Maine Comprehensive Research and Development Evaluation 2008

A Report to the Maine Office of Innovation, Department of Economic and Community Development

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1. Introduction

In 2001, the Maine legislature enacted 5 MRSA §13122-J and 13122-K, which called for evaluation of Maine‘s public investment in R&D, the first to be completed in 2001 and every five years thereafter. This marks the third year of the second five-year cycle of this evaluation series. The Maine Office of Innovation (OOI) within the state‘s Department of Economic and Community Development (DECD) is responsible for overseeing this evaluation process. An advisory board, the Maine Innovation Economy Advisory Board, is charged by the state with providing guidance and input on the activities of the OOI, including the evaluation project. To conduct the R&D Evaluation, OOI has contracted with PolicyOne Research, RTI International[1], and EntreWorks Consulting for design, data gathering, analysis, and reporting.

The evaluation is guided by ―A Science and Technology Action Plan for Maine," developed in 2005.[2] The 2005 Science and Technology Action Plan for Maine includes the following goal: **―Maine's R&D activity will equal $1 billion per year by 2010"**

As stewards of public funds, the legislature has asked for an annual evaluation of R&D programs that receive funding from the state. The evaluation of these programs is based on five primary R&D objectives:

1. Maine‘s investments in R&D will stimulate and sustain consistent, competitive growth for Maine‘s economy.
2. Stimulate a robust R&D enterprise by boosting academic R&D capacity, developing an educated, technically skilled workforce, broadening the impact from the nonprofit research institutions, and increasing private sector R&D activity in key strategic areas important to Maine.
3. Maine‘s Legislature and key policymakers recognize, advance, and celebrate Maine‘s R&D investments and strategic priorities.
4. Maine‘s unique R&D assets and their significance to Maine‘s economy are used to draw new business and investment to the state of Maine.
5. Foster growth of research-intensive companies through a comprehensive network of services and support.

[1] RTI International is a trade name of Research Triangle Institute.

[2] A full copy of ―A Science and Technology Action Plan for Maine" is available at the Maine Office of Innovation‘s Website: http://www.maineinnovation.com/

Using the State‘s Plan as a guide, OOI constructed five questions to be answered by this evaluation, which focus on the R&D-related goals and objectives. They are as follows:

1. Overall, has Maine‘s public investment in research and development stimulated and sustained consistent, competitive growth in Maine‘s economy, especially when compared to other states?
2. Has Maine‘s investment in public and private university R&D led to increased research capacity; the development of an educated, technically skilled workforce; and increased commercialization of university technologies?
3. Are Maine‘s investments in nonprofit research institutions broadening their impact on Maine‘s economy?
4. Is Maine fostering the growth of research-intensive companies, increasing private sector R&D activity, and building a technology-based entrepreneurial community?
5. To what extent are these investments increasing the competitiveness of Maine in its key strategic technology and industry areas?

Evaluation Methodology and Use of Data

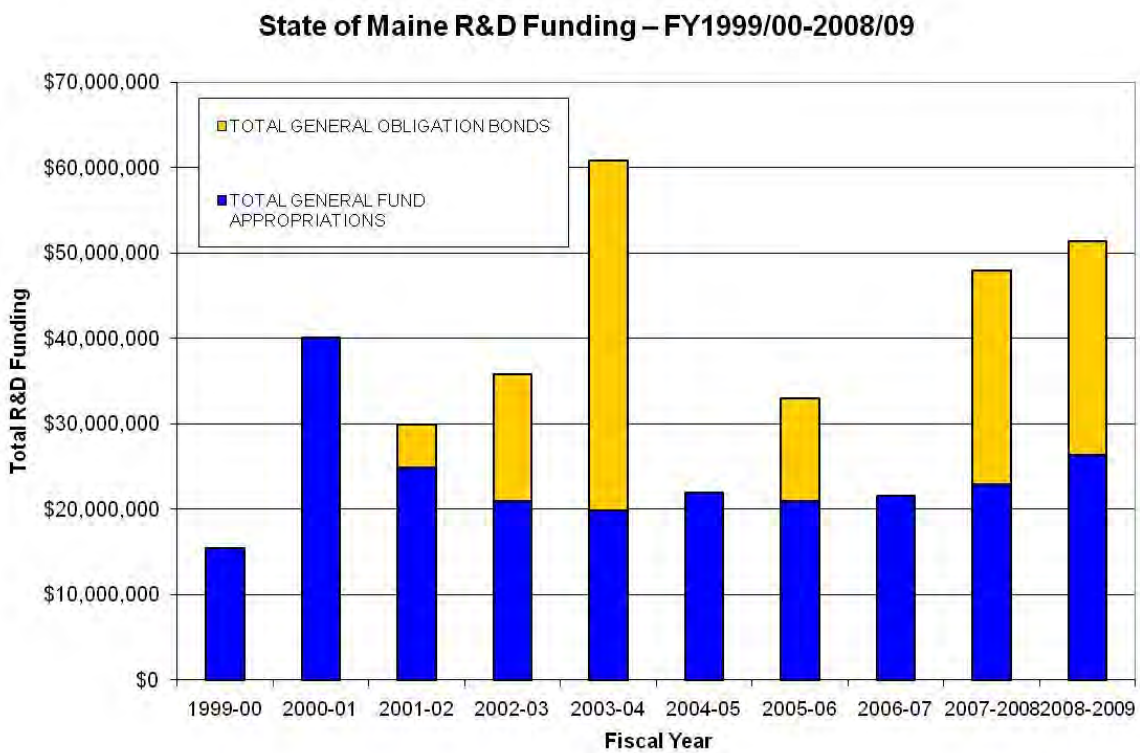
Information used in this evaluation was collected in multiple ways to enable Maine‘s performance to be compared to other states and to ensure consistency of longitudinal data. Federal and university technology transfer data sources were used, along with an extensive survey to the state‘s universities, nonprofits, and companies that receive assistance from state-supported R&D programs.

Much of the data reported by national organizations such as the National Science Foundation and the Bureau of Economic Analysis are at least one to two years old, meaning that 2006 or 2007 may be the latest year that data has been collected and reported for all states. This indicates that national comparisons almost always lag the most recent allocation of state funds. Therefore, readers of this evaluation must not correlate the most recent state budget for R&D with the indicators listed in this report.

2. Findings and Recommendations

Since 1996, the State of Maine has allocated approximately $397 million to R&D efforts: roughly $20 million of general fund dollars each year ($248,662,181 in total from 1996/97 through 2008/09 budget) and nearly $148 million in general obligation bonds (see **Figure 1.1**). In November 2007, Maine voters approved a $50 million bond to be used for research, development, and commercialization. The purpose of Maine's investments since 1996 is to increase the overall research and development (R&D) capacity in the state and to maximize the economic impact that research has on jobs, income, and the overall economy in Maine.

Figure 1.1.



Source: Prepared by PolicyOne Research from data provided by the Maine Legislature, Office of Fiscal & Program Review

Like most states, Maine's rankings among R&D and innovation measures are mixed. According to Maine's 2009 Innovation Index,[3] which ranks Maine in comparison to all fifty states and the District of Columbia, the state ranks 3rd in nonprofit R&D, 13th in entrepreneurial activity, and 15th in SBIR awards. Maine is 9th in science skills of

[3] *Maine Innovation Index 2009*, prepared by PolicyOne Research for the Maine Office of Innovation, January 2009

students and 12th for math skills of students. Maine is among the middle of the pack for overall educational attainment, high-tech employment growth, and Ph.D. scientists and engineers in the workforce. The state is among the lower third of all states in terms of academic R&D performance, venture capital, patents, scientists and engineers in the workforce, science and engineering graduate enrollments, and gross state product growth.

2.1 Findings

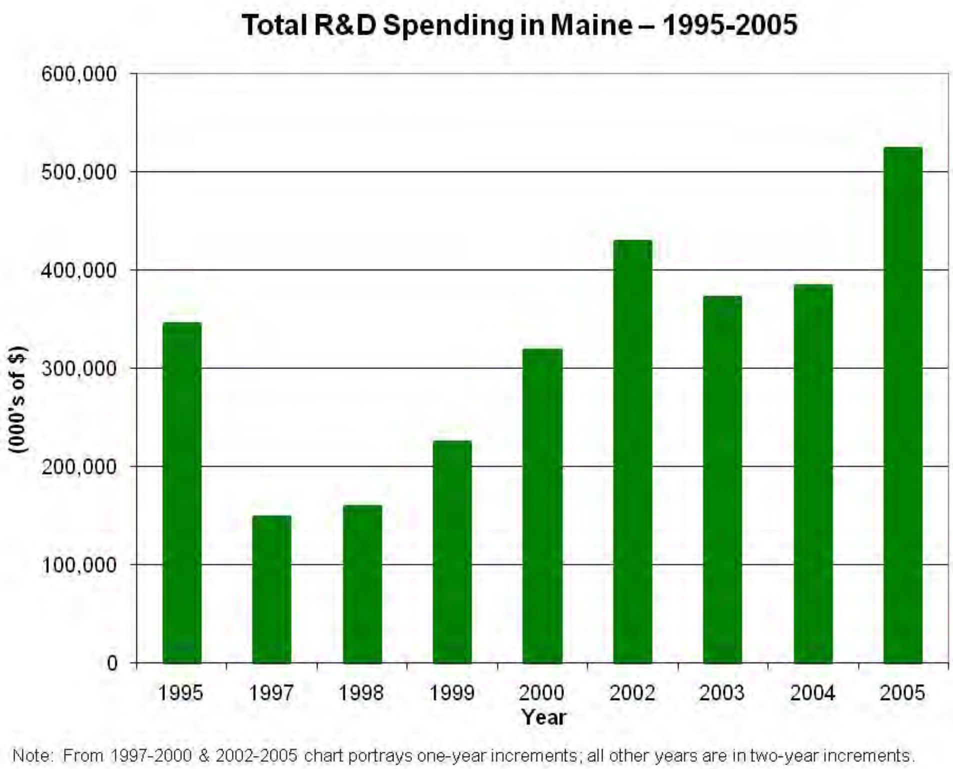
For this evaluation we have assessed and presented our findings in alignment with the five questions defined by the Office of Innovation.

1. Overall, has Maine's public investment in research and development stimulated and sustained consistent, competitive growth in Maine's economy, especially when compared to other states?

Bottom Line: Maine's overall R&D capacity has increased steadily and the direct investment in private sector companies indicates a solid return on public investment, yet the impact of investment has not yet transferred to the broader technology economy.

Total R&D Capacity: Maine's total R&D capacity, as measured by R&D expenditures of universities, nonprofit and private industry, increased from approximately $318 million in total R&D spending in 2000 to $525 million in 2005. This represents an increase of $205 million or 65% over the past six-year reporting period. During that same period, the State of Maine invested approximately $221 million of general funds and bond revenues into R&D efforts ($148 million in general fund appropriations and $73 million in bonds).

Figure 1.2.



Source: Total R&D Performed - National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 - 2005 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges, Survey of Federal Funds for R&D, and Survey of R&D Funding and Performance by Nonprofit Organizations; http://www.nsf.gov/statistics

Overall Economic Growth: Maine's investment in private sector R&D assistance is showing positive results and validates the state's investment in the R&D economy. An economic impact[4] analysis of a subset of the companies served by state programs was conducted for this evaluation. Using the impact analysis, return on investment ratios were calculated for both the most recent one-year and five-year periods. Between 2004 and 2008, the ratio of state's return on investment was approximately 1:8. Thus, for every dollar of public investment, eight dollars of benefits were generated for the Maine economy. The ratio of public return on investment in 2008 was approximately 1:12, higher than that of the impact estimated for a longer time frame.

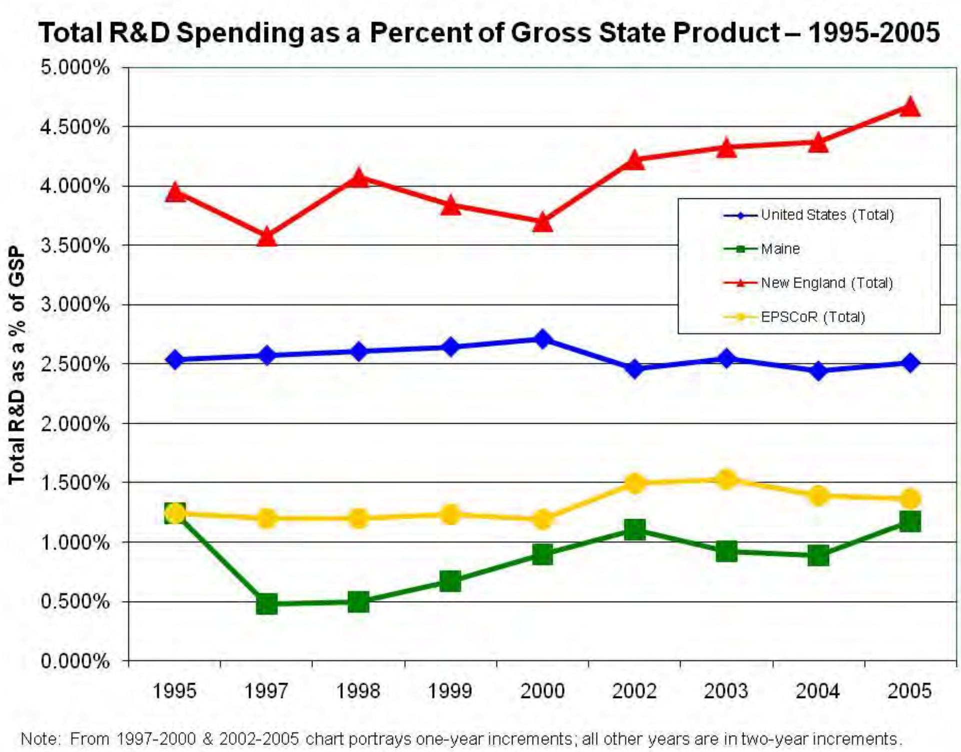
State Comparisons: Maine's 65% growth in total R&D dollars performed from 2000 to 2005 outpaced that of the three reference groups used for this evaluation. During the same period, total R&D spending grew 17% in the U.S. as a whole, 50% among New

[4] The Economic Impact Regional I/O model from Economic Modeling Specialist, Inc. EMSI, was used to calculate the leveraged impact of state investment and detailed results are included in Section 7 of this report

England states, and 52% among EPSCoR (Experimental Program to Stimulate Competitive Research) states[5].

