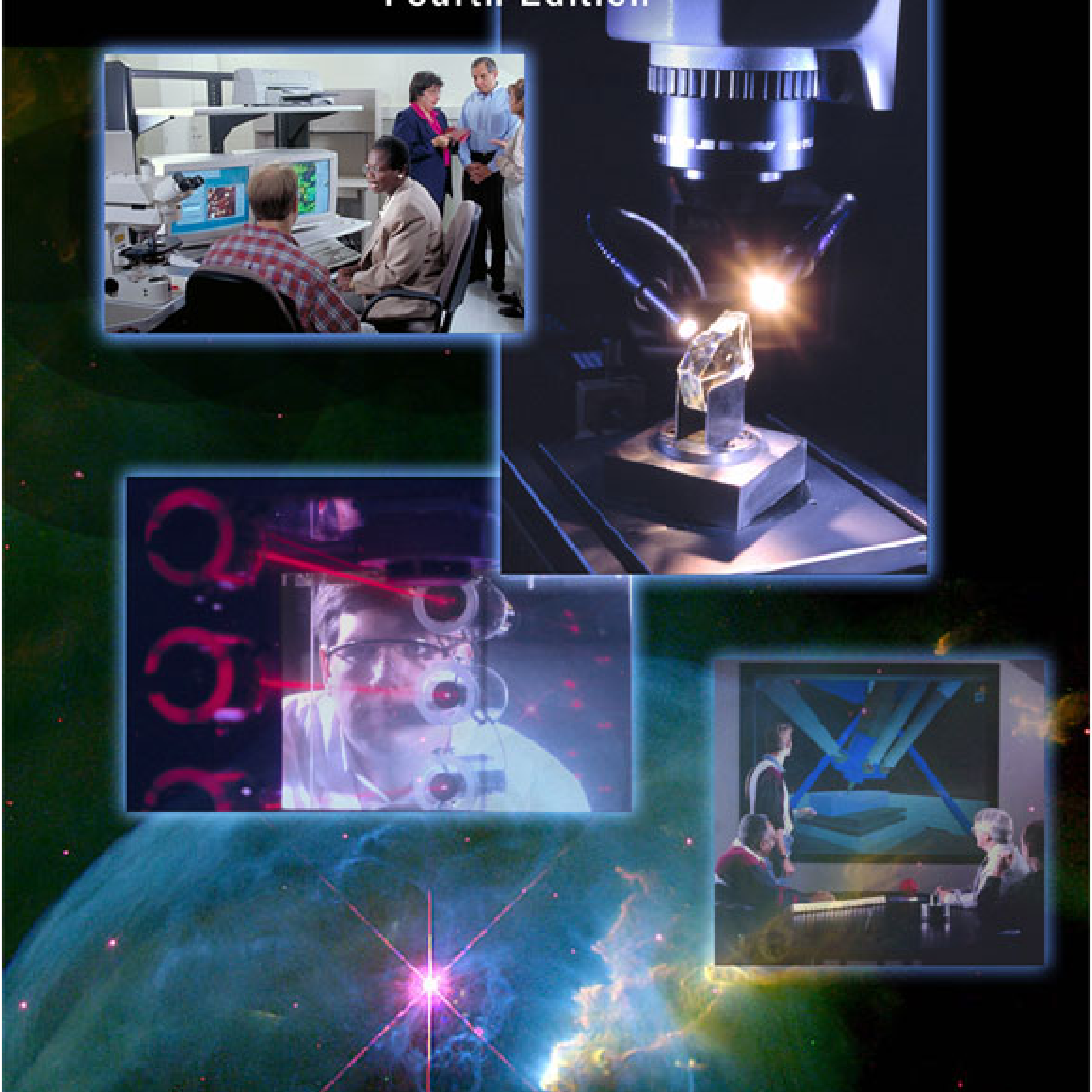
OFFICE OF TECHNOLOGY POLICY

The Dynamics of Technology-based Economic Development

State Science and Technology Indicators

Fourth Edition



The Dynamics of Technology-based Economic Development

State Science and Technology Indicators

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Prepared for

Office of Technology Policy

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Foreword

Technological innovation fuels sustainable economic expansion—creating high-wage jobs, world-class exports, and productivity growth so critical to our nation's long-term global competitiveness. Likewise, technology and innovation are vital to state and regional competitiveness, and have become a determining factor driving economic performance and affecting the local quality of life. It is now common for state policy makers and practitioners to examine their state's comparative advantage in terms of how science and technology assets can be leveraged for economic development.

