methods, management structure and financial conditions. The IES staff can provide recommendations or tap the expertise of Georgia Tech's faculty and research centers. Technical assistance is not limited to engineering questions; staff members have business problem-solving experience and diverse industrial backgrounds.

The IES encompasses the Southeastern Trade Adjustment Assistance Center, a University Center, and an Apparel Manufacturing Technology Center supported by the Defense Logistics Agency. Total funding for all of these programs was $12.2 million in 1988. Approximately $2.5 million is used exclusively for the extension service. In 1988, IES provided business assistance to nearly 900 firms, 80 percent of which were manufacturers. Nearly all had fewer than 500 employees. Technology assistance was provided to 1,500 firms, 90 percent of which were manufacturers. Seventy-six percent had fewer than 50 employees and 23 percent had between 50 and 500 employees.

Maryland's Technology Extension Service

Maryland's Technology Extension Service (TES) is quite similar to Georgia's IES. The program, which is housed in the Engineering Research Center of the University of Maryland, was established in 1984. The role of TES is to provide appropriate assistance in all areas of technology to all Maryland firms on request. Working through five regional offices, TES can address company problems through regional staff expertise, staff of the Engineering Research Center, university faculty, and use of outside resources. The offices are staffed by industrially trained engineers who respond to companies, providing individual technical advice and problem solving. On average the TES will provide up to 5 days of support per problem.

Total funding during fiscal year 1988 was $550,000. TES assists an average of 300 firms per year, most are small and medium-sized manufacturers. Of the 300 firms assisted in 1988, 270 (90 percent) were manufacturers. The program manger reports that 90 percent of the firms assisted require access to established technologies, 10 percent require access to new technologies.

Major areas of assistance include:

o	process improvement	30 percent
o	industrial waste management	25 percent

o	product/process development	15 percent
o	materials handling	10 percent
o	product/process commercialization	10 percent
o	plant layout	5 percent
o	prototype testing	5 percent

Michigan's Industrial Technology Institute

The Industrial Technology Institute (ITI), an independent non-profit center, has created a multi-faceted program for technology development, technology deployment, and training designed to encourage the adoption of productivity enhancing technologies in the durable goods industry. ITI focuses on the design and operation of the factory of the future.

ITI offers its clients a variety of services including: research and development; applications engineering; strategic and technical consulting; evaluation and testing; training; and information services. A number of these services are provided by ITI on a fee for service basis.

ITI was established in 1982. The fiscal year 1988 funding includes $4 million in state funding, $2.4 million in industry funding, $600,000 in federal funding, and $5.4 million in other funding, largely accounted for by contracts with industrial clients. Twenty percent of ITI's budget is allocated to technology assistance, the remainder is allocated to the Institute's multiple research centers. In 1988 ITI provided technology assistance to approximately 150 firms, all of which were manufacturers. Ninety percent of this assistance was in the area of product and process development, the remaining 10 percent was for product and process commercialization.

Michigan Modernization Service

Established in 1985, the Michigan Modernization Service (MMS) now operates as part of the Industrial Technology Institute described above. The MMS provides direct consultations to small and medium-sized manufacturers in the areas of technology deployment, workforce development and market analysis. This consultation includes a basic assessment of the firm's manufacturing operations, and their technology, training, and market needs.

After the initial assessment, an on-site visit is conducted. Following the visit, MMS staff develop a detailed report with recommendations and references. A follow-up meeting is held with the firm to develop an implementation plan.

A unique aspect of the program is the integral role of training. MMS visits to firms are always made by a team which includes a person with expertise in the training area. All recommendations developed for firms also include a training component.

With total fiscal year 1988 funding of $3.2 million, the program employs 48 staff, 28 of whom are technical, 20 business and 7 support. In 1988, the program served 180 manufacturing firms; in 1989 the program expects to handle 300 clients. On average a client receives approximately 6 days of in-depth assistance. The program manager reports that for the most part the firms assisted by the program require access to off-the-shelf technology.

Pennsylvania Technical Assistance Program

The Pennsylvania Technical Assistance Program (PENNTAP) is a joint program of Pennsylvania State University and the Pennsylvania Department of Commerce. Established in 1965, PENNTAP helps business and industry overcome operational setbacks of engineering, scientific, and technical problems, which affect their ability to remain stable and to compete in the marketplace.

It employs full-time professionally trained and experienced technical specialists who provide personalized attention to each problem. The staff also includes technical librarians who operate PENNTAP's Library Information System. From their own knowledge or from the many scientific and technical resources available to them, the technical specialists pass along solutions that represent current and proven information.

PENNTAP, with 13 professional staff, 11 technical and 2 business, had a 1988 budget of $1.3 million. Two-thirds of its budget comes from the university, approximately 20 percent is provided by the state, with the remainder provided by the federal government. PENNTAP serves approximately 1,000 firms per year, 75 percent of whom require access to established technologies.

The following types of services are provided:

o	productivity improvement	45 percent
o	product and process development	25 percent
o	product and process testing	15 percent
o	prototype development	10 percent
o	product and process commercialization	5 percent

Unlike some of the other extension programs, PENNTAP provides no business or management assistance to their clients. Firms needing this type of assistance are referred to other sources.

Pennsylvania's Industrial Resource Centers Program

In 1988, Pennsylvania initiated a new Industrial Resource Centers (IRC) Program designed to transfer both known and advanced technology to small and medium-sized firms. Unlike many of the extension services, the program is not university-based. The centers will help firms address problems encountered in integrating computers into manufacturing processes, improving quality control and production planning, utilizing inventory controls, and providing specialized training for workers.

The program is funded at $10 million a year for 3 years. These state funds must be matched on a 1:1 basis. Eventually it is hoped that the centers will become self-supporting. Initially each center plans to assist 30 to 70 firms annually.

New Jersey's Technology Extension Center Program

The New Jersey Commission on Science and Technology has established a series of Technology Extension (TEX) Centers in four technological areas. They include:

- The John P. Caufield Technology Extension Center for Investigative Cancer Research. The primary focus of this TEX Center is to develop partnerships among industry, hospitals, clinics, and physicians to facilitate technology transfer.

- New Jersey Polymer Extension Center. The Polymer TEX Center provides assistance to New Jersey's polymer firms to resolve and prevent technical problems regarding materials selection, process engineering, and quality control. In addition, the center seeks to accelerate the application of advanced technology to the state's polymer processing industry.

- Technology Extension Center in Information Sciences. This TEX Center exists to aid New Jersey businesses in the areas of computers and telecommunications by providing training, reference resources, demonstration and testing facilities, and the extension services of a full-time professional staff and of subject matter experts, primarily drawn from the faculties of the New Jersey Institute of Technology, Stevens Institute, and other New Jersey colleges and universities.

- Fisheries and Aquaculture Technology Extension Center. This TEX Center aims to improve the productivity of industrial and natural systems used by the states' fisheries and aquaculture industries. The center both conducts and transfers applied and basic research.

Each center receives approximately $500,000 in annual funding from the Commission. During 1988, the four centers served nearly 600 businesses, with each center serving between 100 and 200 clients.

New York State Industrial Innovation Extension Service

The Industrial Innovation Extension Service (IIES) was established by the New York Science and Technology Foundation in 1983. The program provides established, small manufacturing businesses with knowledge, attitudes, and skills so they can address issues of technology-based productivity improvements. Services are provided through five regional organizations operating under contract to the Foundation. Staff of these regional offices

provide assistance to companies to research, evaluate, and implement opportunities for technology and productivity-related improvements.

In the initial stages of the program, the IIES works primarily with manufacturing firms in need of newer, more efficient processes and product development technologies. Management assistance, worker training, and other assistance can also be requested by clients. In these situations, the field representatives act as brokers, referring the client to an appropriate local organization that can provide the needed service.

Total funding for the IIES program in 1988 was $781,000, of which $500,000 was provided by state government. The remainder was provided by universities ($112,000), local governments ($69,000), and other sources ($100,000). IIES assisted 200 manufacturing firms in 1988, over 90 percent of which had fewer than 500 employees. Eighty percent of the services provided was helping companies use existing technology.

Ohio Technology Transfer Organization

Part of Ohio's Thomas Edison Program, the Ohio Technology Transfer Organization (OTTO) provides Ohio businesses with direct access to new technology and research through a statewide network of 34 technology transfer agents based at two-year colleges.

The primary services and activities of OTTO are to:

- Provide one-on-one confidential, technology-related services to Ohio businesses;
- Forecast and identify strategic manufacturing-related technologies crucial to the enhanced productivity of Ohio businesses;
- Assist Ohio businesses in applying strategic technologies considered essential to their future growth; and
- Provide engineering, research and development, and business management problem-solving assistance to Ohio businesses.

OTTO agents work with businesses to determine a company's specific needs and then act as a liaison with a variety of government and education resources throughout the state. In this sense, OTTO is really a brokering program.