Despite Maine‘s growth in total R&D dollars, the state‘s relative position in R&D (when expressed as a percent gross state product) still remains below that of the US, New England region and other EPSCoR states. Over the years, Maine has made some progress though. In 1997, Maine ranked 49th among all states in total R&D as a percent of gross state product; in 2005,[6] it ranked 41st.

Figure 1.3



Total R&D Performed - National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 - 2005 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges, Survey of Federal Funds for R&D, and Survey of R&D Funding and Performance by Nonprofit Organizations; http://www.nsf.gov/statistics. Gross State Product - Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Accelerated Estimates for 2005 and Revised Estimates for 1997-2004; http://www.bea.gov/bea/regional/gsp.htm; 1997-2005 is based on NAICS while 1980-1996 is based on SIC industry classification

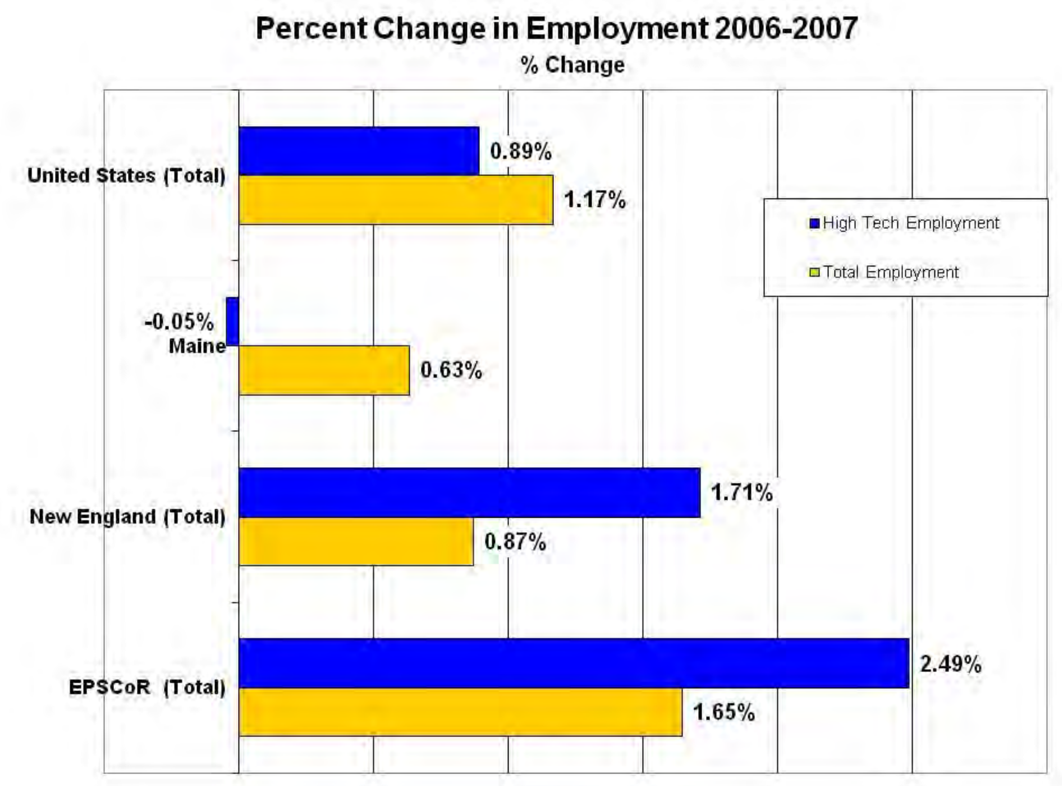
[5] EPSCoR focuses on those states that have historically received lesser amounts of federal R&D funding and have demonstrated a commitment to develop their research bases and to improve the quality of science and engineering research conducted at their universities and colleges. The program currently operates in 23 states: Alabama, Alaska, Arkansas, Delaware, Hawaii, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Carolina, South Dakota, Tennessee, Vermont, West Virginia, and Wyoming, as well as the Commonwealth of Puerto Rico and the U.S. Virgin Islands.

[6] 2005 is the most recent year that comparative data from all states was available.

While technology companies receiving direct assistance from the state have shown steady progress in terms of job creation, Maine's growth in R&D capacity has yet to translate into significant job growth in the broader technology sector. Between 2006 and 2007, high technology employment[7] declined by 0.05 percent in Maine. During this same period, high tech employment in the U.S. grew by 0.89 percent, New England grew by 1.71 percent, and EPSCoR states grew by 2.49 percent. The impact analysis conducted for this study suggests that the drop in technology employment was driven largely by decreases in a few of the larger, traditional manufacturing industries in Maine during this period.

Over the past decade as shown in **Figure 1.4**, technology employment typically outpaced growth in overall employment. This was not true in Maine for the most recent reporting period, 2006 to 2007 where technology jobs lost employment. By comparison, technology employment continued to outpace overall employment in New England and other EPSCoR states.

Figure 1.4



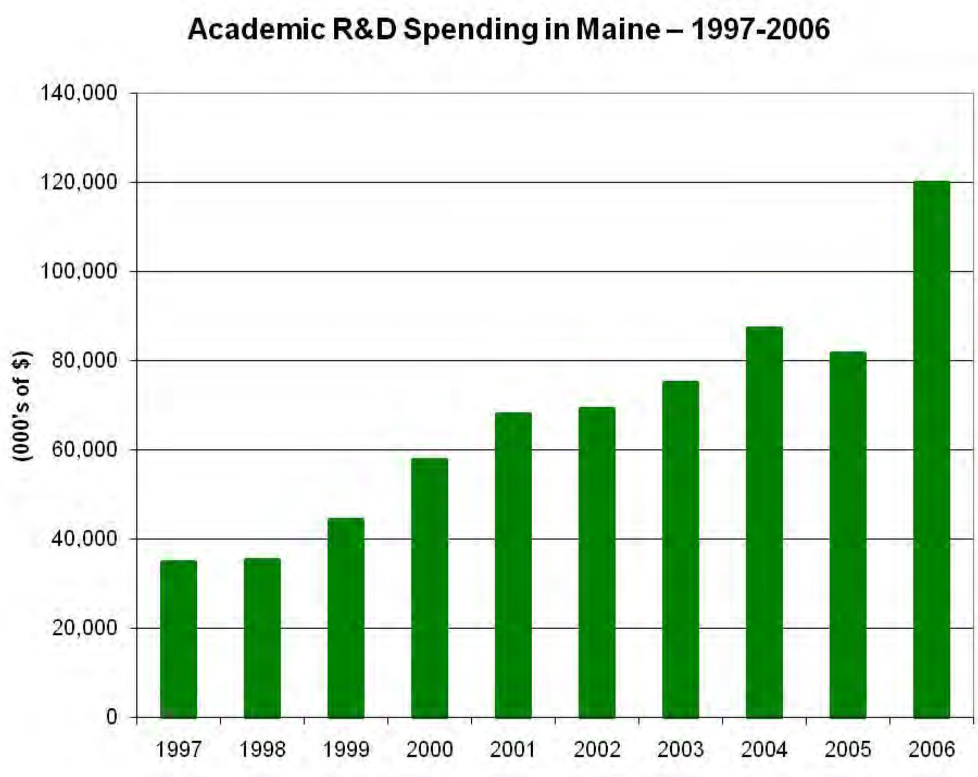
[7] Definition of High Technology is from the U.S. Department of Commerce, based on 39 NAICS codes corresponding to high-technology industries. The industries are listed in **Attachment C** to this report

2. Has Maine's investment in public and private university R&D led to increased research capacity; the development of an educated, technically skilled workforce; and increased commercialization of university technologies?

Bottom Line: Universities have increased their total R&D, while the number of science and engineering graduates has slightly declined over five years, and commercialization of research is much lower than regional and national averages.

University R&D Capacity: The National Science Foundation reported that university R&D in Maine jumped from approximately $70 million in 2001 to almost $120 million in 2006. This represents R&D activity at both public and private institutions.

Figure 1.5.

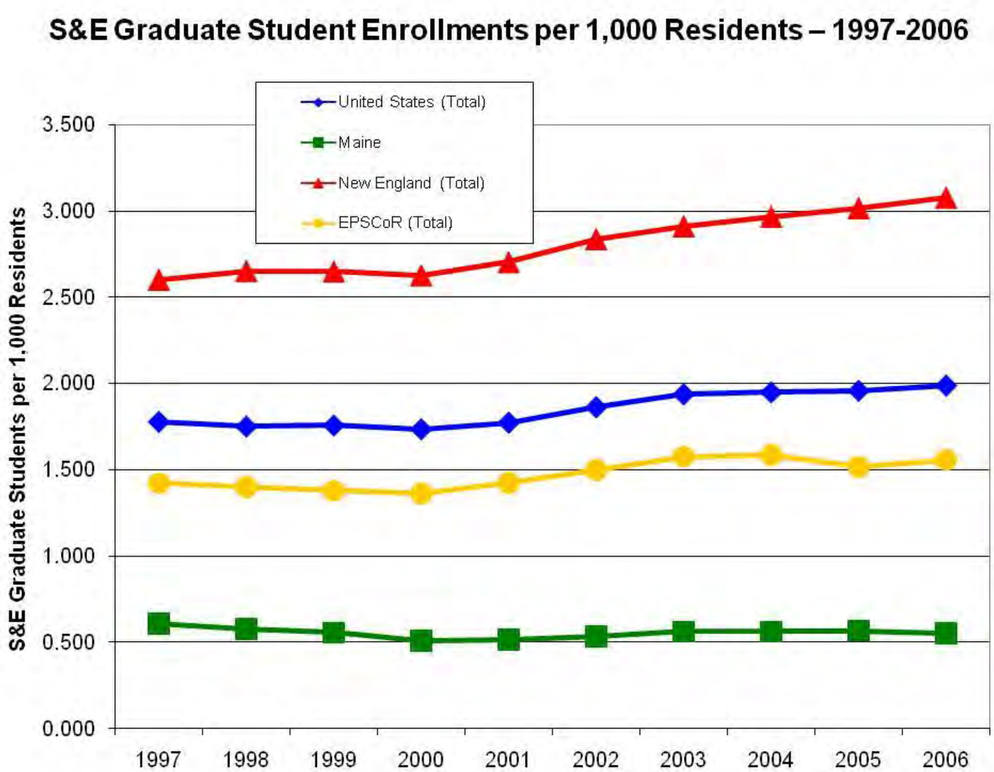


University & College R&D Performed - National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2003 & 2004; Science and Engineering State Profiles: 2005-07
NSF 08-314 | August 2008 http://www.nsf.gov/statistics

In terms of more current data, the recent survey of Maine research institutions conducted for this evaluation noted an increase in academic R&D activity in almost all categories. Universities noted just under $139 million in R&D expenditures, up 208% from last year's reported total of $45 million. The number of new federal grants and contracts received increased by 18%, while the dollar value of those awards increased by 32%. The number of EPSCoR awards increased from four awards in last year‘s survey to nine awards this year. This year‘s survey reported an industry contract total of $4.83 million compared to $2.79 million last year.

Workforce Preparation: The pipeline of skilled workers to support an innovation economy is critical, and Maine lags many other states in this type of workforce preparation. In 2006, Maine awarded 3,791 degrees in science and engineering fields, with master's degrees or doctorates representing 15.6% of those degrees. When the number of degrees per 1,000 residents is compared to EPSCoR and the United States, Maine is below U.S. and EPSCoR averages. On a graduate level in terms of enrollments in S&E programs, Maine is even less competitive. As shown in **Figure 1.6**, the number of students enrolled in graduate-level science and engineering fields expressed per 1,000 residents has remained flat over recent years and at levels two to three times lower than EPSCoR or U.S. averages.

Figure 1.6.



Sources: .S&E Graduate Students - NSF WebCASPAR Database System based on "Survey of Graduate Students and Postdoctorates in Science and Engineering", National Science Foundation and National Institutes of Health; http://webcaspar.nsf.gov. Population: 1980-1989 - Intercensal Estimates of the Total Resident Population of the States, release date Aug. 1996; 1990-1999 - Table CO-EST2001-12-00 - Time Series of Intercensal State Population Estimates: April 1, 1990 to April 1, 2000; Population Division, U.S. Census Bureau; Release Date: April 11, 2002; July 2000-July 2006 -Table 1: Annual Estimates of the Population for the United States and States, and for Puerto Rico: April 1, 2000 to July 1, 2007 (NST-EST2007-alldata), Population Division, U.S. Census Bureau, Release Date: August 18, 2008; http://www.census.gov/popest/estimates.php

Commercialization of Research: Universities have steadily increased total R&D expenditures, yet the commercialization of research, measured by patents and other data, is still less than half that of the national average for universities[8]. According to this year's survey of universities, the number of invention disclosures (20), patent applications (25), patents awarded (6), and license agreements (5) indicate a slight increase over the previous year. Yet these increases in intellectual property (IP)-related applications did not keep pace with the overall growth in R&D expenditures. If Maine universities were to commercialize research as the same rate as similar schools across the country, the output would be double the current level.