In response to state and regional interest in identifying factors that may indicate the role of technology and innovation in influencing economic outcomes, the Technology Administration has produced a fourth edition of ***The Dynamics of Technology-based Economic Development: State Science and Technology Indicators***. This report is an updated collection of metrics approximating the technology infrastructure of states, and contains a new time series section showing the change in metric values for periods up to ten years. It is hoped this new section will enhance state and regional efforts to track the impact of specific initiatives undertaken and trends in state performance.

The Technology Administration and its Office of Technology Policy recognizes that there is no one-size-fits-all policy formula that works to foster technology development and innovation for all regions of the country. As policy analysts, our collective hope is that the data in this document will continue to serve all regions of the country as they seek to better utilize their respective assets and strengths for economic growth and prosperity. We welcome comments on ways to make it even more useful. We look forward to working with leaders around the nation as they seek strategies to better utilize their assets for economic growth and improvements in the quality of life.

Philip J. Bond
Under Secretary of Commerce for Technology

Preface

This report, ***The Dynamics of Technology-based Economic Development: State Science and Technology Indicators***, was compiled for those in the public and private sector who are concerned with regional innovation and competitiveness. The report is the fourth edition, and is an improvement over earlier editions in that it contains a new section with longitudinal data to help users discern patterns or longer-term changes in state innovation capacity and achievement.

Similar to the earlier versions of this work, the report avoids taking a "report card" approach and does not offer any critiques of individual state performance. OTP continues to believe that the appropriate interpretation and application of this data remains the responsibility of those familiar with the special circumstances affecting their states. It is expected that states will likely identify different targets for any given metric and may attempt to reach their goals by different strategies.

The major change in this edition is the inclusion of a new time series section showing the change in metric values for periods up to ten years. It is hoped that this presentation will support economic development professionals' efforts to track the impacts of specific initiatives undertaken or trends in state performance.

The S&T organizations presented on the State Profile pages have also been updated and provide points of entry for a better understanding of each state's S&T infrastructure. An additional change is that the roster of metrics has been modified to account for data that were not published or collected within the time scheduled for this publication. As a result, several metrics were removed or replaced. For example, NAEP Math Test Scores were substituted for NAEP Science Test Scores.

OTP welcomes comments to help assess the value and quality of this edition and to assist in providing improved products. Since the status of the organizations presented in this publication are constantly changing, OTP welcomes input from individual states regarding the most appropriate organizations to be included in their state's listing. To share your comments, please visit the Technology Administration website at http://www.technology.gov/ or send an e-mail to otptech@ta.doc.gov.

Acknowledgments

The contributions of the many individuals who helped to shape this project deserve to be recognized and acknowledged.

First, the support and guidance of Mr. Bruce P. Mehlman who served as Assistant Secretary of Commerce for Technology Policy is greatly appreciated. Mr. Mehlman played an active role in promoting this publication and is a strong advocator of technology-based economic development. His insights and suggestions were helpful during the revision process for this edition.

The day-to-day operational issues associated with this project were managed by the Project Technical Officer, Mr. Douglas Devereaux. Mr. Devereaux saw the need for longitudinal data and led the efforts to create this new section for the fourth edition. He coordinated the Steering Committee activities and resolved the numerous issues that arose during the course of this project. Mr. Devereaux has been designated as the contact point for any questions related to this report.

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The production of this report was facilitated by members of the Steering Committee who made many valuable contributions throughout the entire course of this project. Their suggestions and comments greatly improved the quality and presentation of the final product. The individuals who participated in this capacity were:

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This report and its contents were developed by Taratec Corporation, 1251 Dublin Road, Columbus, OH 43215 under Contract Number SB13591-02-8-0625. Individual members of the contractor team who made significant contributions included: Dr. Paula Dunnigan, who served as the Project Manager; Mr. John Griffin, who provided strategic guidance and review; Mr. Greg Palovchik, who was responsible for data acquisition, computation, and presentation; Mr. Charles Meadows, who prepared the maps and bar charts; and Ms. Jill Cape, who designed and formatted the final report.