The program was funded at $1.5 million in 1988, all of which is provided by the state. Of the 3,000 firms assisted in 1988, approximately 40 percent were manufacturers, 90 percent had fewer than 50 employees. Ninety-one percent of these firms required access to existing technologies.

5.2 FEDERAL AFFILIATES

These programs are sponsored by a federal agency to address a specific need for information or assistance. Four program types were analyzed in the survey. The four program types are: (1) the Small Business Development Centers Program administered by the Small Business Administration; (2) the University Centers Program administered by the Department of Commerce's Economic Development Administration (EDA); (3) the Industrial Applications Centers Program administered by NASA; and (4) the Trade Adjustment Assistance Centers Program administered by the Department of Commerce's International Trade Administration (ITA). Brief descriptions of each program type were given in section 4.2.

Each program receives funds from the federal government which must be matched by funds from other sources (e.g., state or local funds). Certain federal affiliates differ from the state-based programs described earlier because they place a greater emphasis on business assistance. These distinctions are worth noting, especially in the case of the Small Business Development Centers Program. Examples of specific programs are described below.

Small Business Development Centers Program

The Rhode Island Small Business Development Center (RISBDC), located at Bryant College, is typical of SBDCs. Founded in 1982, the center has 15 staff members, almost half of which are business, the rest are technical (13 percent) and support (40 percent) and the majority of their efforts are in the area of business assistance. The RISBDC is a cooperative effort and is jointly funded by the Rhode Island Department of Economic Development, the SBA and the state university system. The RISBDC provides free consulting, low-fee training and related business development services to small state businesses. These services, which are offered at five offices throughout the state are often provided by private consultants who work with RISBDC on a case-by-case basis. The RISBDC has also branched beyond its professional management assistance and has specialty programs in export assistance and SBIR. Eighty percent of the firms assisted were manufacturing and 86 percent were small businesses.

University Centers Program

An example of an EDA University Center is the Nebraska Technical Assistance Center, located at the University of Nebraska-Lincoln. The Center is a cooperative effort and is jointly funded by the University of Nebraska-Lincoln, the Nebraska Department of Economic Development and EDA. Established in 1985, the Center provides technical assistance and information to manufacturers and processors in the area of engineering and technology with the objective of helping these companies improve their productivity. Through these efforts the Center seeks to produce a positive economic impact, as measured by increases in profits, job creation, and investments. The Center accomplishes its objectives through a variety of means, the most significant being direct one-on-one, short-term consultations

with businesses. The Center also facilitates technology transfer through a variety of ways including newsletters, technical bulletins, information searches, workshops, and seminars. Other services include non-legal patent and trademark assistance, research assistance, and referral assistance to other service providers. NTAC specializes in providing short-term, diagnostic technical assistance to manufacturers in the areas of production control, plant layout, safety, materials handling, and automation. Of those firms assisted in 1988, 81 percent were manufacturers, 68 percent were small businesses, and 27 percent were medium-sized businesses. The highest percentage of establishments assisted was small manufacturing firms (52 percent). The Center is part of a network of related service providers including the Nebraska Business Development Centers, the Nebraska Food Processing Center, the State College, and Technical Community College systems. NTAC is also a NASA IAC affiliate.

Industrial Applications Centers Program

The Southern Technology Applications Center (STAC) in Alachua, Florida is one of the 10 IACs across the country. Founded in 1977, the center currently has just over 30 staff, 34 percent of which are technical and 25 percent business. STAC was founded by the state university system and NASA to provide state business and industry with easy access to the latest available information and technology. STAC activities and services can be grouped in a number of categories - information research and document procurement, education, linkage development, business assistance, and funded projects. The diverse services and activities that fall in these categories are all designed to increase high technology economic development and enhance economic competitiveness for the United States. The activities of STAC involve the private, public and academic sector. STAC has area offices throughout the state university system as well as affiliations with 23 universities in the south. Program funds of STAC are oriented primarily towards technology assistance (65 percent), although 15 percent goes to business assistance activities. The majority of the firms assisted by STAC are non-manufacturing (67 percent) and small business (68 percent). The highest percentage of companies assisted is small non-manufacturing companies (44 percent).

Trade Adjustment Assistance Centers Program

The Western Trade Adjustment Assistance Center, located in Los Angeles is an example of an ITA TAAC. Founded in 1978, the center consists of 5 full-time equivalent (FTE) technical, 5.5 FTE business, and 3 FTE support staff. The objectives of the center are to assist: (1) U.S. manufacturers to qualify for trade adjustment assistance; (2) U.S. manufacturers with defining areas of improvements and formulate implementation plans for executing these technical and/or business structural improvements; and (3) with the implementation of structural, long-term improvements through technical assistance and project management activities. The areas of specialization are related to three objectives cited above. The first, pre-certification assistance, helps firms in the preparation of petition forms and supporting documentation required for certification of eligibility in order to apply for trade adjustment

assistance. The second, post-certification assistance, involves diagnostic surveys, the preparation of adjustment proposals to address the firm's short-term problems, assistance in finding non-government funding, and defining the firm's technical needs to carry out the adjustment proposals. The third, post-approval assistance, is concerned with helping the firm to carry out the approved adjustment proposals. The TAAC conducts product development, diversification, marketing, productivity improvement, and related studies. The TAAC assists the impacted firm in the design and installation of accounting, financial, and management control systems. The impacted firm receives assistance with loan applications for government direct, government guaranteed, and non-government funding. The TAAC continues to monitor the firm's activities to ensure that approved strategic plans are on-course and that loan covenants and conditions are being complied with. The orientation of the program is 63 percent technology assistance and 37 percent business assistance. All of the firms assisted in 1988 were manufacturing firms, 63 percent were mid-size companies (50 to 500 employees) and 37 percent were small businesses.

6. STATE-FEDERAL INTERACTIONS

6.1 USE OF FEDERAL PROGRAMS

A wide variety of federal programs designed to encourage technology transfer, technology development and general business development have been established over the years. One element of this study was to examine the extent to which the state and federally-supported programs described above are aware of and use these federal programs and to obtain an assessment of their usefulness.

Overall the federal programs were rated highly by the program managers. The federal program cited as being of greatest assistance in promoting technological innovation is the Small Business Innovation Research (SBIR) Program. Sixty-nine percent of the respondents reported using the SBIR Program and 74 percent gave the program a rating of good.

The SBIR Program was established by Congress in 1982 to provide the opportunity for small firms to participate in federal research and development. The states have found the program to be an important source of seed capital for small technology-based businesses. Over a dozen states have established state programs to complement and build on the federal SBIR Program.

Other highly rated but less frequently used programs included: (a) EDA's University Centers; (b) USDA's Cooperative Extension Service; (c) NSF's Industry/University Cooperative Research Centers; (d) the Department of Commerce's Office of Productivity, Technology and Innovation; and (e) NASA's Commercial Use of Space Program (see table 6.1).

An examination of the use of the 25 federal programs selected for inclusion in the questionnaire, indicates that most of them were used by less than a third of the respondents (see table 6.2). In some cases, this may be due to the fact that these programs provide specialized services that would only be of interest to a limited number of firms. NASA's Commercial Use of Space Program, for example, may have limited value to the majority of the small to medium-sized manufacturers receiving assistance through these programs.

It is also the case, however, that some of these programs appear to be under utilized. Three programs requiring closer examination are: (1) the Federal Laboratory Consortium for Technology Transfer (FLC); (2) the Center for the Utilization of Federal Technology (CUFT); and (3) the NASA Technology Utilization Program. The first two programs were described in chapter 2. The NASA program was described briefly in chapter 2 and analyzed in greater detail in chapters 4 and 5.

Recall that the FLC is an initiative designed to provide access to the technical expertise of the staff of the nation's federal laboratory system. Yet, based on the results of the survey, only 39 percent of the respondents have used the program. Greater outreach may be needed both on the parts of the FLC and its member laboratories, particularly NIST, in order to make program managers aware of the resources that are available to them through the FLC. One way in which this can be done is through the Offices of

Table 6.1 Federal Programs Rated Most Highly by Respondents

Program Name and Sponsor	Percent of Total Respondents that have used the Program	Percent of Total Respondents giving the Program an Assessment of Good
Small Business Innovation Research (SBIR) Program	69	74
University Centers (EDA)	32	74
Commercial Use of Space Program (NASA)	29	69
Cooperative Extension Service (USDA)	43	68
Technology Utilization Program (NASA)	35	68
Office of Productivity, Technology and Innovation[29] (DOC)	24	67
Industry/University Cooperative Research Centers (NSF)	26	67

[29]Now the Office of Technology Policy.