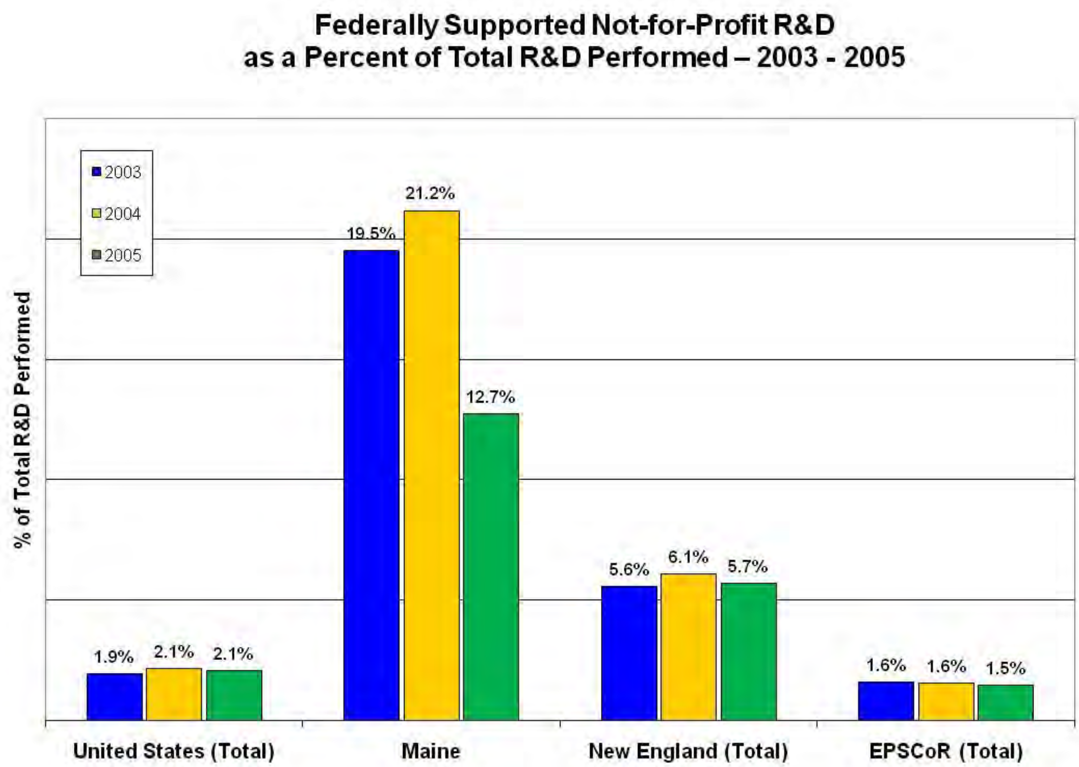
[8] Each year almost 200 universities report R&D activity to the Association of University Technology Managers (AUTM).

3. Are Maine's investments in nonprofit research institutions broadening their impact on Maine's economy?

Bottom Line: The scale of research at nonprofit institutions remains above US average, yet most research is not being commercialized or connected to Maine industry to maximize economic value to the state.

The R&D conducted by Maine's nonprofit institutions continues to be much more extensive than found in other states. According to the National Science Foundation latest data, Maine's nonprofit institutions total R&D spending from federal sources of funds in 2005 was $67 million, almost 13% of the state's total and a ratio six times greater than the U.S. average.

Figure 1.7.



Not for Profit R&D Performed - 1987-2001 from National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 Data Update, derived from Survey of R&D Funding and Performance by Nonprofit Organizations; 2002 & 2003 from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, and 2005; http://www.nsf.gov/statistics

Nonprofit R&D Capacity: Maine's investment in this sector continues to benefit the institutions involved, but has not made the hoped-for broader impacts on Maine's technology industry.

Inputs into nonprofit research (dollars and equipment) continue to increase, while the economic development related outcomes (industry contracts, intellectual property, spin-off companies) have been slower to develop.

> In 2008, Maine's nonprofit research institutions reported $96 million in R&D expenditures, up from $93 million in the previous year. They also reported $199 million in new research equipment, an increase of $7 million from the previous year and over 370,000 square feet of research space (similar to the previous year)[9].
>
> In addition, 345 new extramural proposals were submitted for a total of $184 million. This is down from 352 proposals and $260 million in the dollar value submitted the previous year.
>
> This year showed mixed progress in other intermediate outcomes related to Maine's R&D capacity. In 2008, 113 new federal grants and contracts were received for a total of $67 million, representing an increase of 18% over 2007 in the number of awards and a decrease of 24% in the dollars awarded. Scientific, peer-reviewed journal articles, books, book chapters, and scientific and industry articles published at 508 were down 4% from the level of 530 in 2007.
>
> R&D Outcomes: In 2008, nonprofits reported 299 full-time equivalent research jobs, representing a 9% decrease from the 2007 level of 330 jobs. Industry contracts were down significantly (20 industry contracts valued at $590 thousand, compared to 33 contracts valued at $2.6 million in 2007). From 2007 to 2008, invention disclosures decreased from 30 to 22; patent application increased from 11 to 21, with no patents granted, licenses granted rose from 13 to 14 and license income increased from $485,000 to $896,000 yet no license agreements were with Maine. There were no new spin-off companies or jobs related to nonprofit research.
>
> Our concern with the nonprofit sector continues to be its minimal impact on Maine's economy beyond the direct jobs it provides. This sector has limited interactions with private companies in the state, inhibiting the opportunity for technology transfer and commercialization. In 2008, while 20 contracts with industry were reported by Maine's nonprofit institutions, only one was with a Maine company at a reported contract value of $12,500. Despite the improvements in technology transfer capacity in the past few years, the non-profit sector's production of intellectual property, licenses, and spin-off companies is limited given the large volume of research being performed.

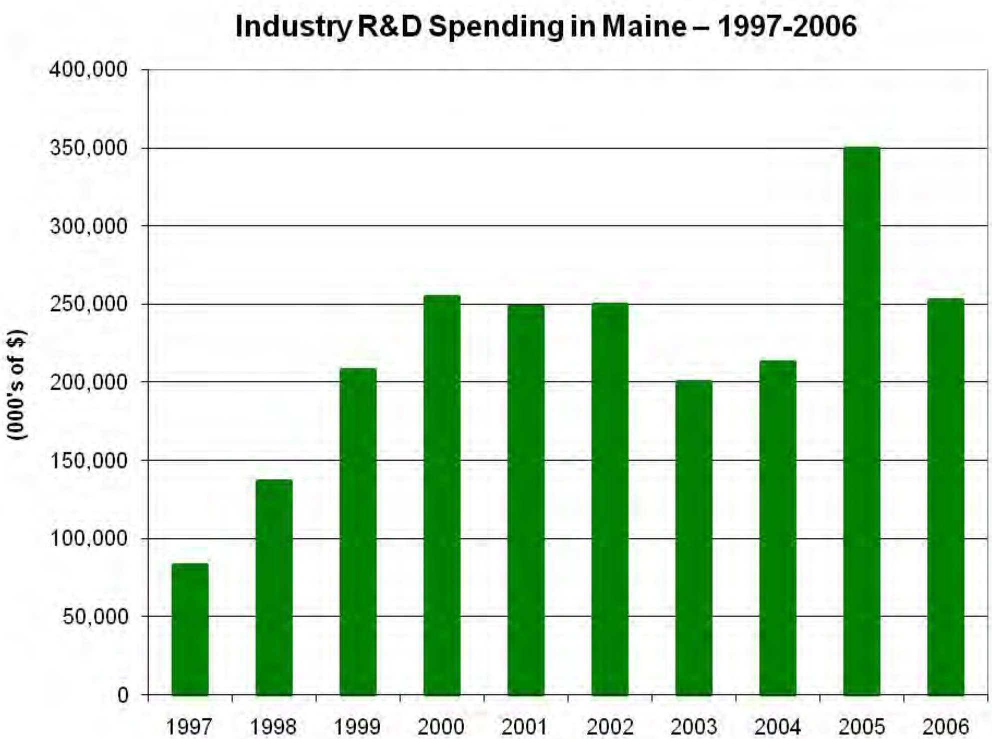
[9] The institution survey findings are included in **Attachment B**.

4. Is Maine fostering the growth of research-intensive companies, increasing private sector R&D activity, and building a technology-based entrepreneurial community?

Bottom Line: Maine's overall private sector R&D remains low, however companies receiving state investment in R&D are showing positive results.

Industry R&D Capacity: The most recent industry R&D data from the National Science Foundation indicates a significant decrease in private sector R&D, from $350 million in 2005 to $250 million in 2006.

Figure 1.10.



Source: Industry R&D Performed – Industry R&D performance is from U.S. Business R&D Expenditures Increase in 2006; Companies' Own and Federal Contributions Rise [August 2008] http://www.nsf.gov/statistics/infbrief/nsf08313/

While overall industry R&D is down, businesses receiving services from state innovation programs are reporting more positive results. The survey respondents spent $46 million in R&D in 2008, which was more than five times the amount of state R&D assistance provided to these companies. Thirty-one percent of the respondents report that they plan to file or have filed patent protection for the innovations developed through state funding.

Fifty-seven companies reported that they were granted a total of 101 U.S. patents in 2008. Another 36 foreign patents were granted to the respondent companies this year. Thirty-seven of the companies surveyed had registered for trademark protection in 2008; 11 have registered copyrights. Seventy-two of the responding companies reported that they have licensed or intend to license their IP.

Entrepreneurial Environment: State investments in R&D and innovation are intended, among other things, to spur the formation or growth of new companies. In the survey results of private sector firms receiving awards from state R&D programs, 26% were quite new, having been established between 2005–2008.

In previous years in which this evaluation was conducted, Maine has performed well in terms of growth in high tech business establishments. However based on the latest data available, 2006-2007, Maine (3.22% growth) has lagged the EPSCoR states (3.46) and the U.S. (3.36) but outpaced New England(1.87) in terms of the growth of high tech business establishments.[10]

Maine's current venture capital environment remains similar to previous years, and reflects that of other states not in the top tier of VC deals. From 2006 to 2007, the number of venture capital deals increased from four to eight; however the total investment dropped from $7.6 million to $6.6 million. The companies participating in Maine R&D programs have also seen a drop in venture capital investments. While a small percent of all companies receive equity funding (nationally, the average is less than 2–3%), approximately 7.7% of survey respondents received equity funding from angel, venture, or state seed funds. These 32 participating companies indicated just under $32 million of new equity infusions in the past year.

[10] Definition of High Technology is from the U.S. Department of Commerce, based on 39 NAICS codes corresponding to high-technology industries. The industries are listed in Attachment E to this report

5. To what extent are these investments increasing the competitiveness of Maine in its key strategic technology and industry areas?

Bottom Line: While overall R&D capacity has grown in the state, there is limited evidence that shows here a systematic link between academic, nonprofit and industry investments. R&D investments are benefiting the institutions and businesses receiving assistance, yet these investments are not generating large-scale benefits for the wider economy.

<u>Growth of Technology Industries</u>: The number of jobs, new businesses, and wealth creation for those receiving support from state-funded R&D programs has been consistently growing. The private sector survey data reveal that Maine continues to support the growth of research-intensive companies through these programs. 855 companies have received assistance from one of the state funded programs in the last five years, and 22% have worked with more than one of these stakeholders. Forty-eight percent of the companies responded to the annual survey.[11]

Of the 413 companies that responded to the evaluation survey, the results were fairly positive given the current economic environment:

- While the number of jobs declined by 3.3%, wages for these companies averaged $42,061, approximately 24% higher than the average state wage of $33,962.12
- Compared to the previous year, firms reported a 36.7% growth in overall revenues and a 41.4% growth in revenue per employee.
- Over 95% of revenues came from sales of products or services compared to grants or contracts, indicating the commercial value and potential for these companies.

Connections between Industry and University/Nonprofit Research: Over the past year, the number of industry research contracts with universities has declined, despite growth in overall academic and nonprofit research. Universities reported an industry contract total of $4.83 million compared to $2.79 million last year. While this is a 73% increase, this rate of growth did not keep pace with the 200% rate of increase for overall R&D spending. Therefore, the percent of industry contracts compared to total R&D expenditures went from 6.2% in 2007 to 3.5% in 2008. In 2008, nonprofit institutions reported 39% fewer industrial contracts and more than a 78% decrease in the dollar value of industry contracts over the previous year‘s survey.