Introduction

1.1 Background

Science and technology (S&T) policies and programs have become an integral part of the economic development plans of most states. As businesses seek sustainable competitive advantages, S&T resources have proven to be powerful assets. Well-conceived and executed programs that strengthen and expand the S&T resources of a state support a broad array of state economic development strategies. New business formation flows directly from research, development, and commercialization of new technologies. Business attraction of industrial clusters is advanced by creating unique competitive advantages rooted in the S&T institutions of a state. Business expansion will accelerate as companies adopt and adapt new technologies to improve the competitiveness of their products and processes. And finally, business retention is increased as companies are able to solve competitiveness problems through the application of technology and the expertise of their state's S&T community.

Perhaps more importantly, S&T can build sustainable competitive advantage, not artificial advantages associated with incentives and subsidies. Application of advanced technologies can provide companies with fundamental methods of improving their quality, their product and service functionality, and their cost competitiveness. S&T programs impact the very hearts of companies—their products and production processes—and provide for more than adjustments to their bottom lines through artificial cost savings.

S&T also builds for the future. Investments made in strengthening the research base in a state will attract further research and development (R&D) investments by both the private and public sector. This growing research capability can result in new knowledge creation, intellectual property development, human resource development and retention, and expert advisors to assist companies and entrepreneurs. The importance of S&T has been recognized for several decades as a potent tool for public policy. Pennsylvania's Ben Franklin Program and Ohio's Thomas Edison Program are now approaching 20 years of operation and are still viewed as keystone programs in their respective states. Both of these programs helped bring their states out of the "rust belt" syndrome of the early 1970s. Most other states have followed suit with programs that support state economic development through creation of specialized centers of S&T excellence.

The successful impact on economic development and the sustainable power of S&T is evident in various places in the United States. In addition to the obvious locations such as Boston, Silicon Valley, Raleigh-Durham, and Austin, we now find pockets of S&T-based economic development exploding in Minneapolis, Seattle, Boulder, and Salt Lake City. Interestingly, all these areas have strong concentrations of S&T resources including research universities and private sector research centers. Federal facilities, such as the National Institutes of Health in Bethesda, Maryland, also have served as catalysts for business growth. These communities demonstrate that S&T-based businesses exhibit the tendency to cluster in areas that have strong technology assets and infrastructure.

It is evident that not all states and communities have equally well-developed S&T infrastructures. There is wide disparity in research funding, facilities, and expertise among the states. The relationship between economic prosperity and S&T capacity is intuitive. Such relationships have led to public policies to support economic development through S&T investments.

1.2 Methodology

1.2.1 Project Objectives

The goal of this project is to enhance public policy decision-making by presenting a selection of indicators related to the technology-based economic development conditions in all 50 states. This publication represents the fourth edition resulting from this effort. It is built upon the feedback and suggestions that were received regarding the first edition that was published in June 2000 and the subsequent editions published in October 2001 and December 2002.

The metrics in this benchmarking exercise were selected so as to be timely, credible, and capable of being updated through publicly available data sources. A number of metrics from the earlier editions have been dropped while new metrics have been added as additional data sources were identified. More specifically, the project objectives were:

- To select a series of metrics that describe the status of science and technology (S&T) assets in states
- To select a series of metrics that describe "high-technology" economic development outcomes
- To develop consistent data sets of publicly available data that quantify the metrics for each state
- To describe each metric, characterize its relevancy to S&T-based economic development, and report the data and rankings for all states
- To present the results for each state

This project presents up-to-date information about the status of an individual state's S&T infrastructure in an easy-to-use format. By providing each state with comparable data for other states, strengths can be reinforced and weaknesses can be identified and appropriate responses formulated by individual states in a manner that seems most appropriate to them.

It is not the intent of this project to create a report card and to grade individual states by an arbitrary standard. Since states choose to pursue different economic development goals and attempt to reach those goals by different routes, it is not appropriate to apply a single set of weighting factors or devise a formula for calculating overall effectiveness. Certain data and metrics in this report may be more relevant to some states than to others. The state rankings for certain metrics may be impacted by special factors—unique to only a few states—that have nothing to do with S&T infrastructure. Appropriate interpretation and application of the data in this report must be the responsibility of the citizens, elected officials, and state employees who are familiar with the special circumstances affecting their states.