Table 6.2 Use and Assessment of Selected Federal Programs

Program Name and Sponsor	Percent of Total Respondents that have used the Program	Percent of Total Respondents Giving the Program an Assessment of Good
Small Business Innovation Research Program (All)	69	74
Small Business Development Center Program (SBA)	66	55
SCORE/ACE (SBA)	48	47
Patent and Trademark Office (Commerce)	43	62
Cooperative Extension Service (Agriculture)	43	63
Job Training Partnership Act (Labor)	41	63
Federal Laboratory Consortium (All)	39	63
Center for Utilization of Federal Technology (Commerce/NTIS)	36	60
Technology Utilization Program (NASA)	33	64
Community Development Block Grants (HUD)	30	57

Table 6.2 Use and Assessment of Selected Federal Programs (continued)

Program Name and Sponsor	Percent of Total Respondents that have used the Program	Percent of Total Respondents Giving the Program an Assessment of Good
Energy-Related Inventions (Energy and Commerce/NIST)	30	58
University Centers Program (Commerce/EDA)	27	69
Commercial Use of Space Program (NASA)	27	67
Office of Small and Disadvantaged Business Utilization (All)	27	46
Small Business Investment Companies (SBA)	27	67
Industry/University Cooperative Research Centers (NSF)	26	67
Trade Adjustment Assistance Centers Program (Commerce/ITA)	25	38
Office of Productivity, Technology and Innovation[30] (Commerce)	24	67
Energy Extension Service (Energy)	19	59

[30]Now the Office of Technology Policy.

Table 6.2 Use and Assessment of Selected Federal Programs (continued)

Program Name and Sponsor	Percent of Total Respondents that have used the Program	Percent of Total Respondents Giving the Program an Assessment of Good
National Appropriate Technology Assistance Service (Energy)	19	59
Computer and Information Science and Engineering (NSF)	18	61
Measurement and Engineering Research Grants (Commerce/NIST)	7	53
Scientific, Technological and International Affairs (NSF)	7	57
Trade Adjustment Assist-ance Workers (Labor)	6	46
Program for Mathematics, Science, Computer Learning and Critical Foreign Languages (Education)	2	50

Research and Technology Applications (ORTAs) located at each of the major federal laboratories. Because nearly every state has one or more federal laboratories, such an approach would have the advantage of being locally-based.

The second program, the Center for the Utilization of Federal Technology (CUFT), was created by the Stevenson-Wydler Technology Innovation Act of 1980 to serve as the collection point for the information generated by the ORTAs. Acting as a special information resource, CUFT offers program managers and the businesses they serve a series of special information products linking them with federal technology and resources. Since many of the resources provided by CUFT bear on the activities of the federal laboratory system, any outreach effort to promote the use of the FLC should also include CUFT. CUFT is also developing its own outreach program which will include on-site training and an information packet of key documents. The training will include information on-line databases as well as on other programs (e.g., the FLC and NIST), whereas the information packet will enable program managers to determine which resources are best suited to the businesses they serve.

The third program is the NASA Industrial Applications Centers (IACs). It is unclear why more state-based programs have not taken advantage of this program. The IACs are distributed across the country, in order to promote ease of access. Furthermore, the services they provide include on-line literature searches as well as training and networking. Several of the IACs are also developing a system of "Affiliates" to bring state-based programs into their service network.

6.2 SUGGESTED APPROACHES FOR PROMOTING THE TRANSFER OF FEDERAL TECHNOLOGY

State and federal program managers agreed that in terms of strategies to promote the transfer of federal technology they would place greatest emphasis on: (1) cooperating actively with federal agencies in their technology transfer programs; and (2) establishing a training program at the state and local level focused on federal technology transfer and cooperation.

Additional strategies of lesser importance are: (a) cosponsoring demonstration projects that apply federally-developed technology; and (b) making use of a clearinghouse to disseminate information on federal research and development. In the area of cosponsoring demonstration projects, NIST's State Technology Extension Program will provide funds on a matching basis to the states to: (1) demonstrate methods by which the states can, in cooperation with federal agencies, increase the use of federal technology by businesses within their states to improve industrial competitiveness; or (2) help businesses in their states take advantage of the services and information offered by the NIST Regional Centers for Transfer of Manufacturing Technology. The clearinghouse approach, on the other hand, will draw on resources such as the shared responsibility between NIST and the Department of Commerce in developing and disseminating information through the Clearinghouse for State and Local Initiatives on Productivity, Technology, and Innovation.

Table 6.3 Potential Strategies for Promoting Federal Technology

Potential Strategies	Average Allocation of $100	
	State-Supported Programs	Federally-Supported Programs
Cooperate actively with federal agencies in their technology transfer programs	34	35
Cosponsor model demonstration projects	24	15
Draw on a federal clearinghouse to disseminate information on federal R&D	16	24
Maintain a training program at the state and local level focused on federal technology transfer and cooperation	26	26

Whereas both state and federal program managers agreed on the ranking of items (1) and (2), they disagreed on the rankings of items (a) and (b). The state respondents placed greater emphasis on cosponsoring demonstration projects, item (a), as compared to drawing on a federal clearinghouse to disseminate information on federal research and development, item (b). On the other hand, the federal respondents favored the clearinghouse, item (b), over demonstration projects, item (b), by nearly the same margin (see table 6.3).

State and federal program managers suggested a number of federal resources which their programs could utilize; most of the suggested information/ technical assistance resources focused on the importance of building and maintaining a "system of networks." The suggestions can, however, be divided into several broad categories: (1) federal publications focused on opportunities for technology commercialization; (2) an on-line system for matching a small business' technology needs to expertise within a federal laboratory; (3) a system of "federal laboratory affiliates;" and (4) personnel exchange programs. The four categories listed above are arranged according to the degree of commitment they require from a participating program. Each category will be described briefly in the text which follows. The section concludes with an outline of a process for matching specific technological needs with a federal source of expertise.

Several federal agencies prepare publications which describe technologies thought to have potential for commercialization. Perhaps the best known examples of this type of publication are NTIS's Tech Notes and NASA's Tech Briefs. Tech Notes is published by CUFT and was described earlier. Tech Briefs is published by NASA's Technology Utilization Program. Tech Briefs is widely disseminated by NASA; it has been published since 1962. Each of its 10 yearly issues contains information on newly developed products and processes, advances in basic and applied research, improvements in shop and laboratory techniques, new sources of technical data and computer programs, and other innovations originating at NASA field centers or at the facilities of NASA contractors. Firms interested in a particular innovation may get more detailed information by requesting a technical support package from NASA. The Technology Utilization Program also publishes an annual Spinoff volume and the NASA Patent Abstracts Bibliography, a semiannually updated compendium of NASA patented inventions available for licensing.

The Oak Ridge National Laboratory publishes a series Technology Applications Bulletins. These bulletins are made available through the Energy Systems Office of Technology Applications. Each bulletin contains brief descriptions of selected technologies and reports. The bulletins provide guidance on how to obtain further information, gain access to technical resources, and initiate direct contact with Energy Systems researchers.

On-line systems are an important resource for many programs. Several states have initiated programs to develop software for matching the research needs of small businesses with research organizations (e.g., a state university or a center of excellence). Many states, through the university/college system, have developed faculty profile databases. Generally, these databases are searched using keywords to describe the individual's area of expertise.

Although some databases can provide only name, address, telephone number, and areas of expertise, others can give complete professional and educational background. In addition, a variety of publications exist which list databases by subject area. Some documents provide information on such categories of information as: data centers; expert databases; high tech directories; SBIR; selling overseas; and technology assistance.

Two federal resources aimed at linking businesses with federal technical experts are CUFT's Directory of Federal Laboratory and Technology Resources and the FLC Clearinghouse. Whereas CUFT produces a publication which can, at least in principal, be put on-line, the FLC Clearinghouse is an operational database. The FLC Clearinghouse contains information on most of its member laboratories. Basically, the FLC Clearinghouse provides each member laboratory with a questionnaire. One or more technology transfer agents (e.g., a member of an ORTA) completes the questionnaire by indicating the types of research being performed at the laboratory. This information is then stored in the FLC Clearinghouse database.

The FLC Clearinghouse contains much of the type of information needed to match the needs of businesses with a federal expert. Unfortunately, there are a number of complicating factors which have reduced the usefulness of the FLC Clearinghouse. Survey results indicate that many program managers are unaware of the FLC and hence would not know about the FLC Clearinghouse. Another, and potentially serious, problem concerns the completeness of the FLC's database. The last area concerns the keywords used in classifying federal technologies and how they relate to the keywords used by states which have on-line systems. The three complicating factors just mentioned imply that the FLC Clearinghouse needs to be analyzed critically from the perspective of the states and their business clientele before the program managers will be able to use the system with confidence.

A system of "federal laboratory affiliates" is currently being used by organizations such as NASA to provide access to federal technology. The NASA affiliates system creates partnerships between state-based programs and a NASA Industrial Applications Center (IAC). The state-based programs benefit because their domain of expertise is expanded (e.g., new capabilities to retrieve computerized business and technical information). Similarly, the SBDCs have a special arrangement which enables them to access a wide variety of on-line databases at no charge to their clients.