[11] The survey findings are included in **Attachment A**.
[12] 2007 state wage of $33,962 reported by the Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Table 1.1. Key R&D-Related Indicators from Maine Innovation Index 2009

Indicator	Maine 1-Year Trend	Maine 5-Year Trend	Maine Compared to EPSCoR Most Current Year	Maine National Rank 1–51 with 1=best; (year)	
				5 Years Prior	Most Current Year
Total R&D Performance	↑	↑	↓	38 (2000)	35 (2005)
Industry R&D Performance	↓	↔	↓	36 (2002)	38 (2006)
Academic R&D Performance	↑	↑	↓	49 (2002)	42 (2006)
Not-for-Profit Laboratory R&D Performance	↓	↓	↑	4 (2001)	3 (2005)
Federal R&D Obligations	↑	↓	↓	8 (2001)	25 (2005)
State R&D Investments	↑	↑	N/A	N/A	N/A
SBIR/STTR Funding	↑	↑	↑	33 (2002)	8 (2006)
Venture Capital Investments	↓	↑	↓	44 (2003)	38 (2007)
Patents Issued	↓	↓	↓	40 (2003)	43 (2007)
Entrepreneurial Activity	↓	N/A	↔	10 (2004)	31 (2007)
High Technology Employment – % Change	N/A	N/A	↓	N/A	25 (2007)
High Technology Business Establishments – % Change	N/A	N/A	↓	N/A	44 (2007)
S&E Occupations in the Workforce	N/A	N/A	↓	N/A	44 (2006)
Ph.D. Scientists and Engineers in the Labor Force	↑	↑	↑	29 (1999)	28 (2006)
Science and Engineering Graduate Enrollments	↔	↑	↓	51 (2002)	51 (2006)
Science and Engineering Degrees Awarded	↑	↑	↓	31 (2002)	33 (2008)

Ranking is among all states plus District of Columbia, with 1=best. Latest year is in parentheses.

Key:
↑ = Improving Trend or Higher
↓ = Decreasing or Lower
↔ = No Change or Equal
N/A = Not Applicable or Data Not Available

2.2 Recommendations

As the state continues its essential investments in innovation, it should understand the core focus of different investment strategies:

- **Scale**: Strategies to increase the total amount of R&D being conducted in the State of Maine (how much)
- **Pace:** Strategies to enhance the speed and degree in which research is commercialized into tradable goods and services (how fast)
- **Value**: Strategies to strengthen the economic impact of R&D, including direct and indirect jobs, new businesses, increased exports, and wealth generation (how well)

We cannot expect every state-supported effort to support all three elements at once; every initiative will and should have a core focus or mission. However, the combination of all state R&D efforts should result in an effective blend of these elements. Therefore, an evaluation of state funding should not only assess changes in the scale of R&D spending (i.e. are we spending more?), but it should also assess the degree to which the R&D is making a difference to the Maine economy (i.e. are we spending better and smarter?).

In terms of scale, Maine has increased its overall R&D capacity, with this year‘s report showing record setting levels of R&D expenditures. Yet the economic impact in terms of private sector job and business growth, new patents and products, industry R&D has not kept pace. Some of this lag results from a longer time to pay-off from R&D spending, but, even with this lag, Maine can do better in terms of converting R&D investments into bottom-line benefits for Maine‘s businesses, communities, and residents. The time is right to turn the focus to issues of pace and value—setting clear goals to increase the rate of technology transfer, industry R&D, and new product development; and providing the resources to grow the jobs and wealth generated from the state‘s new start-ups and small technology companies.

The following recommendations target three clearly identified gaps in the state‘s innovation economy: a lack of technology transfer and commercialization of research from our universities and nonprofit institutions, limited growth of companies after they start, and a lack of industry R&D that sustains the R&D pipeline. The recommendations provide a starting point for this conversation about getting the most out of the state‘s existing and future investments in R&D.

Increase the level of technology transfer and commercialization at university and nonprofit R&D institutions. While the state has logically invested in increasing the total volume of research at universities and nonprofit research centers, there appears to be a timely opportunity to also begin a targeted effort to commercialize more research.

Increase levels of technology transfer and commercialization activities in universities and nonprofit research institutions:

- The state should create a focused strategy for building technology transfer capacity throughout the state. In addition to the traditional patenting and licensing support provided thus far, a strategy might provide resources for regular training and mentoring on technology transfer and intellectual property (IP) to both institutional management and research staff; create reward and incentive programs that encourage technology transfer and entrepreneurial activities; proactively work with faculty who may have commercially attractive inventions; provide resources for review of approval of resulting disclosure, patent and other IP activities.
- State policymakers should consider the creation of a statewide patent fund that invests in protecting innovative ideas from Maine institutions. Funds should be matched by Maine institutions as an incentive for them to begin their own dedicated patent budgets. An impartial review board should be established to review patent fund applications. This fund could be managed through the OOI.
- The state should increase resources to the University of Maine, Orono, for additional staff to support the level of activity taking place through the Office of Research and Economic Development. The campus has demonstrated the ability to spur technology commercialization with its applied research centers, strong ties to industry, and the most experience in technology transfer and start-up formation in the state.

Enhance opportunities to align university and nonprofit with industry and federal research. Currently, a large portion of university and nonprofit research is focused in areas where Maine does not have a strong base of local industry or high levels of local employment. The state should identify methods where it can create better alignment between university research strengths and industry needs and assets. Other states have strengthened connections between industry and universities/nonprofits by funding industry-driven research collaboratives where an industry association or a group of companies works with research institutions. Other states encourage industry-university connections through industry-led grants that provide a company matching research funds for efforts involving universities and nonprofit institutions in the state.

- Specially, the state should foster the development of a statewide system to connect entrepreneurs and businesses to university and nonprofit R&D facilities and expertise. Best practices in other states include a comprehensive information system of university and nonprofit R&D resources, a brokering function to help the private sector more easily connect with these resources, and assistance connecting university-industry research with seed funds and other resources for commercialization.

Enhance the entrepreneurial infrastructure to foster greater growth and market opportunities for start-ups and small technology businesses. The majority of Maine‘s innovation-based companies are small and the amount of start-up activity appears to growing. These companies, however, appear to stagnate after a certain size and are not growing at rates seen in most other states. The opportunity for Maine is to take this base of small technology companies and provide the resources necessary for growth.

- Maine should begin efforts to develop a more comprehensive and customized system of intense commercialization services for innovation-based entrepreneurs that go beyond the traditional incubator or small business assistance model. A fledgling effort to develop this system began in 2003, but never gained traction among business service providers or entrepreneurs. Maine's business support providers should revisit this effort, and expand the role of private sector partners in leading a new initiative. Efforts in Oklahoma, North Carolina, and Oregon can provide examples of different models used to provide comprehensive services to entrepreneurs.
- Maine's policy makers should consider several steps to help build local networks and strengthen the state's ―culture" of entrepreneurship. The state should consider provide seed funding to stimulate the creation of such local networks, and also provide technical assistance and training on how to start and manage these organizations. Given the current difficult funding environment, DECD may need to consider alternative approaches to funding this effort. CDBG funds may provide one tool in this regard as other states, such as North Carolina, have deployed Federal funds for this purpose. In addition, Maine should consider establishing a Governor's Entrepreneur of the Year award and a Governor's Cup Business Plan Competition. Both of these efforts offer a low-cost means to send the message that Maine is an ―entrepreneur-friendly" state.
- Maine's entrepreneurs will benefit greatly from access to sources of expertise, assistance, and funding that are located outside of the state. Maine's proximity to the Boston metropolitan area, one of the nation's leading centers of entrepreneurship, provides Maine with a potential competitive advantage on this front. Better connections into these networks can lead to increased deal flow, more and better opportunities for Maine start-ups, and support from experienced accountants, bankers, and attorneys who are used to working with start-up companies.

Increase Industry R&D: The state can help spur the level of industry R&D through public policies and incentives that encourage Maine companies to expand and reinvest in their R&D.

- Maine should develop a Small Business Innovation Research (SBIR) matching fund that matches all or part of Phase I and II Federal awards. This relatively new strategy, recently adopted by several states, has produced impressive early results in leveraging federal funds and increasing the number of SBIR awards and participating companies in their state.
- State policymakers should investigate options to modify its existing R&D tax credit to be competitive with credits provided in other states. First, allow a limited amount of tax credit to be applied to all research, not just incremental

research expenditures (this could be limited to a base amount of research spending). Second, increase the tax credit rate on incremental R&D spending and basic research to be competitive with other states.

- The state should make modifications to High Technology Investment Tax Credit and Jobs & Investment Tax credit to reflect the current environment of innovation-based companies. Many tax credits were developed in an era of recruiting large businesses rather than growing strong companies from within. Therefore, these tax credits may actually be counterproductive to the growth of start-ups into larger enterprises. Reducing job or investment requirements to be more in line with the size of today‘s science and technology company would work to grow businesses that already have a foothold in the state

3. Evaluation Results

This section details the answer to each of the five questions posed by the evaluation and presents the evidence obtained from the annual private sector survey, the survey of the R&D institutions, the case study on technology transfer capacity and start-up activity, the economic impact analysis, and the 2009 Innovation Index.[13]

Based on available information and given the current rate of growth, the overall goal of reaching $1 billion in R&D activity by 2010, as stated in the 2005 Science and Technology Action Plan for Maine, is likely unattainable. As noted in the Plan, considerable additional state investment will be required to reach the goal, especially in programs that are showing direct economic impact and the leveraging of other resources. In addition to the scale of R&D in Maine, the pace of progress and the resulting economic value will also need to increase in order to make the most out of our public investments.

3.1 Maine's Competitive Position

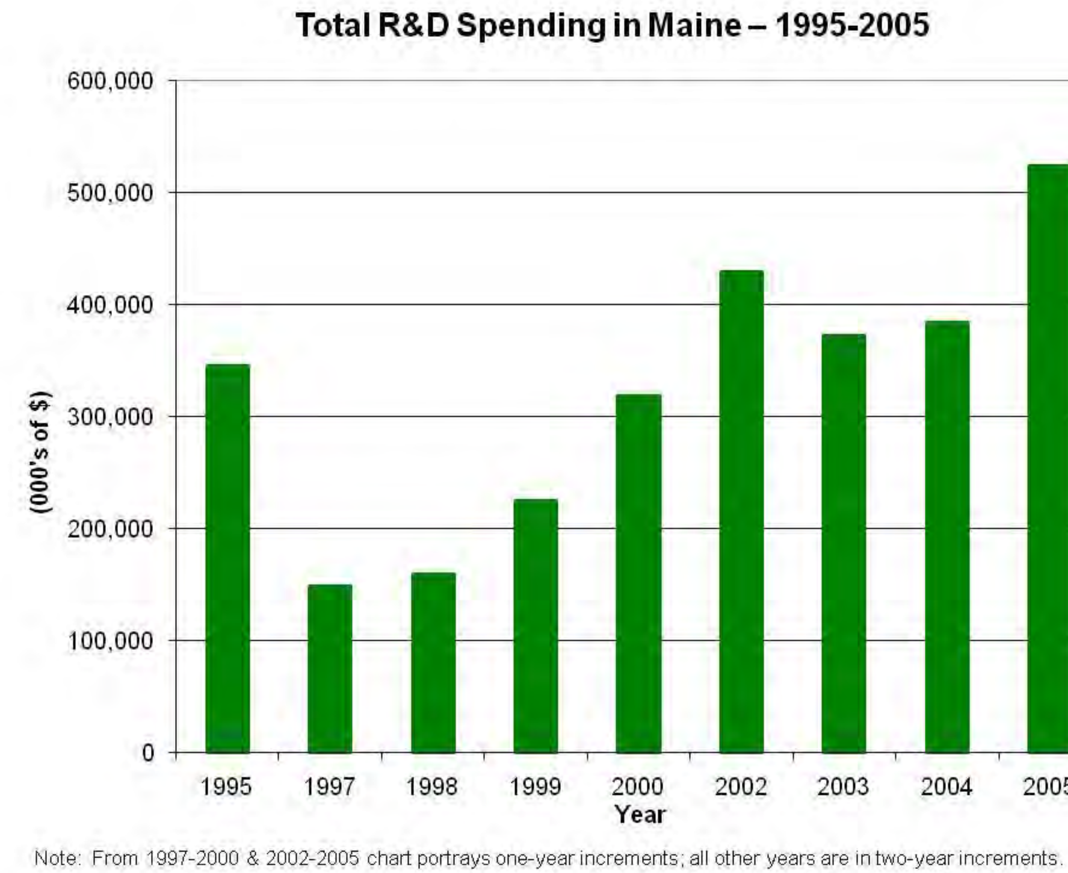
Overall, has Maine's public investment in research and development stimulated and sustained consistent, competitive growth in Maine's economy, especially when compared to other states?

Bottom Line: Maine's overall R&D capacity has increased steadily and the direct investment in private sector companies indicates a solid return on public investment, yet the impact of investment has not yet transferred to the broader technology economy.

Total R&D Capacity: According to the National Science Foundation, Maine's total R&D capacity has increased from approximately $319 million in total R&D spending in 2000 to $524 million in 2005 (see **Figure 3.1).** This represents an increase of $205 million or 64% over the past five-year reporting period. During that same period, the State of Maine invested approximately $127 million of general funds and another $61 million in bond funding into R&D efforts for a total Maine investment of $188 million.

[13] The private sector survey instrument is included as **Attachment A** and the findings as **Attachment B**. The R&D Institutions Survey is included as **Attachment C** and the data as **Attachment D**. The case study is in **Section 4** and the impact study in section 7 of this report. The Innovation Index for 2009 is under separate cover.