1.2.2 Project Organization

This project was carried out using a team approach. Members of the team included:

- The Project Manager, Mr. Douglas Devereaux, from Technology Administration
- A Steering Committee consisting of members from various sectors of the U.S. Department of Commerce, the National Science Foundation, and the Federal Reserve Board of Governors
- The contractor, Taratec Corporation, from Columbus, Ohio

1.2.3 Project Work Plan

The initial project task was to identify appropriate data and data sources that could be used to characterize the S&T infrastructure of individual states. Working collaboratively, the team generated lists of potential candidate measures for consideration. Each of the candidate measures was investigated by the contractor, who assessed the quality, consistency, and extent of coverage of the data. Based on these factors, the team selected a total of 38 measures—25 input measures and 13 output measures—for further refinement. There were some changes in the metrics used between the third and fourth editions of this publication.

The S&T-stimulating input measures fell into three main categories:

- Funding In-Flows
- Human Resources
- Capital Investment and Business Assistance

The outcome data categories were focused on:

- High-technology Intensity of the State's Business Base
- Other Outcome Measures (patents, fast-growing companies, earnings, and work force employment).

Each of the measures was converted to a metric by eliminating its scale sensitivity. The team recognized that scale differences in the data or measures between states could bias any ranking in favor of the larger states. For instance, the size of the civilian work force differs by more than 60-fold and the size of the total business establishment payroll by more than 100-fold when the states are directly compared. To account for these differences in scale, the data from each of the measures were converted to a quotient that reflected the intensity of that measure on the state's business base or its impact on the state's economy. To the extent possible, scale sensitivity has been minimized in the final set of metrics and in the state rankings.

This attempt to reduce scale sensitivity meant that some compromises were necessary in selecting the year of the data used in the numerator and denominator. The most recent data available were always used in the numerator. Whenever possible, the year of data used in the denominator of each metric was selected to be as close as possible to the year of the data used in the numerator. In some cases, this meant using the middle year in the denominator when a 3-year average was used in the numerator. In other cases, it meant using the latest data available in the denominator, even though the year of that data was prior to the year of the data used in the numerator.

A second area of metric definition deserving special note involves the definition of high-technology industries. For the second edition, the project team began with the list of high-technology Standard Industrial Classification (SIC) codes that was identified by the Bureau of Labor Statistics (BLS) in 1999[1] and is based on measures of industry employment in both R&D and technology-oriented occupations. BLS used Occupational Employment Statistics surveys from 1993, 1994,and 1995 in which employers were asked to explicitly designate workers who were actually engaged in R&D activity. The researchers identified 31 three-digit "R&D intensive" industries in which the number of R&D workers and technology-oriented occupations accounted for a proportion of employment that was at least twice the average for all industries surveyed. These industries had at least 6 R&D workers per thousand workers and 76 technology-oriented workers per thousand workers. The 31 three-digit SIC codes that comprised the BLS list of high-technology industries consisted of 27 manufacturing industries and 4 service industries. The team felt that there was value in beginning with a list that resulted from a documented selection process, was broadly known and used, and originated from a government source. Adhering to these criteria provided assurances that the list of high-technology SIC codes was not selected in a manner calculated to provide advantage to a particular state or region of the country, nor did it reflect the biases or the agenda of any particular group.

During the time interval between the research that was done to develop the BLS list and the present, federal data acquisition has completed a transition from SIC codes to North American Industry Classification System (NAICS) codes. Data from the U.S. Census Bureau used in this publication was reported in terms of the NAICS codes published in 1997. This has had a direct impact on the metrics associated with "high-technology industries" since the SIC codes from the BLS list are no longer searchable. To address this need, Mr. Carl Shepherd from the Office of Technology Policy with assistance from the U.S. Census Bureau, converted the BLS list of SIC codes into NAICS codes using the concordance between the two classification systems. Judgement was required because this was not a simple renumbering process but involved splitting and/or combining codes. Allowances had to be made to account for partial categories. The resulting list of high-technology NAICS codes developed by Mr. Shepherd includes a total of 39 codes that range from four to six digits. Twenty-nine of these codes apply to manufacturing industries and ten represent service industries. Table 1 identifies the NAICS codes that have been included in the definition of "high-technology industries" that has been used in this edition.

The 1997 list of NAICS codes differs from the original BLS list of SIC codes in that it contains a larger number of codes related to information technology industries, particularly those related to systems design, data processing, and software. Also, there are more numerous and broader codes pertaining to rapidly growing industries such as communications, audio and video equipment, and computers. An update to the 1997 NAICS codes was published in 2002. This update would have had a small effect on the list of codes in Table 1, but it was not in use by the U.S. Census Bureau at the time the data for the publication were actually collected by the Bureau.