Technology transfer has frequently been described as a "contact sport." Consequently, several states have used personnel exchange programs to ensure that the one-on-one relationships between their program and a federal laboratory are formed. For example, New York places state-sponsored technology transfer specialists at each of the two major federal laboratories in the state. During their internship, the state specialists gain in-depth and first-hand knowledge of the lab's R & D activities. Similarly, the state encourages personnel from the federal labs to become familiar with the business needs within the state and the state resources available to businesses. Such an exchange, repeated at regular intervals, promotes a more complete understanding of business needs and how the federal labs can be of greatest assistance.

The previous discussion begins to bring into focus a process through which state-based programs can more efficiently access federal technology. Over the past several years many approaches have been explored. Of particular relevance to this study is a model process used by NERAC, Inc. The NERAC process has been tested and documented.[31] In addition to providing a conceptual framework for the transfer of federal technology, it serves to set the stage for several specific recommendations given in the next chapter.

The NERAC Process

The NERAC organization had its start as a regional program known as the New England Research Applications Center. After leaving the University of Connecticut, the full name was dropped and the organization incorporated as NERAC. Also, since NERAC, Inc. operates nationally, the New England part of the original acronym was no longer felt to be appropriate.

Each time a business requests guidance on a technical problem, NERAC assigns the problem to the technical specialist most knowledgeable in the topic area. This individual works with the business and other NERAC staff in order to gain a complete understanding of the problem area.

Next, NERAC's technical specialist identifies the federal laboratory responsible for work in this area. This step actually takes place in several stages. Having defined the problem to a narrow topic area, NERAC's technical specialist determines what federal agency is responsible for research in the topic area. Next, he or she telephones the ORTA in the agency's nearest laboratory to request assistance in identifying the most appropriate agency laboratory performing research in the topic area. The underlying premise is that the technology transfer officer in the laboratory's ORTA is better qualified than NERAC to identify the best source of assistance within its sister laboratories.

Based upon this individual's recommendation, NERAC contacts the technology transfer officer at the appropriate laboratory. After a preliminary discussion, this officer refers NERAC to the laboratory scientist or engineer most qualified in the specialized topic area. NERAC's staff contacts this federal expert, describes the problem or technological area and ascertains the person's receptiveness to talking with the business. Most often, this federal expert agrees to talk with the business, but sometimes he or she refers NERAC to someone who is more directly involved in the research area.

Finally, the business and federal expert are put in contact with each other. Through this process, NERAC lays the groundwork for direct telephone communication between its clients and the appropriate laboratory personnel. Followup accompanies all such exercises to verify satisfactory performance.

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[31] Daniel U. Wilde and Nan R. Cooper, "Exploiting the Resources of the Federal Laboratories," Proceedings of the 1989 Technology Transfer Society Meeting, March 1990, pp. 43-48.

This model procedure differs greatly from alternative models in that NERAC is situated at the juncture of the information flow between industry and government. That is, NERAC receives input from the industrial participant clarifying what information is desired, then seeks out the appropriate federal source based upon the recommendations of those most closely acquainted with the federal network. At no time is there a loss of "control" in this process.

Several advantages accrue from NERAC's model procedure. First, it results in a direct, convenient, and fast transfer of technology and information. The typical turnaround time in linking businesses with a federal expert is 36 hours. This short response time means businesses are able to move forward undelayed. Other models of technology transfer often require several days before a response is provided.

Second, it assures greater control. NERAC controls the search for the best-qualified federal expert for each unique problem. Consequently, the problem of miscommunication between laboratory personnel is minimized. The end result is therefore a higher-quality, more appropriate match. Moreover, the NERAC search procedure keeps to a minimum information on the research activities of the business. This measure ensures that limitations are placed on the number of "outsiders" who have knowledge of any business' proprietary research activities.

7. SUMMARY

Chapters 1 through 6 of this report have presented the major findings of a study requested in the Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418). The purpose of the study was to capture information on the various programs the states are using to promote technological innovation. The study was carried out in cooperation with the National Governors' Association (NGA). NIST and NGA worked through the Governors' Offices, primarily their Science and Technology Advisors, to collect information on their key programs.

A two-pronged approach was used in carrying out the study; this approach corresponds to Parts I and II of the report, respectively. The first part of the report focused on an in-depth review of the literature on technology transfer and technology extension services. Special emphasis was placed on federal technology transfer efforts and on identifying and documenting state technical outreach and economic development activities. The second part of the report was concerned with a discussion of the major findings associated with a nationwide survey of state and federal extension services.

Because so much information was presented in the body of the report, it is useful to revisit the six items stated in section 1.1 which the Act requires the study to include. The text which follows provides an explicit statement of items (a) through (f) of the Act as they were given in section 1.1. Following the statement of each item, a brief description is given of the study's major findings which relate to that item. This approach provides a capsule summary of the overall study.

Crosswalk Between Study Requirements and Study Findings

Requirement A: **A thorough description of each state program, including its duration, annual budget, and the number and types of businesses it has aided.**

The present system for delivering services to small and medium-sized businesses is decentralized. There are a large number of organizations, supported by both the federal and state governments, working directly with businesses. The services offered by these organizations vary greatly as does the extent to which these programs provide assistance on technological issues.

All regions of the country are served by organizations providing direct assistance to businesses, although the type of organizations providing services and the services provided may differ greatly.

Total funding for all federal and state programs included in the survey was $620 million in fiscal year 1988. Forty-eight percent of the funding for these programs comes from state government, with the federal government contributing approximately 26 percent. The remainder is contributed by industry (12 percent) and universities (9 percent). Local governments

contributed approximately one percent. State-based programs accounted for nearly $550 million of the total. The four federal-affiliated programs (i.e., the Small Business Development Centers, University Centers, Industrial Applications Centers, and Trade Adjustment Assistance Centers) accounted for the balance (somewhat in excess of $70 million).

Although a number of the programs have been in operation for more than 20 years, many are relatively new. Of the 230 programs for which detailed information was received, 156 were in operation prior to 1986. Between 1986 and 1988, 74 new programs were created. The more-established programs (i.e., those in operation prior to 1986) tended to have significantly higher average expenditures - the margin was in excess of 2:1.

The firms being assisted are overwhelmingly small businesses. This is true regardless of the type of service being provided. A breakdown by size of firm shows that approximately 60 percent of the firms being assisted have fewer than 50 employees. Furthermore, these businesses need access primarily to existing off-the-shelf technology rather than advanced state-of-the art technology.

Program managers allocated $519 million for services to businesses. Of this amount, $121 million or 23 percent is allocated for technology assistance services. Another 23 percent is allocated to technology research centers and 17 percent to business assistance. Twenty-four percent of total funds are allocated to other activities (i.e., activities not covered by the survey questionnaire). A majority of these funds are probably allocated to research and development grant programs. Technology assistance services are being provided at a fairly even rate to manufacturing and non-manufacturing firms. Approximately two-thirds of the firms receiving business assistance, however, are non-manufacturing firms.

Requirement B: <u>A description of any anticipated expansion of each state program and its associated costs</u>.

In the near future, most programs are planning to expand the services they offer to small and medium-sized businesses. The 156 programs which were in existence prior to 1986 are projected to increase their expenditures by approximately 17 percent.[32] When data on all programs were considered, total expenditures rose from $620 million in fiscal year 1988 to $663 million in fiscal year 1989. Generally speaking, the types of services planned for expansion focus on technology assistance and business assistance.

The respondents were asked to indicate the types of technology assistance services being provided during the 1985 through 1987 time period and in 1988 and to identify the services to be expanded during the 1988-1989 year. Their responses indicated that, by and large, the organizations are expanding services currently being offered rather than changing the mix of services

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[32]Total expenditures during fiscal year 1988 were estimated to be $487 million; for fiscal year 1989 total expenditures were projected to be $569 million.

provided. For example, the responses from the state-based programs indicated that 85 percent are currently engaged in networking and referrals and 69 percent are planning to expand those services, 81 percent offer seminars and workshops and 66 percent plan to expand, and 77 percent provide technical counseling and 60 percent plan to expand. On the other hand, only 43 percent provide liaison to the nation's system of federal laboratories and only 36 percent plan to expand.

The most common business assistance services provided by the state-based programs are business plan preparation and evaluation (73 percent), small business consulting (72 percent), management assistance (61 percent), and financial analysis (55 percent). The least commonly provided services include labor analysis (19 percent), business forecasting (26 percent), and site location assistance (42 percent). As was the case for technology assistance, the organizations included in the survey intend to continue to expand existing services rather than change the mix of services offered.

Requirement C: An evaluation of the success of the programs in transferring technology, modernizing manufacturing processes, and improving the productivity and profitability of businesses.

Technology transfer can be accomplished by examining existing research, actively searching for technology that has commercial applications, and then assisting in the development of a process or product and associated business. It can also attempt to accelerate the diffusion of either advanced or off-the-shelf technology to existing industry. The latter is usually accomplished by providing some combination of information and field service.