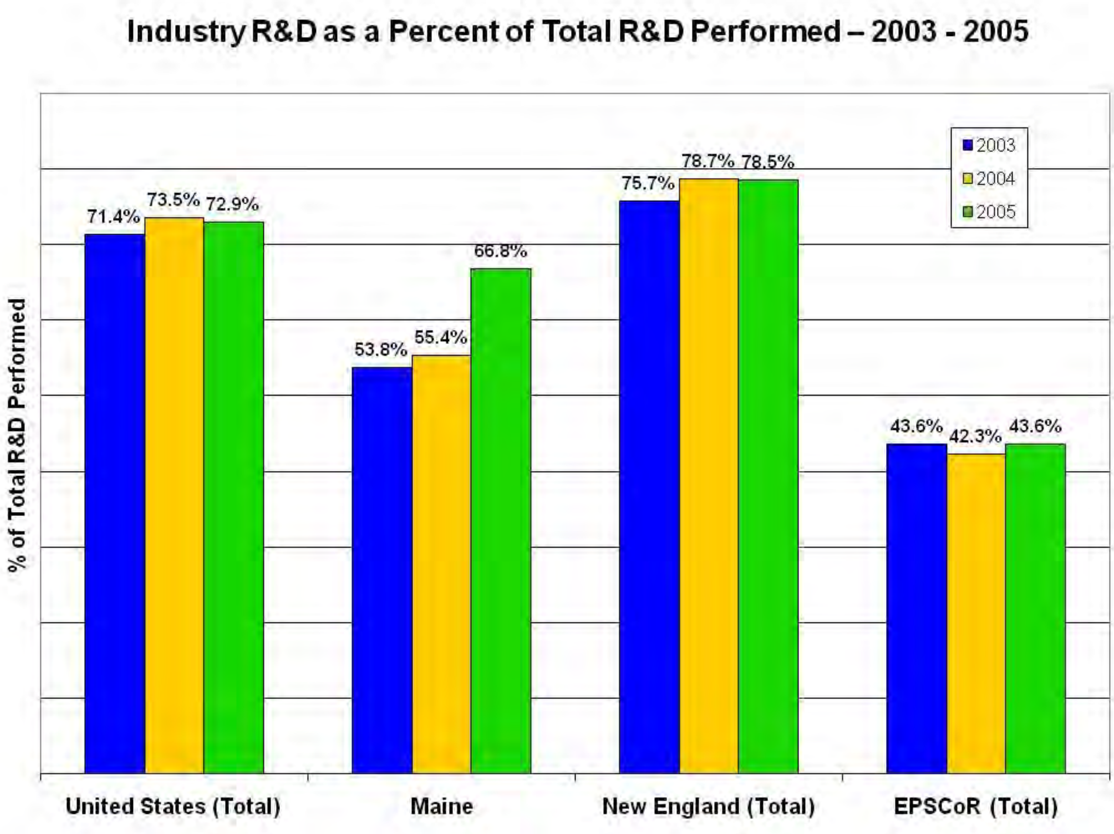
Figure 3.1.



Sources: Total R&D Performed – National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2005 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges, Survey of Federal Funds for R&D, and Survey of R&D Funding and Performance by Nonprofit Organizations; http://www.nsf.gov/statistics.

Maine‘s R&D environment is unusual in that a larger portion of the R&D is performed by nonprofit research institutions. **Figures 3.2** through **3.4** show the relative importance of the three types of R&D performers in Maine. As indicated in **Figure 3.2** industry has a larger role in the Maine‘s R&D than in other EPSCoR states but lower than the United States and New England as a whole.

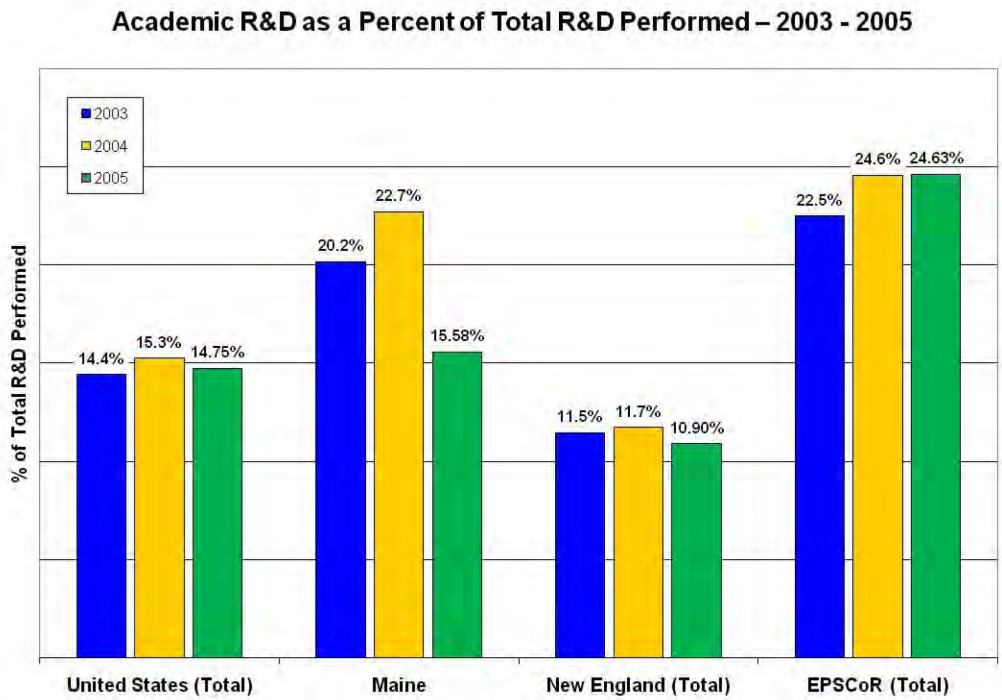
Figure 3.2.



Source: Industry R&D Performed – Industry R&D performance is from U.S. Business R&D Expenditures Increase in 2006; Companies' Own and Federal Contributions Rise [August 2008] http://www.nsf.gov/statistics/infbrief/nsf08313/

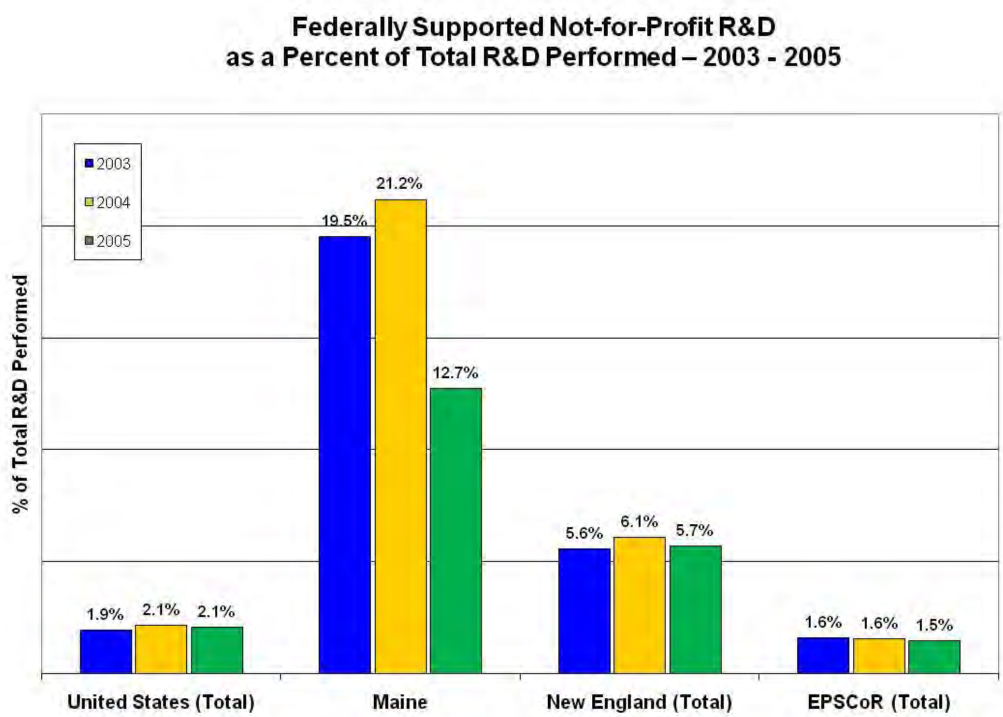
Figure 3.3 shows a decrease in Academic R&D as a percent of total R&D in the last year available, but still remains higher than the rate in the United States or in the New England states as a whole. **Figure 3.4** indicates the importance of nonprofit R&D to Maine. While the total percent of nonprofit R&D has declined over the past several years, it still is approximately six times greater than the U.S. or EPSCoR average.

Figure 3.3.



Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2006; http://www.nsf.gov/statistics.

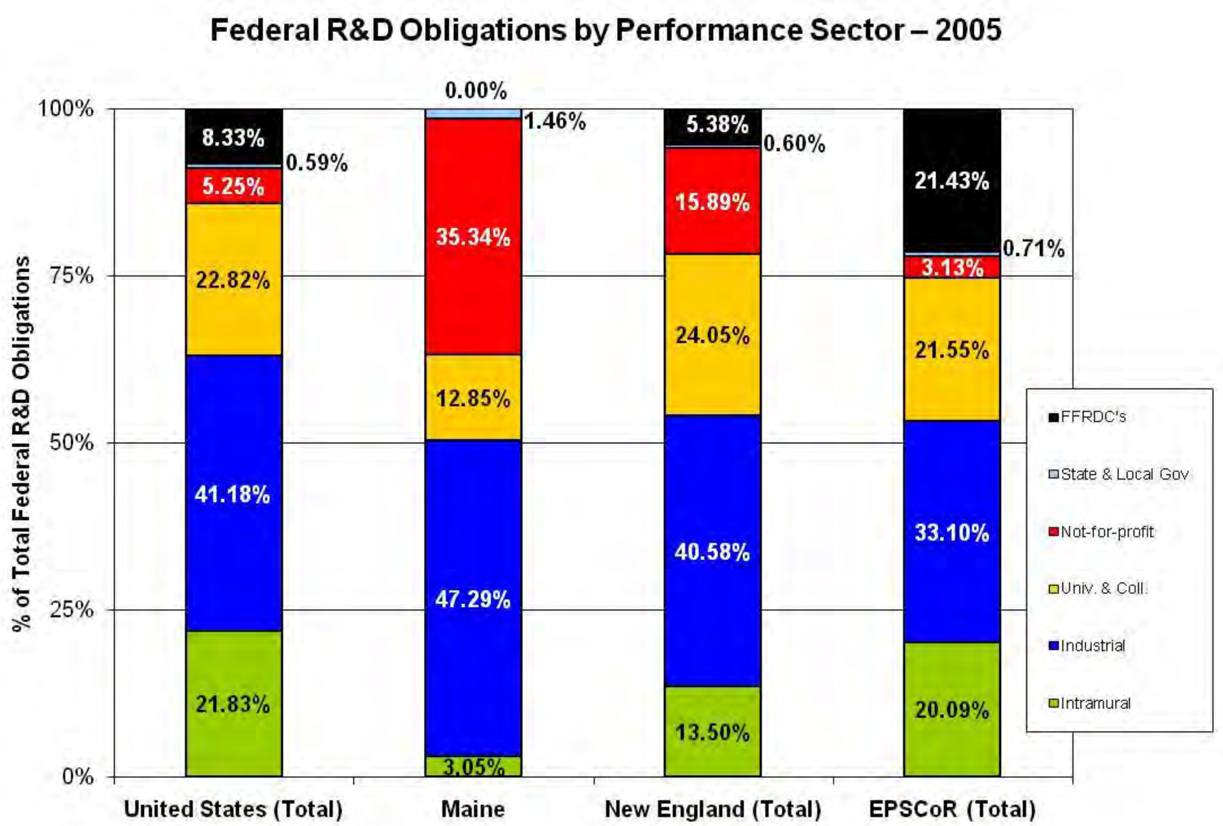
Figure 3.4.



Source: Not for Profit R&D Performed – 1987-2001 not for profit R&D performed is from National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 Data Update, derived from Survey of R&D Funding and Performance by Nonprofit Organizations; 2002-2005 is from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, and 2005; http://www.nsf.gov/statistics

The federal government is a major funder and plays a critical role in spurring R&D. **Figure 3.5** illustrates how federal R&D dollars are distributed among various sectors. Again, nonprofit R&D received a disproportionate share of federal funds compared to other states, and Maine industry received more than any of the other reference groups.

Figure 3.5.



Source: Federal R&D Obligations – National Science Foundation/Division of Science Resources Statistics; Survey of Federal Funds for Research and Development: Fiscal Years 2003, 2004, and 2005; http://www.nsf.gov/statistics

Further assessing the performance of Maine R&D by sector using the latest data available, 2001-2005[14], **Table 3.1** compares Maine's five-year investment levels[15] by

[14] 2005 was the last year that the National Science Foundation reported total R&D performance by state; therefore, state budgets for the same period were used to consistently compare data.

[15] Maine's investment by sector was estimated based on actual general fund appropriations and binds for the State's R&D related programs and an estimated percent of allocation of those funds from the Maine Office of Innovation.

sector with the percent contribution of each sector towards total R&D performance in the latest year and the growth in each R&D sector.

While Maine has invested 52% of its state R&D funding in the universities between 2001 and 2005, the universities represented only 16% of the total R&D performance. Conversely, while the state has invested 21% in industry R&D through private sector-focused programs, industry performs over 67% of the state's R&D. The nonprofit sector received 25% of funding and accounted for 13% of the total research.