After the metric definition step was completed, the data were gathered electronically and transferred to appropriate spreadsheet software. Data gathering for this project was completed in October 2003, and the data given in this report represent the latest data available to the best of our knowledge. During the time required for

[1] Hecker, Daniel, "High-technology Employment: A Broader View," *Monthly Labor Review*, June 1999, p18.

review, approval, and publication of this report, more recent data sets will likely become available for certain metrics. The rankings on individual metrics and the state profiles should be considered as snapshots taken at a particular time, with the understanding that the state indicators are dynamic and will evolve over time.

The values of individual metrics were calculated, and the states were ranked relative to each metric. The rankings were defined so that those states with highest numerical value were given the lowest numerical ranking. For instance, the state receiving the largest number of Small Business Innovation Research (SBIR) grants per 10,000 businesses located in that state received a ranking of one. Conversely, the state with the smallest number of SBIR grants per 10,000 businesses received a ranking of fifty. Rankings were done for each of the 50 states or for each state for which data were available in instances in which the data set was not complete.

1997 NAICS Code	Industry
32411	Petroleum Refineries
3251	Basic Chemical Manufacturing
3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
3254	Pharmaceutical and Medicine Manufacturing
3255	Paint, Coating, and Adhesive Manufacturing
3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing
3259	Other Chemical Product and Preparation Manufacturing
332992	Ordnance & Accessories Manufacturing - Small Arms Ammunition Manufacturing
332993	Ordnance & Accessories Manufacturing - Ammunition (except Small Arms) Manufacturing
332994	Ordnance & Accessories Manufacturing - Small Arms Manufacturing
332995	Ordnance & Accessories Manufacturing - Other Ordnance and Accessories Manufacturing
3331	Agriculture, Construction, and Mining Machinery Manufacturing
3332	Industrial Machinery Manufacturing
3333	Commercial and Service Industry Machinery Manufacturing
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing
3339	Other General Purpose Machinery Manufacturing
3341	Computer and Peripheral Equipment Manufacturing
3342	Communications Equipment Manufacturing
3343	Audio and Video Equipment Manufacturing
3344	Semiconductor and Other Electronic Component Manufacturing
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
3346	Manufacturing and Reproducing Magnetic and Optical Media
3353	Electrical Equipment Manufacturing
33599	All Other Electrical Equipment and Component Manufacturing
3361	Motor Vehicle Manufacturing
3362	Motor Vehicle Body and Trailer Manufacturing
3363	Motor Vehicle Parts Manufacturing
3364	Aerospace Product and Parts Manufacturing
3391	Medical Equipment and Supplies Manufacturing
5112	Software Publishers
514191	On-Line Information Services
5142	Data Processing Services
5413	Architectural, Engineering, and Related Services
5415	Computer Systems Design and Related Services
5416	Management, Scientific, and Technical Consulting Services
5417	Scientific Research and Development Services
6117	Educational Support Services
811212	Computer and Office Machine Repair and Maintenance

Table 1. BLS R&D Intensive High Technology Industries Converted into NAICS Codes

The data for the District of Columbia and Puerto Rico have been included at the bottom of each data chart in the individual Metric Descriptions in Section 2 for purposes of comparison. In many cases, specific pieces of data were not available for these areas. Occasionally, the data for these areas were not taken from the same source as the data for the 50 states, or they were not available for the same year. For these reasons, the District of Columbia and Puerto Rico were not included in the rankings, nor were they included in the calculation of the national average for each metric unless specifically noted below the data table.

The national average for each metric was calculated by independently summing the state values for both the numerator and the denominator of each metric and then dividing the two. For instance, when calculating the national average for the number of SBIR awards received per 10,000 business establishments, the average number of SBIR awards received annually by companies in each state was totaled to obtain the national average number of SBIR awards. Next, the total number of business establishments in the 50 states was calculated by adding the number of business establishments in each state. Finally, the value for the national average for the average annual number of SBIR awards per 10,000 business establishments was calculated by dividing the first total by the second total.

In the table of metric values, the symbol N/A is used to indicate that data is not available for this particular state from the given data source. A dash in the metric table of values indicates that the value could not be calculated, usually because the initial data were not available. The national value in the table of metric values usually represents the sum of the numerator and denominator values for the 50 states. In instances where the national value is listed as the United States, it represents the values from the 50 states plus the District of Columbia and is defined in a note following the data table.