A review of programmatic objectives indicates that many state-based programs focus strongly on assisting small manufacturers. Similarly, many states which are developing strategic plans or have undertaken other types of planning activities have targeted manufacturing technologies (see sec. 3.3 and 3.4). Both the micro activities of the programs and the macro activities of the states affect small manufacturers, although it may be some time before the objectives of individual programs are folded into the objectives of a state's strategic plan. Whereas a strategic plan may focus on actions (e.g., businesses formed, jobs created, etc.), an individual program provides services which tend to be more activity related. To be sure, the target audience and the types of services provided vary considerably across programs (see sec. 4.2 and 5.1 for specific examples). The level of service is also a variable (e.g., literature searches, referrals to experts, on-site visits, etc.). One measure of program activity is throughput. This measure provides information on the number of firms assisted by type of service; it is straight forward and unambiguous and provides a reference point for more complex analyses. For this item, three types of services are of central importance: (1) technology assistance; (2) incubators; and (3) seed capital.

Ninety-four of the state-based programs provided information on the number and type of businesses receiving technology assistance services. Of the approximately 35,000 firms receiving technology assistance services, 52

percent were manufacturers and 48 percent were non-manufacturing businesses. The firms receiving technology assistance from these organizations are overwhelmingly small businesses - 63 percent of the firms had fewer than 50 employees. On average, 66 percent of the firms assisted required access to established technology while only 37 percent required access to new technologies. The areas within the innovation process where technology assistance services were provided include: (a) product/process development, 33 percent; (b) product/process commercialization, 25 percent; (c) product/process testing, 12 percent; (d) prototype development, 11 percent; (e) other, 19 percent. The types of technologies targeted in 1988 include: manufacturing technologies (35 percent); information sciences (15 percent); biotechnology and life sciences (15 percent); and material sciences (10 percent).

A specific tool used to support new, small businesses is the incubator. Thirty-seven state-supported organizations provided detailed information on incubator operations. Of these, seven were economic development organizations, and 30 were technology development organizations. Data was provided on 164 incubators. The number of incubators more than doubled between 1985 and 1988. Based on the survey, the average number of jobs per incubator was 32. On average, each incubator facility housed 6.5 establishments with an average size of 5 employees per firm; the average number of years a firm spends in an incubator is three. Most incubators limit the time a firm can remain in the incubator to 4 years. The incubators reported 367 graduates (i.e., firms that went on to move out of the incubator). Of these, the respondents indicated that 91 percent are still in business.

States have become increasingly active in providing start-up and early stage financing (i.e., seed capital) for new technology-based businesses. Forty-three program managers provided information on state-supported seed capital programs. Total funding for these programs was reported as $41 million in public funds and $59 million in private funds. These programs assisted approximately 1,300 firms in 1988. One-third were manufacturing firms and 88 percent had fewer than 50 employees. Program managers reported targeting 30 percent of their 1988 funds to manufacturing technologies, 20 percent to information technologies and 18 percent to biotechnology and life sciences.

Requirement D: An assessment of the degree to which state programs make use of federal programs, including the Small Business Innovation Research program and the programs of the Federal Laboratory Consortium, the National Technical Information Service, the National Science Foundation, the Office of Productivity, Technology, and Innovation, and the Small Business Administration.

Overall, federal programs were rated highly by the states. The program cited as being of greatest assistance in promoting technological innovation was the Small Business Innovation Research (SBIR) Program. The SBIR Program was established by Congress in 1982 to provide the opportunity for small firms to participate in federal research and development. The states have found the program to be an important source of seed capital for small technology-based

businesses. Sixty-nine percent of the respondents reported using the SBIR Program and 74 percent gave the program a rating of good. In addition, more than a dozen states have established state programs to complement and build on the federal SBIR Program.

Other highly rated but less frequently used programs included: (a) EDA's University Centers; (b) USDA's Cooperative Extension Service; (c) NSF's Industry/University Cooperative Research Centers; (d) the Department of Commerce's Office of Productivity, Technology and Innovation (now the Office of Technology Policy); and (e) NASA's Commercial Use of Space Program.

An examination of the use of the 25 federal programs selected for inclusion in the questionnaire, indicates that most of them were used by less than a third of the respondents. In some cases, this may be due to the fact that these programs provide specialized services that would only be of interest to a limited number of firms. NASA's Commercial Use of Space Program, for example, may have limited value to the majority of the small to medium-sized manufacturers receiving assistance through these programs. It is also the case, however, that some of these programs appear to be under utilized. Three programs which will require follow-up examinations are: (1) the Federal Laboratory Consortium for Technology Transfer (FLC); (2) the Center for the Utilization of Federal Technology (CUFT); and (3) the NASA Technology Utilization Program.

Requirement E: **A survey of what additional federal information and technical assistance the programs could utilize**.

State and federal program managers suggested a number of federal resources which their programs could utilize. Most of the suggested information/ technical assistance resources focused on the importance of building and maintaining a "system of networks." The suggestions can, however, be divided into several broad categories: (1) federal publications focused on opportunities for technology commercialization; (2) an on-line system for matching a small business' technology needs to expertise within a federal laboratory; (3) a system of "federal laboratory affiliates;" and (4) personnel exchange programs.

Several federal agencies prepare publications which describe technologies thought to have potential for commercialization. Perhaps the best known examples of this type of publication are NTIS's Tech Notes and NASA's Tech Briefs. These publications provide guidance on how to obtain further information, gain access to technical resources, and in some cases initiate direct contact with technical specialists.

On-line systems are an important resource for many programs. Two federal resources aimed at linking businesses with federal technical experts are CUFT's Directory of Federal Laboratory and Technology Resources and the FLC Clearinghouse. Whereas CUFT produces a publication which can, at least in principal, be put on-line, the FLC Clearinghouse is an operational database. The FLC Clearinghouse contains information on most of its member laboratories.

A system of "federal laboratory affiliates" is currently being used by organizations such as NASA to provide access to federal technology. The NASA affiliates system creates partnerships between state-based programs and a NASA Industrial Applications Center (IAC). The state-based programs benefit because their domain of expertise is expanded (e.g., new capabilities to retrieve computerized business and technical information).

Several states have used personnel exchange programs to ensure that the one-on-one relationships between their program and a federal laboratory are formed. Such an exchange, repeated at regular intervals, promotes a more complete understanding of business needs and how the federal labs can be of greatest assistance.

Requirement F: **An assessment of how the services could be more effective agents for the transfer of federal scientific and technical information, including the results and application of federal and federally-funded research.**

State and federal program managers agreed that in terms of strategies to promote the transfer of federal technology they would place greatest emphasis on: (1) cooperating actively with federal agencies in their technology transfer programs; and (2) establishing a training program at the state and local level focused on federal technology transfer and cooperation.

Additional strategies of lesser importance are: (a) cosponsoring demonstration projects using new federally-developed technology; and (b) making use of a clearinghouse to disseminate information on federal research and development.

Whereas both state and federal program managers agreed on the ranking of items (1) and (2), they disagreed on the rankings of items (a) and (b). The state respondents placed greater emphasis on cosponsoring demonstration projects, item (a), as compared to drawing on a federal clearinghouse to disseminate information on federal research and development, item (b). On the other hand, the federal respondents favored the clearinghouse, item (b), over demonstration projects, item (a), by nearly the same margin.

APPENDIX A

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Plainview, NY 11803
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La Grande, OR 97850
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Portland, OR 97223
503-246-4844

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Lehigh University
NET Ben Franklin Technology Center
125 Goodman Drive
Bethlehem, PA 18015
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Mr. Jacques Koppel
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Office of Technology Development
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Harrisburg, PA 17120
717-787-4147

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State Director
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Mr. Sam Dorrence
Wyoming Science, Technology & Energy Authority
P.O. Box 3395
Laramie, WY 82071

APPENDIX B

STATE COORDINATOR'S QUESTIONNAIRE

Return to:

Marianne K. Clarke
National Governors' Association
444 North Capitol Street, NW, Suite 250
Washington, DC 20001

Code #

A STUDY OF CURRENT STATE TECHNOLOGY EXTENSION SERVICES

SUMMARY QUESTIONNAIRE

TO BE COMPLETED BY STATE COORDINATORS

Congress and the Administration have called upon the National Institute of Standards and Technology, formerly the National Bureau of Standards, to carry out a program of technology development and transfer in collaboration with industry, universities, other Federal agencies, and with State and local governments. Among the National Institute of Standards and Technology's new responsibilities outlined in the Technology Competitiveness Act portion of the Trade Bill, is a Study of Current State Technology Extension Services. The Study is being undertaken jointly with the National Governors' Association (NGA) with advice and guidance from the NGA Working Group on State Initiatives in Applied Research.

The purpose of the Study is to provide an understanding of what each State is doing to promote technological innovation and job creation. This information will be useful for Congress in identifying a Federal role which is supportive of State efforts and will be of use to Governors in assessing the effectiveness of their technology extension efforts.