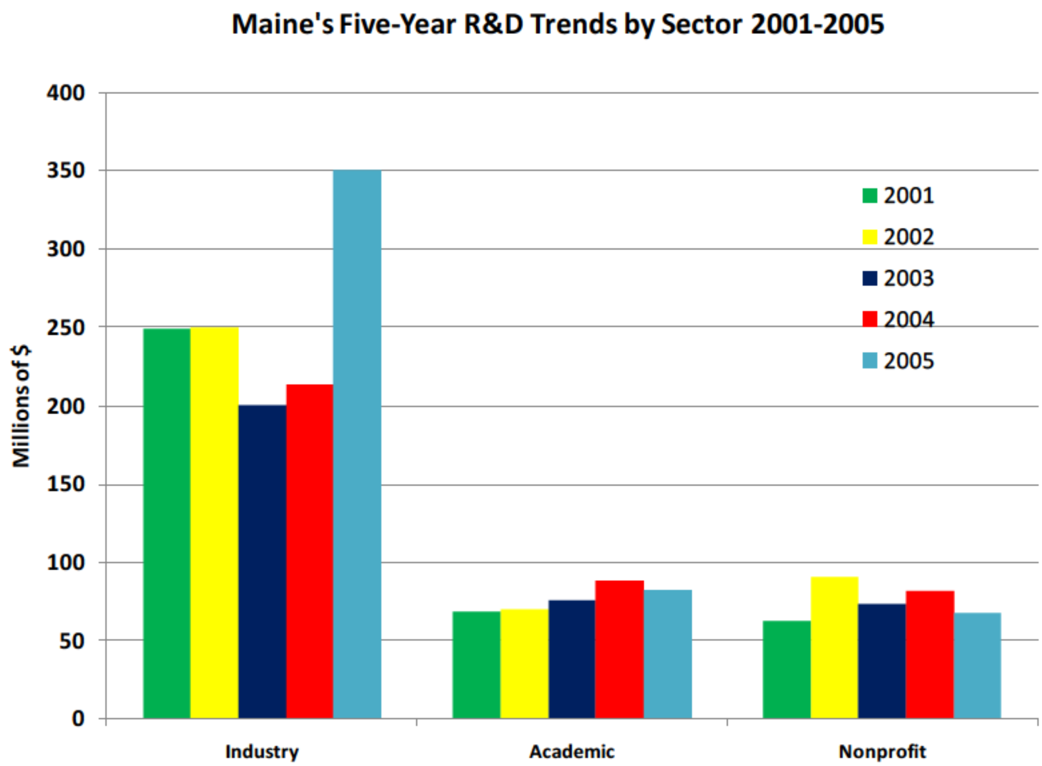
Table 3.1. Five-Year Comparison of Public Investment (2001–2005) and Performance of R&D (2001–2005)

	% of Maine Public Investment in R&D 2001–2005	% of Performance of R&D, 2005	Maine % Change in Performance of R&D, 2001–2005	U.S. % Change in Performance of R&D, 2001–2005
Industry	**21%**	**67%**	**41%**	**14%**
Academia	**52%**	**16%**	**20%**	**40%**
Nonprofit	**27%**	**13%**	**7%**	**32%**

The performance of Maine's industry sector outpaced the national growth during that same period while it lagged in the academic and non-profit sectors.

Figure 3.6. presents trends in R&D performance by sector between 2001 and 2005. Year to year data indicates significant fluctuations. In 2005, decreases were experienced in the academic and nonprofit sector, while an increase was experienced in the industry sector. More recent data which is available for 2006 for industry and academic R&D, but not for nonprofit, indicates that industry R&D fell from the 2005 level of $350 million to $253 million in 2006 and academic R&D increased from the 2005 level of $82 million to $120 million in 2006, a net loss of $49 million in 2006.

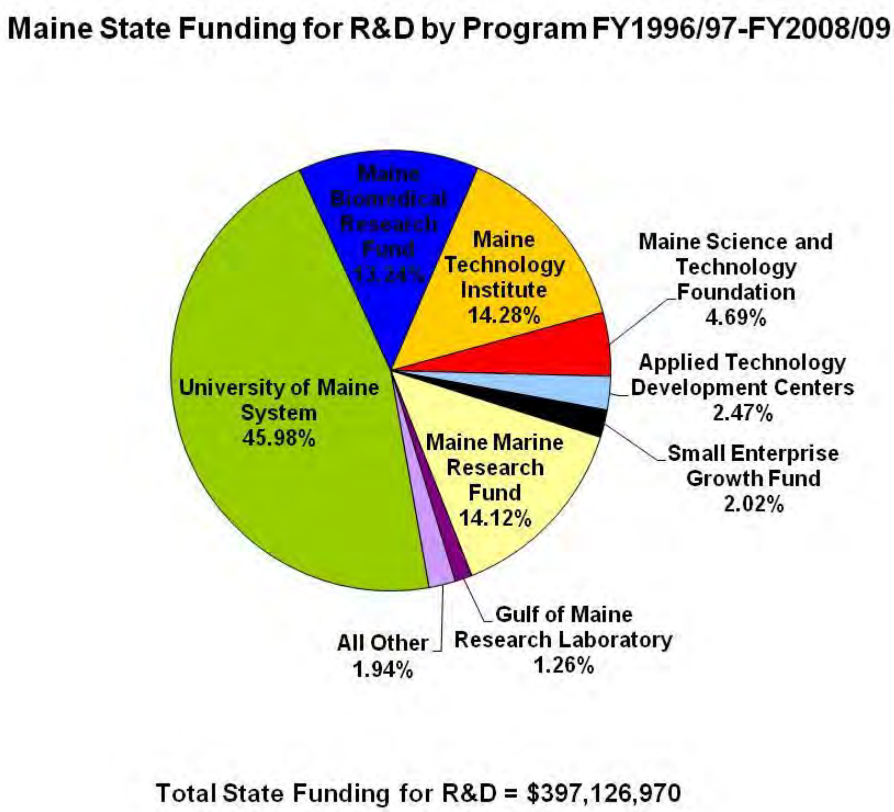
Figure 3.6.



Sources: Total R&D Performed – National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2005 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges, Survey of Federal Funds for R&D, and Survey of R&D Funding and Performance by Nonprofit Organizations; http://www.nsf.gov/statistics.

Figure 3.7 shows the distribution of R&D investments by major program areas over the past five years. While some programs serve a combination of industry, university, and nonprofit clients, most programs are concentrated on one primary sector. The University of Maine receives the most funding, followed by the Maine Technology Institute and the Biomedical Research Fund.

Figure 3.7.



Source: State R&D investment was compiled by PolicyOne Research, Inc. from data provided by the Maine Legislature, Office of Fiscal & Program Review.

<u>Economic Growth</u>: The economic growth impacts of R&D investments can be evaluated directly through the companies served by state R&D investment and by national statistics used to evaluate innovation and R&D performance. Using data collected from the companies receiving services from state-supported programs, Maine‘s investment in specific private sector R&D assistance is showing positive results and serves to help validate the state‘s investment in the R&D economy.

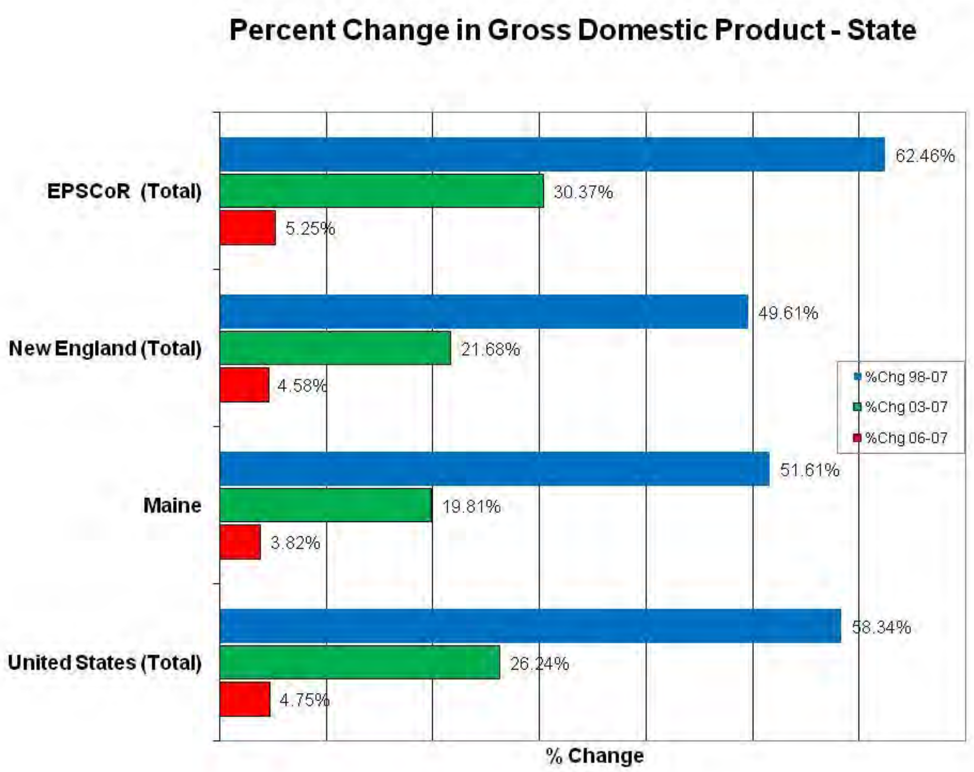
An economic impact[16] study on the companies served by state programs was used to estimate the statewide economic impact generated by the companies served by Maine's R&D programs. The 262 companies in our sample generated $1.23 billion in revenues and employed 5,197 workers in 2008. Adding $697 million of indirect impact resulting from those companies, they have produced a total impact of nearly $2 billion in Maine for 2008. Over the last year, those companies have seen their revenues increase by $82.8 million, or a 7% increase. The increase of $82.8 million resulted in a total impact of 763 jobs between 2007 and 2008, accounting for 244 direct jobs created among those companies and 519 indirect jobs from other companies to provide goods and services. Consequently, this improved performance resulted in a total additional impact of $123 million to the state economy during the past year.

In terms of return on investment, using the impact analysis, ratios were calculated for both the last one-year and last five-year periods. Between 2004 and 2008, the ratio of state's return on investment was approximately 1:8. Thus, for every dollar of Maine state investment, eight dollars of benefits were generated for the Maine economy. The ratio of state's return on investment in 2008 was approximately 1:12, higher than that of the impact estimated for a longer time frame.

<u>National data on economic growth</u>. One way to understand the impact of these investments is to compare Maine's overall economic progress relative to the other EPSCoR states and the rest of the United States. **Figure 3.8** shows that during the last ten year period for which data is available (1998-2007), Maine's gross state product (GSP) grew by 51.61 percent. This growth rate is slightly higher than the overall GSP growth for New England (49.61%) during the same period, yet is below the 62.46% growth rate for EPSCoR states and the 58.34% growth rate for the United States. From 2006–2007, however, Maine experienced a growth rate of only 3.82% while New England GSP grew at 4.58%, EPSCoR states at 5.25%, and the United States at 4.75%.

[16] An economic input-output model developed by the Economic Modeling Specialist, Inc., EMSI was used to calculate the leveraged impact of state investment. Detailed results are contained in section 7 of this report. The total number of companies used for the impact analysis is 262, which is less than the 413 companies responding to the private sector survey. For the impact analysis companies and individuals that did not provide employment and revenue data were removed.

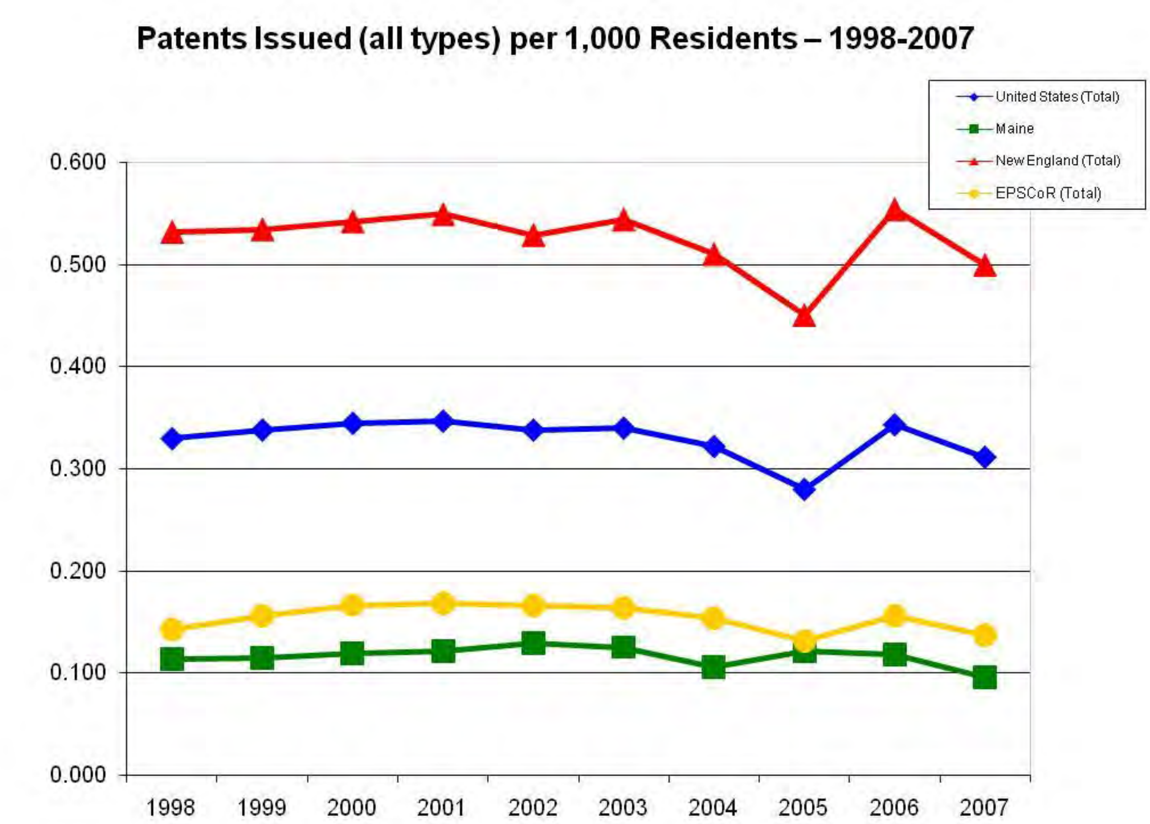
Figure 3.8.