The indicator value index represents the indicator value for each state divided by the indicator value for the national average and multiplied by 100. For each metric, this produced a series of dimensionless index values representing the performance of individual states. The national average, representing the states for which data was available, has been assigned a value of 100. States performing above the national average will have index values greater than 100, and those performing below the national average will have index values less than 100. The indicator value index is equivalent to the national average when data is available for all 50 states.

The map showing state performance appears on each metric page. It portrays performance by color intensity. The five color ranges shown on the map represent indicator index values of less than 50, 50–94, 95–105, 106–150, and greater than 150, where the indicator index value of all the states with data for that metric is defined as 100. In this edition, call-outs of the states of Rhode Island and Delaware have been added to make it easier to identify the performance level of these geographically small states.

The source citations from which the data used to calculate each metric were extracted are provided on the appropriate Metric Description pages in Section 2 and again in the Appendix where they have been collected to facilitate reproduction. In some instances, the data were obtained on-line from databases capable of being directly queried. In these cases, the web addresses given in the source citation are the (URL) addresses from which the initial queries were made.

Data pertaining to individual states are presented in Section 3 as a series of State Profiles. The State Information Contacts were obtained from the U.S. Census Bureau, Statistical Abstract of the United States, "Appendix 1b, Guide to State Statistical Abstracts", <http://www.census.gov/prod/2003pubs/02statab/app1b.pdf>. Appendix 1 identifies the state sources for the most recent state statistical abstracts as of the publication date of the 2002 Edition of the Statistical Abstract of the United States. These sources are usually designated as data repositories for the state. In a few cases, the source was a commercial entity, and the state census data center designated by the U.S. Census Bureau was selected instead. For questions pertaining to the raw data, inquiries should be directed first to the source of the data, provided in Section 2 as well as in the Appendix, and then to the State Statistical Information Contact.

The State Profiles in Section 3 also contain a brief sketch of each state describing its population, gross state product, number of business establishments, per capita income, and percent of the population living in poverty. The first three of these measures are scale sensitive, and their rankings are intended to give the reader a picture of the state's comparative economic position. Data describing the overall state economic conditions were obtained from publications of the U.S. Census Bureau, the U.S. Department of Commerce's Bureau of Economic Analysis, and the U.S. Department of Labor's Bureau of Labor Statistics. Detailed citations of these sources are provided in the Appendix.

The third element of the State Profiles in Section 3, Science and Technology Organizations, identifies significant organizations in a state's S&T infrastructure. Included in this section are government agencies, public/private partnerships, and university partnerships. These organizations were identified through web-searches and suggestions from individuals familiar with the activities of a particular state. The organizations selected for inclusion are intended to represent a variety of entry portals into a state's S&T infrastructure. Some are general in scope and others are technology-specific. Each of the organizations is briefly described, and an Internet address has been provided to facilitate access to it. Questions related to the content of a state's S&T infrastructure should be directed to an appropriate organization where they will be answered or referred. Selection or omission of an organization does not imply that an assessment regarding its effectiveness, importance, or relative ranking has been done as part of this project.

The final section in each State Profile contains a bar chart depicting the state's performance on each of the 38 metrics. The chart has been divided into quartiles, and the length of the bars represents the state's performance in terms of the percent of national average for each metric. To the left of each bar the numerical rank for that metric is listed. Following the metric title for each bar, the state's value for the metric is given in parentheses. The definition of each metric can be found in Section 2, and the source of the data is given in both Section 2 and in the Appendix. Details related to the raw data and to the state's exact ranking on a particular metric can be found in the chart for that metric in Section 2.

In response to numerous requests, a new section known as Time Series has been added to the fourth edition of this publication. It displays longitudinal data covering periods of up to ten years and is intended to show data trends over time. Ten metrics were selected for inclusion in this inaugural version of the new section. These time series metrics were selected on the basis of data availability and consistency and on their importance to economic development practitioners at the state level. The behavior of each metric over time is presented on two facing pages. The left-hand page describes the change in the national value for the indicator over the time period, both in a bar chart and in the accompanying discussion. Below the national value of the indicator, the change in both its numerator and the denominator values over time are described. The right-hand page contains a table showing the annual value of the indicator for individual states. It covers the period of time for which comparable data are available up to a maximum of ten years.