In order to cover a wide array of State programs that may be administered by a number of different agencies or offices, we are asking that the members of the NGA Working Group serve as State coordinators. The State coordinator will be responsible for: (1) completing this Summary Questionnaire, if applicable; and (2) either completing the Program Manager's Questionnaire or distributing it to the appropriate State offices for completion. The Program Manager's Questionnaire requests information on the following types of programs: (1) Business Assistance; (2) Incubators; (3) Research Parks; (4) Seed Capital; (5) Technology Assistance; and (6) Technology/Research Centers. If the State operates several programs within any of these categories, please complete a survey form for each program.

Attached is a list of programs which we have identified in your State for inclusion in the study. Please add any programs that have been omitted. Please note that Small Business Development Centers and EDA-supported University Centers will receive questionnaires directly and need not be included in your response.

We would like to thank you in advance for your cooperation and support. We know that the completion of the questionnaire will require time and effort on your part but we believe the final product will be useful to you and your colleagues in other States. If you have any questions, please call Marianne Clarke at (202) 624-5380.

PLEASE RETURN BY NOVEMBER 30, 1988

This questionnaire was approved by the Office of Management and Budget (OMB) on September 28, 1988, OMB Control Number 0693-0007.

This **Summary Questionnaire** should be completed only by those States with a single office responsible for science and technology programs. **If such an office does not exit**, please complete the **Program Manager's Version** of the questionnaire.

SECTION I: GENERAL INFORMATION

1. Organization Name: _____

2. Administering Agency: _____

3. Address: a) _____

   b) _____

   c) _____

4. City: _____ 5. State: _____

6. Zip Code _____ 7. Date Established: _____

8. Director: _____

9. Title: _____

10. Telephone: _____

11. Principal Contact: _____

12. Title: _____

13. Telephone: _____

14. Telecopier: _____

15. Number of staff (full-time equivalent) employed (as of June 30, 1988):

    a) Professional (Technical): _____

    b) Professional (Business): _____

    c) Support Staff: _____

16. Organizational Objectives (50 words or less):

17. **Financial Data:** Estimate the total funds (including overhead and any other operating costs) received or anticipated (in thousands of $) by your organization by fiscal year from each of the sources listed below. Indicate when your fiscal year begins (_____).

Source of Funds	Funds (thousands of $)			
	1986	1987	1988	1989(est)
a) Federal Government				
b) State Government				
c) Local Government				
d) University				
e) Industry				
f) All Other				
TOTAL				

Please use the following definitions in answering question 18.

Business Assistance: Business assistance focuses on providing general business management information such as personnel, accounting and legal advice.

Incubators: Incubator facilities provide office and lab space for start-up companies at below-market rates. Shared support services such as clerical, reception and data processing are often made available.

Research Parks: Research parks are planned groupings of technology companies that encourage university/private relationships.

Seed Capital: Money is provided for projects that are at an early stage of development or that offer job creation potential but may not have the return on investment expected by commercial venture capitalists. Includes research grant and product development programs.

Technology Assistance: Technology assistance focuses on providing specialized services such as technical information, invention evaluation, technical counseling and patent information. Technology assistance includes both information exchange and active out-reach programs to provide access to newly-created technologies and to promote innovative applications of established technologies.

Technology/Research Centers: These centers generally concentrate their studies in a particular field which is usually based on the strengths of the university and/or the major industries in the State.

18. **Program Orientation:** List the programs supported by your office and the date they were established.

Functional Area	Program Name and Date Established
a) Business Assistance	
b) Incubators	
c) Research Parks	
d) Seed Capital	
e) Technology Assistance	
f) Technology/Research Centers	

19. **Support Services:** Check the box in **Column 1** if your office provided that service during 1985, 1986 or 1987. Check the box in **Column 2** if your ogranization is **currently providing** that service. Check the box in **Column 3** if your organization is either providing that service at an increased level or is planning an expansion in 1989.

Type of Service	Column 1 Provided 85, 86, 87	Column 2 Provided 88	Column 3 Expanded 88 or 89
a) Bond Issues for Technology-Based Businesses	☐	☐	☐
b) Business and/or Technology Assistance to Small and Medium-Sized Businesses	☐	☐	☐
c) Export Assistance for Technology-Based Businesses	☐	☐	☐
d) Industry-University (Research and/or Personnel Exchange)	☐	☐	☐
e) Joint Venture/Partnership Counseling	☐	☐	☐
f) Marketing Programs for Technology-Based Businesses	☐	☐	☐
g) Matching Grants	☐	☐	☐
h) Networking and Referrals	☐	☐	☐
i) Patenting and Licensing	☐	☐	☐

SECTION II: RELATIONSHIPS WITH FEDERALLY-SPONSORED PROGRAMS

20. If your organization **has used or been associated** with a specific program, provide an assessment of how well that program complements your organization's objectives.

Program Name	Have Used Program Y=Yes N=No	If Yes, Frequency of Use 1=Frequent 2=Sometimes 3=Seldom	If Yes, Program Assess. 1=Good 2=Fair 3=Poor
a) Center for Utilization of Federal Technology (Commerce/NTIS)	☐	____	____
b) Commercial Use of Space Program (NASA)	☐	____	____
c) Community Development Block Grants (HUD)	☐	____	____
d) Computer and Information Science and Engineering (NSF)	☐	____	____
e) Cooperative Extension Service (Agriculture)	☐	____	____
f) Energy Extension Service (Energy)	☐	____	____
g) Energy-Related Inventions (Energy and Commerce/NBS)	☐	____	____
h) Federal Laboratory Consortium (All)	☐	____	____
i) Industry/University Cooperative Research Centers (NSF)	☐	____	____

20. (Continued)

Program Name	Have Used Program Y=Yes N=No	If Yes, Frequency of Use 1=Frequent 2=Sometimes 3=Seldom	If Yes, Program Assess. 1=Good 2=Fair 3=Poor
j) Job Training Partnership Act (Labor)	☐	____	____
k) Measurement and Engineering Research Grants (Commerce/NBS)	☐	____	____
l) National Appropriate Technology Assistance Service (Energy)	☐	____	____
m) Office of Productivity, Technology and Innovation (Commerce)	☐	____	____
n) Office of Small and Disadvantaged Business Utilization (All)	☐	____	____
o) Patent and Trademark Office (Commerce)	☐	____	____
p) Program for Mathematics, Science, Computer Learning and Critical Foreign Languages (Education)	☐	____	____
q) Scientific, Technological and International Affairs (NSF)	☐	____	____
r) SCORE/ACE (SBA)	☐	____	____
s) Small Business Development Center Program (SBA)	☐	____	____
t) Small Business Innovation Research Program (All)	☐	____	____

20. (Continued)

Program Name	Have Used Program Y=Yes N=No	If Yes, Frequency of Use 1=Frequent 2=Sometimes 3=Seldom	If Yes, Program Assess. 1=Good 2=Fair 3=Poor
u) Small Business Investment Companies (SBA)	☐	____	____
v) Technology Utilization Program (NASA)	☐	____	____
w) Trade Adjustment Assistance Centers Program (Commerce/ITA)	☐	____	____
x) Trade Adjustment Assistance Workers (Labor)	☐	____	____
y) University Centers Program (Commerce/EDA)	☐	____	____
Other Federal Programs (Please List)			
aa)_____ _____	☐	____	____
bb)_____ _____	☐	____	____
cc)_____ _____	☐	____	____

21. Below is a list of strategies through which your organization does or could facilitate the transfer of Federal scientific and technical information, including the results and application of Federal and Federally-funded research/technology. Indicate the importance of each strategy by showing how you would allocate $100 of program funds among them.

Strategies	How would you allocate $100?
a) Cooperate actively with Federal agencies in their technology transfer programs	_____
b) Cosponsor model demonstration projects	_____
c) Draw on a Federal clearinghouse to disseminate information on Federal R&D	_____
d) Maintain a training program at the State and local level focused on Federal technology transfer and cooperation	_____

22. Provide comments and/or indicate other ways in which your organization does/could promote:

a) Federal technology transfer:

b) Technology transfer in general:

APPENDIX C

PROGRAM MANAGER'S QUESTIONNAIRE

Return to:

Code #

Marianne K. Clarke
National Governors' Association
444 North Capitol Street, NW, Suite 250
Washington, DC 20001

A STUDY OF CURRENT STATE TECHNOLOGY EXTENSION SERVICES

PROGRAM MANAGER'S QUESTIONNAIRE

Congress and the Administration have called upon the National Institute of Standards and Technology, formerly the National Bureau of Standards, to carry out a program of technology development and transfer in collaboration with industry, universities, other Federal agencies, and with State and local governments. Among the National Institute of Standards and Technology's new responsibilities outlined in the Technology Competitiveness Act portion of the Trade Bill, is a Study of Current State Technology Extension Services. The Study is being undertaken jointly with the National Governors' Association (NGA) with advice and guidance from the NGA Working Group on State Initiatives in Applied Research.