Source: Gross state product is from Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997-2007; http://www.bea.gov/regional/gsp/; 1997-2007 is based on NAICS while 1980-1996 is based on SIC industry classification.

Patents are often used as one measure of knowledge creation. In 2007, 126 patents were issued to Maine individuals and organizations. The total number of patents has decreased from a year earlier (156 patents in 2006) and five earlier (168 patents in 2002). **Figure 3.9** shows that in the past 10 years in terms of patents expressed on a per 1,000 resident basis for Maine, the trend line for patents has been relatively flat from 1998 to 2003 followed by decreases in 2004 and 2007. On this indicator, Maine lags all the reference groups.

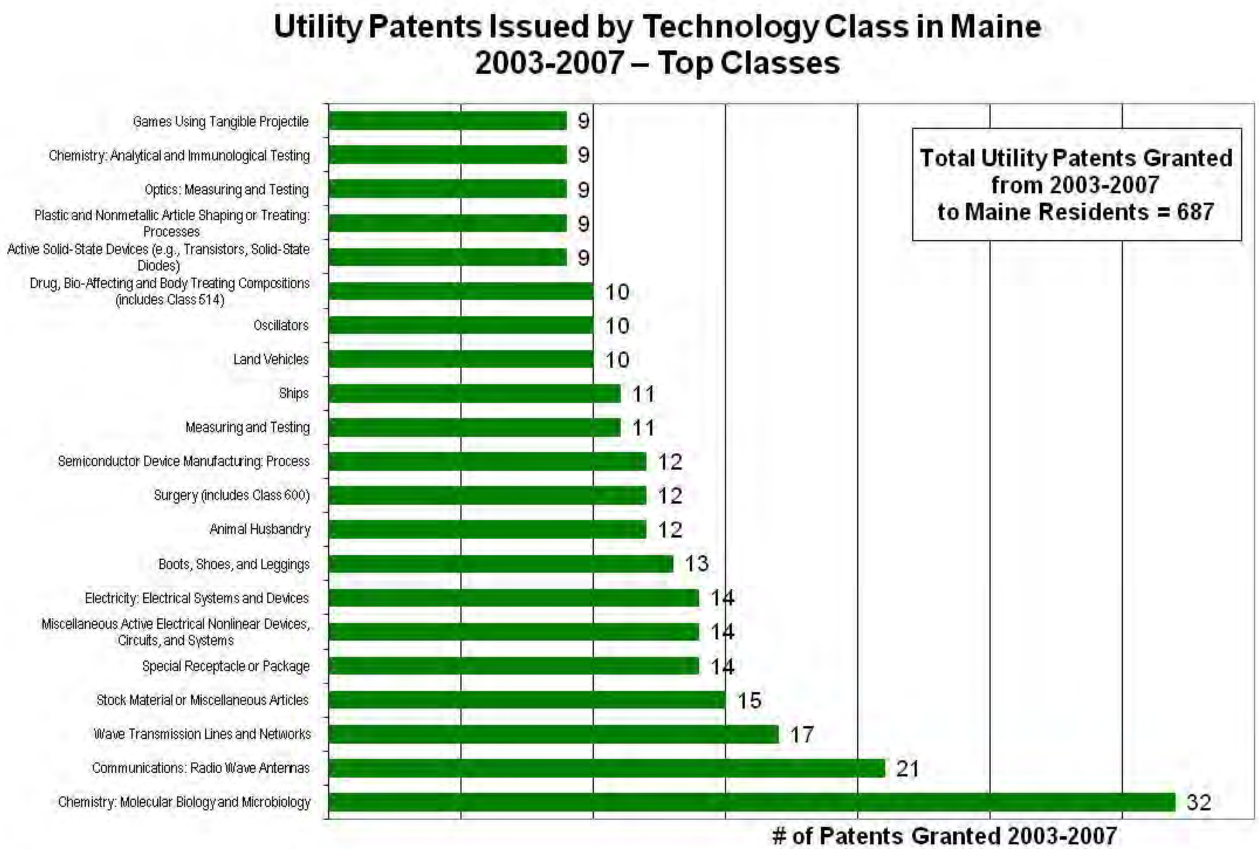
Figure 3.9.



Source: Patents – Total patents issued was from "Patent Counts by Country/State and Year, All Patents, All Types", January 1, 1977-December 31, 2007; by Calendar Year; US Patent and Trade Mark Office, December 2007; http://www.uspto.gov/

Our understanding of the growth of knowledge in Maine is enhanced by a review of the classes of patents issued in the state since 2003. As shown in **Figure 3.10**, most patents were issued in areas related to chemistry and micro/molecular biology, and then in communications, and electronics.

Figure 3.10.



Source: Utility patent data were from "Patenting by Geographic Region (State and Country), Breakout by Technology Class, 2003-2007 Utility Patent Grants by Calendar Year of Grant, U.S. Patent and Trademark Office; www.uspto.gov

3.2 Maine's University Research Capacity

Has Maine's investment in public and private university R&D led to increased research capacity; the development of an educated, technically skilled workforce; and increased commercialization of university technologies?

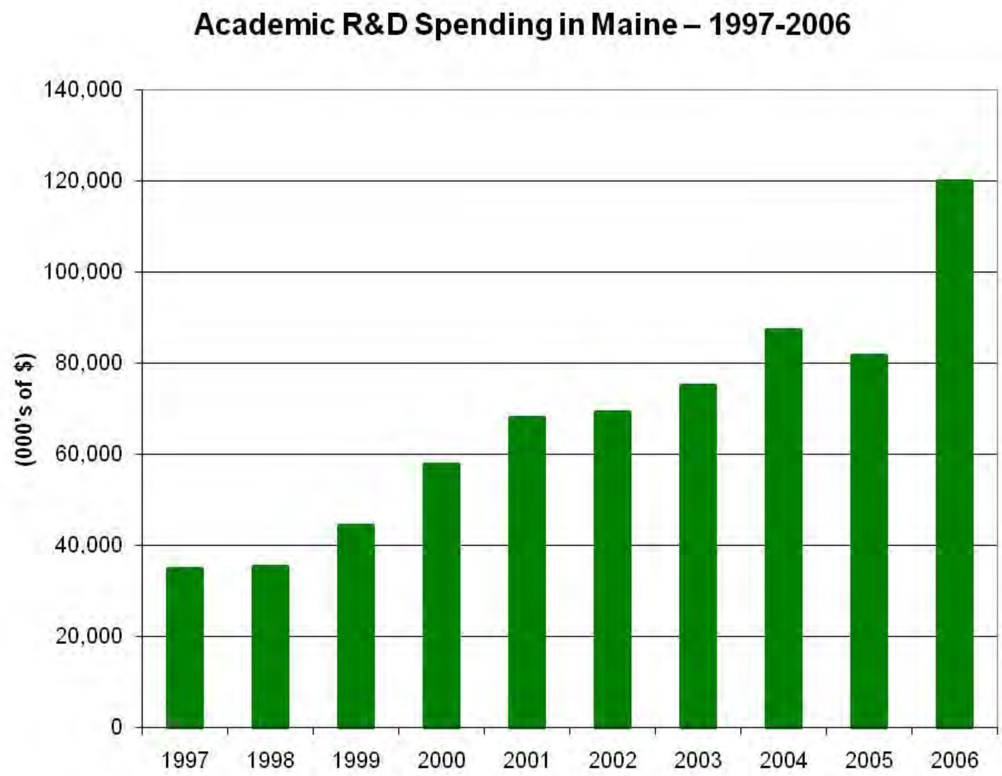
Bottom Line: Universities have increased their total R&D, while the number of science and engineering graduates has slightly declined over five years and commercialization of research remains lower than national averages.

Over the past five years, FY 2004-05 through FY 2008-09, Maine has allocated over $112 million or 64% of state R&D investments to universities. The universities funded by Maine R&D programs and included in the annual evaluation survey consist of the following institutions:

- Maine Maritime Academy
- University of Maine, Machias
- University of Maine, Orono
- University of New England
- University of Southern Maine

As indicated in **Figure 3.11** and based on R&D data reported to the National Science Foundation, the scope of Maine's academic R&D performance has jumped significantly, growing from approximately $70 million in 2002 to slightly more than $120 million in 2006-- an increase of 73%.

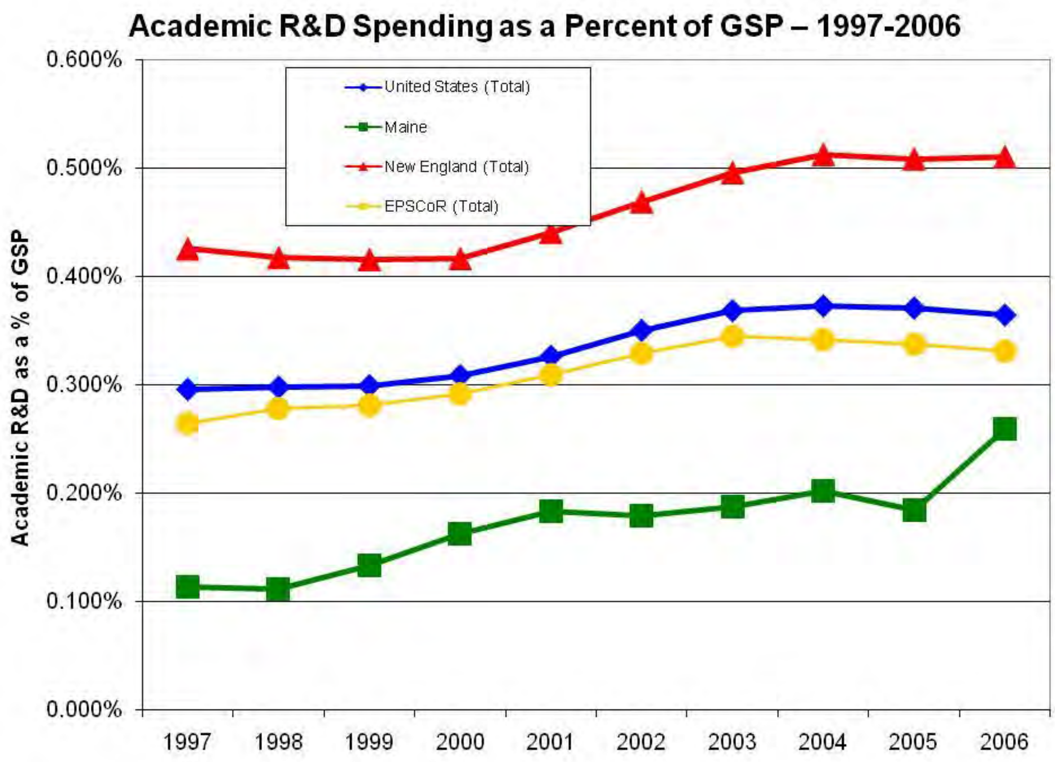
Figure 3.11.



Sources: University & College R&D Performed - National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2003 & 2004; Science and Engineering State Profiles: 2005-07 NSF 08-314 | August 2008 http://www.nsf.gov/statistics

When expressed as a percent of gross state product, Maine still lags the benchmark groups including the EPSCoR states. The state, however, is making ground on this indicator (see **Figure 3.12.).** In 2006, R&D performed at Maine academic institutions represented 0.26 percent of GSP compared to 0.36 percent in the U.S. as a whole, 0.51 percent among New England states, and 0.33 percent for all EPSCoR states combined. Between 2002 and 2006, academic R&D in Maine grew by 73 percent, far outpacing the growth experienced on average in the U.S and New England (31 percent), and the EPSCoR states (33 percent).

Figure 3.12.



Sources: University & College R&D Performed - National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2003 & 2004; Science and Engineering State Profiles: 2005-07 NSF 08-314 | August 2008 http://www.nsf.gov/statistics. Gross state product is from Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997-2007; http://www.bea.gov/regional/gsp/; 1997-2007 is based on NAICS while 1980-1996 is based on SIC industry classification.