1.3 Major Metric Groups

1.3.1 Funding In-Flows

This first set of input metrics is designed to measure the amount of science, technology, and research resources flowing into the state from governmental and private sources. These financial resources measure the opportunities to generate knowledge, intellectual property, and specialized human resources. The specific metrics included in this category are:

1. Expenditures for Total R&D Performed per $1,000 of GSP: 2001
2. Expenditures for Industry-performed R&D per $1,000 of GSP: 2001
3. Expenditures for Federally Performed R&D per $1,000 of GSP: 2001
4. Expenditures for University-performed R&D per $1,000 of GSP: 2001
5. Federal Obligations for R&D per $1,000 of GSP: 2001
6. Average Annual Number of SBIR Awards per 10,000 Business Establishments: 2000–2002
7. Average Annual SBIR Award Dollars per $1,000 of GSP: 2000–2002
8. Average Annual Number of STTR Awards per 10,000 Business Establishments: 2000–2002
9. Average Annual STTR Award Dollars per $1,000 of GSP: 2000–2002

The raw data for the numerators of seven of these metrics are expressed in terms of dollars and two in terms of the number of awards. To eliminate scale sensitivity, a normalization or scaling factor was used for each measure. In the cases where the numerator was in terms of dollars, gross state product (GSP) was selected to reflect the impact of the dollar investment on the state's economy. In the case of the number of SBIR and STTR awards, the number of businesses in the state was used since these awards are made to businesses.

1.3.2 Human Resources

The second set of input metrics measures the ability of the labor market to support the science and engineering needs of technology-based businesses. It includes measures of the flow and stock of workers with advanced degrees, undergraduate degrees, and technical associates degrees. The specific metrics included in this category are:

10. National Assessment of Educational Progress (NAEP) in Math Average State Test Scores: 2000
11. Percent of the Population that has Completed High School: 2002
12. Percent of the Population with a Bachelor's Degree: 2002
13. Associate's Degrees Granted as a Percent of the 18–24 Year Old Population: 2000–2001
14. Bachelor's Degrees Granted as a Percent of the 18–24 Year Old Population: 2000–2001
15. Percent of Bachelor's Degrees Granted in Science and Engineering: 2000–2001
16. Science and Engineering Graduate Students as a Percent of the 18–24 Year Old Population: 2001
17. Computer Specialists Employed per 10,000 Civilian Workers: 2001
18. Life and Physical Scientists Employed per 10,000 Civilian Workers: 2001
19. Engineers Employed per 10,000 Civilian Workers: 2001
20. Persons with a Recent Bachelor's Degree in Science or Engineering per 10,000 Civilian Workers: 2001
21. Persons with a Recent Ph.D. Degree in Science or Engineering per 10,000 Civilian Workers: 2001

The NAEP scores represent the average statewide test results in science at the eighth grade level. Other metrics were expressed in terms of percentages, so state size or population was not an issue. For the number of degrees awarded, however, it was necessary to normalize the data to account for population differences. The 18–24 year age range was selected since this is the age group that is most likely to be pursuing higher education. This segment of the population most closely approximates the target market for higher education. This is not to imply that all people receiving degrees are in this age sector, but state higher educational capacity and output should show a relationship to the size of this population segment.

The data for four metrics-high school completions and the three metrics related to recent degrees in the work force-are unchanged from the second edition. The Census Bureau is in the process of reweighting the 2001 educational attainment data based upon the 2000 Census. Data on recent degrees are collected every two years, and the data for 2001 are not yet available.

1.3.3 Capital Investment and Business Assistance

The third set of input metrics measures the amount of financial and business support being provided to state businesses. Capital is one of the most critical needs for new business formation and growth. Capital is very fluid, yet there clearly are tendencies for companies in certain areas to receive disproportionate funding. In fact, the ability to attract capital often is the basis for entrepreneurs deciding where to establish their businesses. Capital takes many forms, including early stage seed and venture, loans and grants, and public offerings. In addition to capital, other forms of assistance can help to facilitate business growth and development. The metrics in this section indicate the capacity and support structure for encouraging new business formation. The specific metrics included in this category are:

22. Amount of Venture Capital Funds Invested per $1,000 of GSP: 2002
23. Average Annual Amount of SBIC Funds Disbursed per $1,000 of GSP: 2000–2002
24. Average Annual Amount of IPO Funds Raised per $1,000 of GSP: 2000–2002
25. Number of Business Incubators per 10,000 Business Establishments: 2003

Again, it was necessary to normalize or scale the data to account for the large differences in size of the state economies. Data that were obtained in the form of dollars were normalized to the GSP of the state. Support services were normalized to the number of state businesses.