The purpose of the Study is to provide an understanding of what each State is doing to promote technological innovation and job creation. This information will be useful to Congress in identifying a Federal role which is supportive of State efforts and will be of use to Governors in assessing the effectiveness of their technology extension efforts.

This questionnaire is designed for use by managers of a technology extension program. A separate, summary questionnaire, has been designed for use by State coordinators who may be responsible for a variety of programs in their State.

The questionnaire for this portion of the Study is divided into two parts:

1. Background Information
2. Program Orientation

Part 1 contains 2 sections. Part 1 is designed to collect information on your program and on its relationships with several key Federal programs. The two sections of Part 1 are entitled:

I. General Information
II. Relationships With Federally-Sponsored Programs

Part 2 contains 6 sections. Each section refers to a specific program focus. **Only those sections which are of major importance to your program require a response.** The six sections in Part 2 are concerned with the following extension program activities:

III. Business Assistance
IV. Incubators
V. Research Parks
VI. Seed Capital
VII. Technology Assistance
VIII. Technology/Research Centers

We would like to thank you in advance for your cooperation and support. We know that the completion of the questionnaire will require time and effort on your part but we believe the final product will be useful to you and your colleagues in other States. If you have any questions, please call Marianne Clarke at (202) 624-5380.

PLEASE RETURN BY NOVEMBER 30, 1988

This questionnaire was approved by the Office of Management and Budget (OMB) on September 28, 1988, OMB Control Number 0693-0007.

PART 1: BACKGROUND INFORMATION

SECTION I: GENERAL INFORMATION

1. Organization Name: _____

2. Administering Agency: _____

3. Address: a) _____

   b) _____

   c) _____

4. City: _____ 5. State: _____

6. Zip Code _____ 7. Date Established: _____

8. Director: _____

9. Title: _____

10. Telephone: _____

11. Principal Contact: _____

12. Title: _____

13. Telephone: _____

14. Telecopier: _____

15. Number of staff (full-time equivalent) employed (as of June 30, 1988):

    a) Professional (Technical): _____

    b) Professional (Business): _____

    c) Support Staff: _____

16. Organizational Objectives (50 words or less):

17. **Financial Data:** Estimate the total funds (including overhead and any other operating costs) received or anticipated (in thousands of $) by your organization by fiscal year from each of the sources listed below. Indicate when your fiscal year begins (_____).

Source of Funds	Funds (thousands of $)			
	1986	1987	1988	1989(est)
a) Federal Government				
b) State Government				
c) Local Government				
d) University				
e) Industry				
f) All Other				
TOTAL				

18. **Outreach:** Below is a list of strategies for increasing your clients awareness of how your program could benefit them. Indicate the importance of each strategy by showing how you would allocate $100 of program funds among them.

Strategies	How would you allocate $100?
a) Advertising (e.g., journals, radio, trade associations, etc.)	_____
b) Direct solicitation	_____
c) Field agents	_____
d) Networking (e.g., seminars, workshops, etc.)	_____
e) Other (_____ _____)	_____

Please use the following definitions in answering question 19.

Business Assistance: Business assistance focuses on providing general business management information such as personnel, accounting and legal advice.
Incubators: Incubator facilities provide office and lab space for start-up companies at below-market rates. Shared support services such as clerical, reception and data processing are often made available.
Research Parks: Research parks are planned groupings of technology companies that encourage university/private relationships.
Seed Capital: Money is provided for projects that are at an early stage of development or that offer job creation potential but may not have the return on investment expected by commercial venture capitalists. Includes research grant and product development programs.
Technology Assistance: Technology assistance focuses on providing specialized services such as technical information, invention evaluation, technical counseling and patent information. Technology assistance includes both information exchange and active out-reach programs to provide access to newly-created technologies and to promote innovative applications of established technologies.
Technology/Research Centers: These centers generally concentrate their studies in a particular field which is usually based on the strengths of the university and/or the major industries in the State.

19. **Program Orientation:** Estimate the percent of staff resources allocated to each functional area during **1988.** Estimate the percent of total funds allocated to each functional area during **1987, 1988 and 1989.**

Functional Area	Percent of Staff 1988	Percent of Funds		
		1987	1988	1989(est)
a) Business Assistance				
b) Incubators				
c) Research Parks				
d) Seed Capital				
e) Technology Assistance				
f) Technology/Research Centers				
g) Other: _____ _____				
TOTAL	100	100	100	100

SECTION II: RELATIONSHIPS WITH FEDERALLY-SPONSORED PROGRAMS

20. If your organization **has used or been associated** with a specific program, provide an assessment of how well that program complements your organization's objectives.

Program Name	Have Used Program Y=Yes N=No	If Yes, Frequency of Use 1=Frequent 2=Sometimes 3=Seldom	If Yes, Program Assess. 1=Good 2=Fair 3=Poor
a) Center for Utilization of Federal Technology (Commerce/NTIS)	☐	____	____
b) Commercial Use of Space Program (NASA)	☐	____	____
c) Community Development Block Grants (HUD)	☐	____	____
d) Computer and Information Science and Engineering (NSF)	☐	____	____
e) Cooperative Extension Service (Agriculture)	☐	____	____
f) Energy Extension Service (Energy)	☐	____	____
g) Energy-Related Inventions (Energy and Commerce/NBS)	☐	____	____
h) Federal Laboratory Consortium (All)	☐	____	____
i) Industry/University Cooperative Research Centers (NSF)	☐	____	____

20. (Continued)

Program Name	Have Used Program Y=Yes N=No	If Yes, Frequency of Use 1=Frequent 2=Sometimes 3=Seldom	If Yes, Program Assess. 1=Good 2=Fair 3=Poor
j) Job Training Partnership Act (Labor)	☐	____	____
k) Measurement and Engineering Research Grants (Commerce/NBS)	☐	____	____
l) National Appropriate Technology Assistance Service (Energy)	☐	____	____
m) Office of Productivity, Technology and Innovation (Commerce)	☐	____	____
n) Office of Small and Disadvantaged Business Utilization (All)	☐	____	____
o) Patent and Trademark Office (Commerce)	☐	____	____
p) Program for Mathematics, Science, Computer Learning and Critical Foreign Languages (Education)	☐	____	____
q) Scientific, Technological and International Affairs (NSF)	☐	____	____
r) SCORE/ACE (SBA)	☐	____	____
s) Small Business Development Center Program (SBA)	☐	____	____
t) Small Business Innovation Research Program (All)	☐	____	____

20. (Continued)

Program Name	Have Used Program Y=Yes N=No	If Yes, Frequency of Use 1=Frequent 2=Sometimes 3=Seldom	If Yes, Program Assess. 1=Good 2=Fair 3=Poor
u) Small Business Investment Companies (SBA)	☐	____	____
v) Technology Utilization Program (NASA)	☐	____	____
w) Trade Adjustment Assistance Centers Program (Commerce/ITA)	☐	____	____
x) Trade Adjustment Assistance Workers (Labor)	☐	____	____
y) University Centers Program (Commerce/EDA)	☐	____	____
Other Federal Programs (Please List)			
aa)_____ _____	☐	____	____
bb)_____ _____	☐	____	____
cc)_____ _____	☐	____	____

21. Below is a list of strategies through which your organization does or could facilitate the transfer of Federal scientific and technical information, including the results and application of Federal and Federally-funded research/technology. Indicate the importance of each strategy by showing how you would allocate $100 of program funds among them.

Strategies	How would you allocate $100?
a) Cooperate actively with Federal agencies in their technology transfer programs	_____
b) Cosponsor model demonstration projects	_____
c) Draw on a Federal clearinghouse to disseminate information on Federal R&D	_____
d) Maintain a training program at the State and local level focused on Federal technology transfer and cooperation	_____

22. Provide comments and/or indicate other ways in which your organization does/could promote:

a) Federal technology transfer:

b) Technology transfer in general:

PART 2: PROGRAM ORIENTATION

SECTION III: BUSINESS ASSISTANCE

Answer questions 23 through 27 if your organization provides business assistance.

23. **Type of Service:** Check the box in **Column 1** if your organization provided that service during **1985, 1986 or 1987.** Check the box in **Column 2** if your organization is **currently providing** that service. Check the box in **Column 3** if your organization is either providing that service at an increased level or is planning an expansion in 1989.

Type of Service	Column 1 Provided 85, 86, 87	Column 2 Provided 88	Column 3 Expanded 88 or 89
a) Business Forecasting	☐	☐	☐
b) Business Plan Preparation/Evaluation	☐	☐	☐
c) Feasibility Studies	☐	☐	☐
d) Financial Analysis	☐	☐	☐
e) Joint Venture/Partnership Counseling	☐	☐	☐
f) Labor Analysis	☐	☐	☐
g) Management Assistance and Studies	☐	☐	☐
h) Marketing Surveys	☐	☐	☐
i) Site Location Assistance	☐	☐	☐
j) Small Business Consulting	☐	☐	☐

24. Estimate the number of establishments assisted:

a) 1985: _____
b) 1986: _____
c) 1987: _____
d) 1988: _____
e) 1989: _____

25. **Establishment Data:** Estimate the number of establishments assisted by your organization during 1988. Please classify establishments by type (manufacturing versus non-manufacturing) and size. An establishment, as defined by the Census, counts each store, office, or plant with one or more employees as a separate entity. Non-manufacturing establishments are those major industry groups involved in: agriculture, mining, construction, and services (transportation, finance, government enterprises, etc.).

Type of Establishment	Number of Establishments				TOTAL
	Less than 50	Between 50 & 500	More than 500	Don't Know	
Manufacturing					
Non-Manufacturing					
Don't Know					
TOTAL					

26. **Assistance to Individuals:** Estimate the number of individuals assisted (e.g., innovators, entrepreneurs, etc.) during 1988: _____.

27. Percentage of establishments assisted during 1988 which required access to:

a) Newly-created technologies: _____
b) Established technologies: _____

SECTION IV: INCUBATORS

Answer questions 28 through 32 if your organization supports incubators.

28. Provide estimates of the following background statistics:

	Number of Incubators	Number of Establish-ments	Number of Employees	Number of Graduates
a) 1985:	_____	_____	_____	_____
b) 1986:	_____	_____	_____	_____
c) 1987:	_____	_____	_____	_____
d) 1988:	_____	_____	_____	_____
e) 1989:	_____	_____	_____	_____

29. Percentage of establishments incubated during 1988 which required access to:

a) Newly-created technologies: _____
b) Established technologies: _____

30. Percentage breakdown by type of technology targeted during 1988:

a) Aerospace: _____
b) Biotechnology and Life Sciences: _____
c) Earth Sciences: _____
d) Information Technologies: _____
e) Manufacturing Technologies: _____
f) Materials Sciences: _____
g) Other (_____

_____): _____

31. Number of years an establishment spends in an incubator:

a) Average: _____
b) Maximum: _____

32. Percentage of establishments graduated between 1985 and 1987 which:

a) Are Still in Business: _____
b) Are No Longer in Business: _____
c) Don't Know: _____

SECTION V: RESEARCH PARKS

Answer questions 33 through 35 if your organization supports research parks.

33. Provide estimates for the following background statistics:

	Number of Parks	Percent of Available Space Occupied (Square Feet)
a) 1985:	_____	_____
b) 1986:	_____	_____
c) 1987:	_____	_____
d) 1988:	_____	_____
e) 1989:	_____	_____

34. Provide estimates for the following establishment statistics:

	Number of Establishments	Number of Employees
a) 1985:	_____	_____
b) 1986:	_____	_____
c) 1987:	_____	_____
d) 1988:	_____	_____
e) 1989:	_____	_____

35. Percentage breakdown by type of technology targeted during **1988**:

a) Aerospace: _____
b) Biotechnology and Life Sciences: _____
c) Earth Sciences: _____
d) Information Technologies: _____
e) Manufacturing Technologies: _____
f) Materials Sciences: _____
g) Other (_____

_____): _____

SECTION VI: SEED CAPITAL

Answer questions 36 through 41 if your organization provides seed capital.

36. Establishments assisted:

Year	Number of Establish-ments	Public (thousands of $)		Private (thousands of $)
		Pension	Other	
1985				
1986				
1987				
1988				
1989				

37. **Establishment Data:** Estimate the number of establishments assisted by your organization during **1988**. Please classify establishments by type (manufacturing versus non-manufacturing) and size. An establishment, as defined by the Census, counts each store, office, or plant with one or more employees as a separate entity. Non-manufacturing establishments are those major industry groups involved in: agriculture, mining, construction, and services (transportation, finance, government enterprises, etc.).

Type of Establishment	Number of Establishments				TOTAL
	Less than 50	Between 50 & 500	More than 500	Don't Know	
Manufacturing					
Non-Manufacturing					
Don't Know					
TOTAL					

38. Percentage of establishments assisted between **1985 and 1987** which:

a) Are Still in Business: _____
b) Are No Longer in Business: _____
c) Don't Know: _____

39. Percentage of establishments assisted during **1988** which required access to:

a) Newly-created technologies: _____
b) Established technologies: _____

40. Percentage breakdown by type of technology targeted during **1988**:

a) Aerospace: _____
b) Biotechnology and Life Sciences: _____
c) Earth Sciences: _____
d) Information Technologies: _____
e) Manufacturing Technologies: _____
f) Materials Sciences: _____
g) Other (_____

_____): _____

41. Percentage breakdown by type of funds provided during **1988**:

a) Product/process development: _____
b) Product/process testing: _____
c) Prototype development: _____
d) Product/process commercialization: _____
e) Other: _____

SECTION VII: TECHNOLOGY ASSISTANCE

Answer questions 42 through 48 if your organization provides technology assistance.

42. **Type of Service:** Check the box in **Column 1** if your organization provided that service during **1985, 1986 or 1987.** Check the box in **Column 2** if your organization is **currently providing** that service. Check the box in **Column 3** if your organization is either providing that service at an increased level or is planning an expansion in 1989.

Type of Service	Column 1 Provided 85, 86, 87	Column 2 Provided 88	Column 3 Expanded 88 or 89
a) Demonstration Projects	☐	☐	☐
b) Joint Venture/Partnership Counseling	☐	☐	☐
c) Networking & Referrals	☐	☐	☐
d) Product Design and/or Evaluation	☐	☐	☐
e) Seminars/Workshops	☐	☐	☐
f) State liaison to Federal Labs	☐	☐	☐
g) Technical Counseling	☐	☐	☐
h) Technical Data Services	☐	☐	☐
i) Technical literature dissemination/review	☐	☐	☐
j) User request and response	☐	☐	☐

43. Estimate the number of establishments assisted:

a) 1985: _____
b) 1986: _____
c) 1987: _____
d) 1988: _____
e) 1989: _____

44. **Establishment Data:** Estimate the number of establishments assisted by your organization during **1988**. Please classify establishments by type (manufacturing versus non-manufacturing) and size. An establishment, as defined by the Census, counts each store, office, or plant with one or more employees as a separate entity. Non-manufacturing establishments are those major industry groups involved in: agriculture, mining, construction, and services (transportation, finance, government enterprises, etc.).

Type of Establishment	Number of Establishments				TOTAL
	Less than 50	Between 50 & 500	More than 500	Don't Know	
Manufacturing					
Non-Manufacturing					
Don't Know					
TOTAL					

45. **Assistance to Individuals:** Estimate the number of individuals assisted (e.g., innovators, entrepreneurs, etc.) during **1988**: _____.

46. Percentage of establishments assisted during **1988** which required access to:

a) Newly-created technologies: _____
b) Established technologies: _____

47. Percentage breakdown by type of technology targeted during 1988:

a) Aerospace: _____
b) Biotechnology and Life Sciences: _____
c) Earth Sciences: _____
d) Information Technologies: _____
e) Manufacturing Technologies: _____
f) Materials Sciences: _____
g) Other (_____

_____): _____

48. Percentage breakdown by type of assistance provided during 1988:

a) Product/process development: _____
b) Product/process testing: _____
c) Prototype development: _____
d) Product/process commercialization: _____
e) Other: _____

SECTION VIII: TECHNOLOGY/RESEARCH CENTERS

Answer questions 49 and 50 if your organization supports technology centers or research centers.

49. Provide estimates for the following background statistics:

	Number of Centers	Number of Establishments Participating
a) 1985:	_____	_____
b) 1986:	_____	_____
c) 1987:	_____	_____
d) 1988:	_____	_____
e) 1989:	_____	_____

49. Background statistics (continued):

	Number of Small and Medium-sized Establishments	Number of Manufacturing Establishments
a) 1985:	_____	_____
b) 1986:	_____	_____
c) 1987:	_____	_____
d) 1988:	_____	_____
e) 1989:	_____	_____

50. Percentage breakdown by type of technology targeted during 1988:

a) Aerospace: _____
b) Biotechnology and Life Sciences: _____
c) Earth Sciences: _____
d) Information Technologies: _____
e) Manufacturing Technologies: _____
f) Materials Sciences: _____
g) Other (_____

_____): _____

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11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.)

This report presents the findings of a Nationwide study of State and Federal organizations providing business and technology assistance to small and medium-sized businesses. The purpose of this report is twofold. First, it summarizes the recent literature on technology transfer and technology extension. Included in the literature survey is a review of selected Federal technology transfer programs, a review of State technical outreach and economic development activities, and an analysis of State efforts in the key areas of program implementation and program evaluation. Second, it summarizes the results of a Nationwide survey of State and Federal technology extension services. The survey was carried out in cooperation with the National Governors' Association. It represents the first comprehensive study of how these programs reach out to provide technological assistance to businesses at the local level and the degree to which such programs make use of Federal programs and activities in carrying out their missions.

12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)
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