1.3.4 Technology Intensity of the Business Base

The first set of output metrics measures the extent to which a state is growing the types of businesses that are classified in high-technology industries. As noted earlier, the designation of high-technology industries is based on the definition from the Bureau of Labor Statistics that was subsequently modified to incorporate NAICS codes in place of the original SIC codes. The companies in these industries are most likely to benefit from strong state S&T programs.

As might be expected, companies in these industries were found to be attractive on a national basis. Although only 5.9% of U.S. business establishments are classified in these NAICS codes, they employ 8.9% of the U.S. work force and account for 14.6% of the U.S. payroll. The following metrics were used to characterize the technology intensity of a state's business base:

26. Percent of Establishments in High-technology NAICS Codes: 2000
27. Percent of Employment in High-technology NAICS Codes: 2000
28. Percent of Payroll in High-technology NAICS Codes: 2000
29. Percent of Establishment Births in High-technology SIC Codes: 2000
30. Net Formations of High-technology Establishments per 10,000 Business Establishments: 2000

The first four metrics in this set are reported as percentages, so no scaling factor is required. Each of these metrics indicates the extent to which the state's business base is concentrated in the NAICS codes that represent high-technology industries. The final metric, net formations of technology intensive establishments, was normalized to the total number of business establishments in the state to minimize the effect of state size factors.

1.3.5 Outcome Measures

The second set of outcome metrics measures the economic development characteristics of the area. Essentially, these metrics are the variables that the S&T programs attempt to improve. The correlation between S&T assets, how effectively they are used by the states, and how much of an impact they exert on economic development is exceedingly complex and dependent upon many external factors. The specific measures included in this category are:

31. Average Annual Number of U.S. Patents Issued per 10,000 Business Establishments: 2000–2002

32. Number of Technology Fast 500 Companies per 10,000 Business Establishments: 2002
33. Number of Inc. 500 Companies per 10,000 Business Establishments: 2002
34. Average Annual Pay per Worker: 2001
35. Average Percent of the Population Living Above the Federal Poverty Threshold: 1999–2001
36. Per Capita Personal Income: 2002
37. Labor Force Participation Rate: 2002
38. Percent of the Civilian Work Force Employed: 2002

The first three metrics in this set are based on the number of patents issued and the number of fast-growing companies. Obviously, they can be expected to increase as the size of a state's business base increases, making it difficult to compare states of widely differing sizes. For this reason, these measures were normalized to the number of businesses in the state. The remaining metrics are expressed in terms that are independent of the size of the state, so no normalization was required.

It should be pointed out that the percent of the population living above the federal poverty threshold was used in place of the more common poverty rate or percent of the population living at or below the federal poverty threshold. This manner of expressing the metric was selected because it represents a positive outcome. Also for the first time in this edition, the three-year state average is used for the poverty data instead of single-year data. This change regarding state-level data for this metric was recommended by the U.S. Census Bureau.

1.4 Time Series Metrics

Ten metrics were selected for inclusion in the new time series section of this report. To the extent that can be determined, each of these time series metrics is based upon a consistent data set that has not been subject to major changes in definition or collection methodology. Therefore, the data presented in this section should be useful for identifying trends that have developed over time, both nationally and at the state-level.

The following metrics and associated years of data have been included in this section of this report:

1. Total R&D Performed per $1,000 of Gross State Product (1993, 1995, 1997–2001)
2. Expenditures for Industry-performed R&D per $1,000 of Gross State Product (1993, 1995, 1997–2001)
3. Expenditures for University-performed R&D per $1,000 of Gross State Product (1992–2001)
4. Annual SBIR Award Dollars per $1,000 of Gross State Product (1992–2001)
5. Percent of the Population with a Bachelor's Degree (1993–2002)
6. Bachelor's Degrees Granted as a Percent of the 18–24 Year Old Population (1992–2001)
7. Science and Engineering Graduate Students as a Percent of the 18–24 Year Old Population (1992–2001)
8. Venture Capital Funds Invested per $1,000 of Gross State Product (1995–2001)
9. Annual Number of U.S. Patents Issued per 10,000 Business Establishments (1992–2001)
10. Per Capita Personal Income (1993–2002)

For each metric, an attempt was made to include the most recent ten years of data. In some instances, this was not possible because data were collected only in alternate years or for only a portion of the last decade.