The survey of university and nonprofit research institutions conducted for this annual evaluation also revealed considerable growth in academic R&D capacity in Maine in the past year. Based on the 2008 survey in 2008:

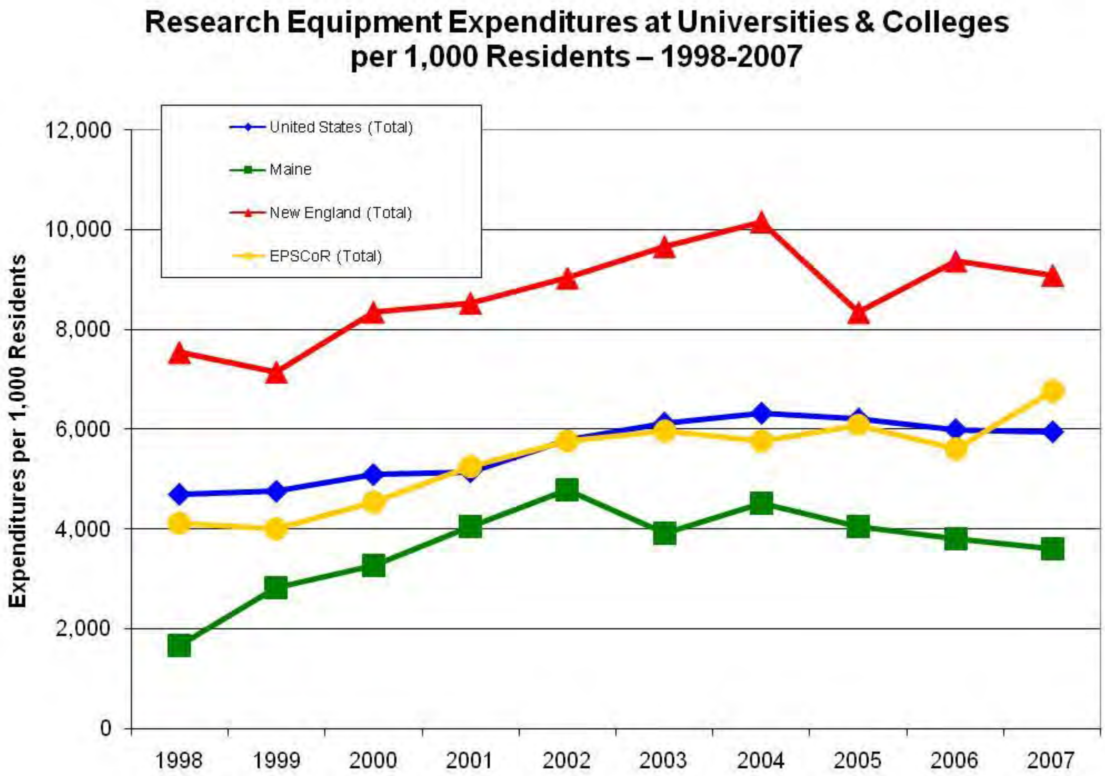
- Universities noted just under $139 million in R&D expenditures, up 208% from last year‘s $45 million R&D total.
  - The number of new federal grants and contracts received increased by 18%, while the dollar value of those awards increased by 32%.
  - Industry grants and contracts increased to 316 in 2008, which was 33% higher than the 2007 total of 237. This year‘s survey reported an industry contract

total of $4.83 million compared to $2.79 million last year, yet industry contracts actually decreased as percent of all academic R&D.

- The number of EPSCoR awards increased from four awards in last year's survey to nine awards this year.
- The number of federal research grants and contracts was up 18% over last year, and the dollar amount of $84,637,718 was an increase of over 30% over 2007 levels.
- In 2008, universities reported 20 disclosures, 25 patents applied for, and 6 patents awarded—an increase from the previous year. Licenses increased from four in 2007 to five in 2008, but license revenues decreased almost 75% from $500,027 in 2007 to $127,599 in 2008.
- In 2008, 750 science graduate students and 5,107 undergraduate students enrolled, compared to 735 graduate and 5,784 undergraduate students reported in the 2007 evaluation.
- In 2008, $2,591,089 in new major research equipment, compared to $2,404,052 in 2007
- Peer-reviewed publications were down for journal articles, book chapters and books compared to last year.

Building R&D capacity at universities requires investment in facilities and infrastructure. **Figure 3.13** tracks the research equipment expenditure at universities and colleges. From 1998 through 2002, Maine's investment in R&D equipment outpaced the United States and EPSCoR states. Yet over the past several years, Maine's research equipment investment has shown a steady decline since 2004 and continues to lag benchmark states. In 2007, Maine invested $3,600 per 1,000 residents in research equipment while the United States invested $5,950, per 1,000 residents. EPSCoR states invested $6,800 and New England invested $9,000 per 1,000 residents.

Figure 3.13.

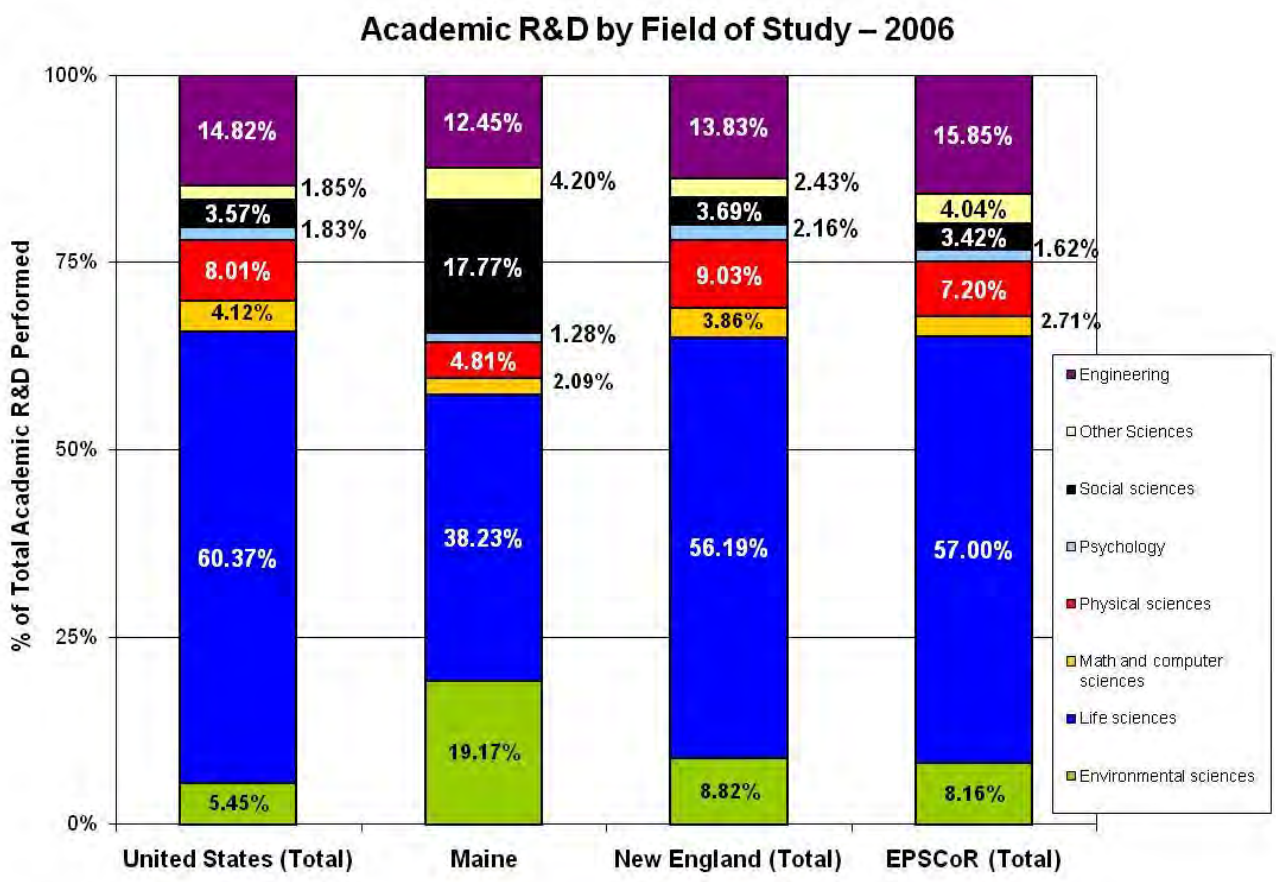


Source: Research Equipment Expenditures – National Science Foundation, WebCASPAR Database System from "Survey of Research and Development Expenditures at Universities and Colleges," http://webcaspar.nsf.gov.

A state's academic research tends to be clustered in specific fields, much like industry clusters that are unique to states and regions. Therefore, comparison of research fields with other states is less about performance and more about unique specialization that could be a precursor to new economic activity. **Figure 3.14** shows that Maine's academic research is much more concentrated in environmental sciences and social sciences than other comparable regions. Since Maine is actively pursuing industry growth in environmental and energy industries, connecting this research to commercial undertakings will be critical.

While life sciences remains the largest field of study, Maine's concentration of life sciences expertise falls below the United States or other EPSCoR states. Computer science and engineering research fields have smaller concentrations than other states, which does not correspond with the high concentration of Maine's technology industries in this field.

Figure 3.14.



Source: University & College R&D Performed – National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2006. http://www.nsf.gov/statistics

<u>Commercialization of research</u>: While overall R&D expenditures have increased at fairly rapid pace for universities, commercialization of research has been slower. In this year's survey to universities, 20 invention disclosures (up from 19 in 2007), six patents awarded (up from 3 in 2007), and two start-ups were recorded (up from 1 in 2007, however no jobs were reported for these two start-ups). The 2008 survey figures for these indicators tend to place Maine in the lower tier of university technology transfer performance.

Table 3.2 projects the levels of commercialization that might occur in Maine if universities were performing at the same level as the average for the 189 universities that report technology transfer activity to the Association of University Technology Managers (AUTM). The table takes AUTM averages and predicts performance based on two sets of data: the total reported to the National Science Foundation for all Maine universities and the R&D expenditures reported through the evaluation survey each year.

Data indicate that the universities underperform for both sets of predicted results, suggesting that while overall R&D is increasing, the commercialization of research has not kept pace with this level of growth. AUTM and other national research has demonstrated that the level of technology transfer outcomes (e.g., patents, licenses, and revenues) is directly correlated with a systematic focus on technology transfer and the amount of budget allocated to staff and patent expenses.[17]

Table 3.2. Predicted and Actual Technology Transfer Metrics for Maine Universities

	Average U.S. for universities, hospitals, and nonprofit inst.	Predicted for all Maine universities based on NSF data reported for public & private universities	Actual for universities (survey totals)	Predictions based on the total R&D reported in evaluation survey to universities & nonprofits	Actual for both universities and nonprofits
Invention disclosures	**$2.4m in R&D expenditure per disclosure**	**50 disclosures**	**20**	**97 disclosures**	**42**
Patents filed	**$2.85m in R&D expenditure per filed patent**	**42 patents**	**25**	**81 patents**	**46**
Licenses	**$9.13m in R&D expenditure per license**	**13 licenses based on survey reporting**	**5**	**25.6 licenses**	**19**
Start-ups	**$85m in R&D expenditure per start-up**	**1.5 start-ups per year**	**n/a**	**2.8 start-up**	

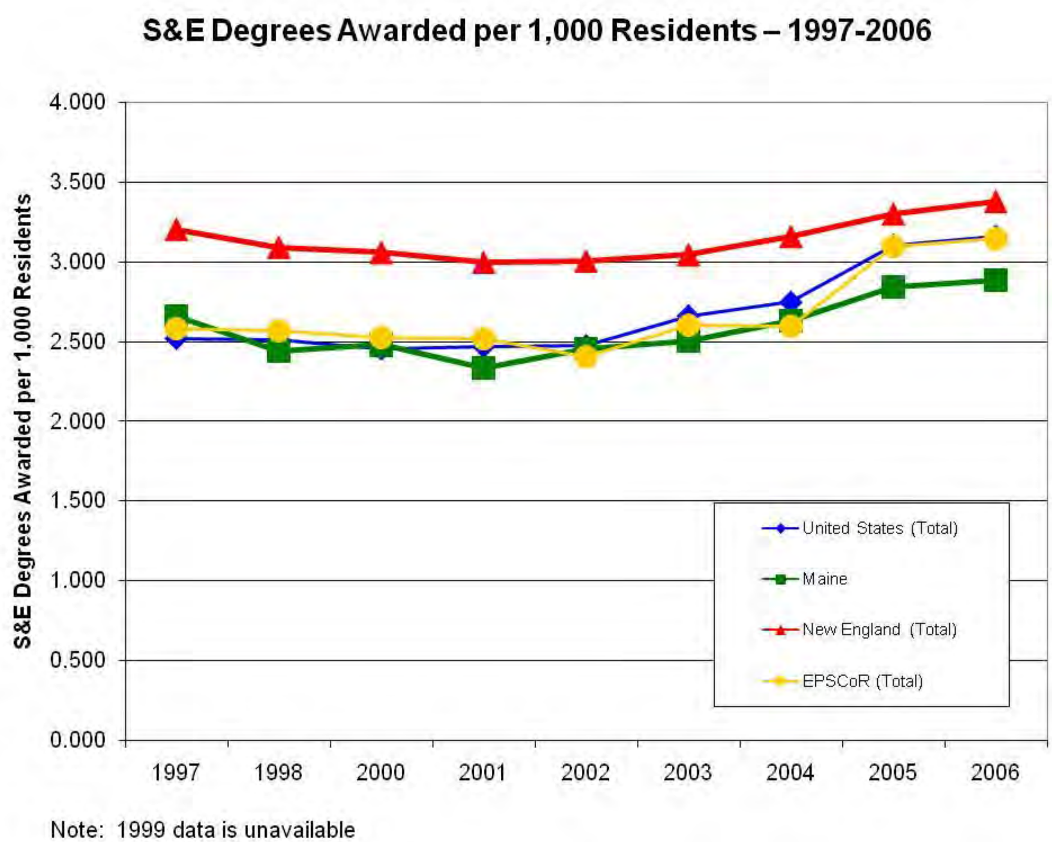
Source: AUTM 2006 survey data was used to calculate U.S. averages for university, hospital, and nonprofit institutions. Predictions for Maine were calculated using AUTM averages and reported R&D expenditures in the current survey of nonprofits ($234 m) and the total reported to NSF ($120 m). Actual for Maine was determined by the same survey results. While universities reported 2 start-up companies, there were no jobs associated with those companies and therefore, were not included in the above table.

<u>Maine‘s science and engineering workforce</u>: Universities contribute to the skills and education of the workforce in many ways. One contribution is the preparation of students to enter science and engineering fields that drive the innovation of most industries. In 2006, Maine awarded 3,791 degrees in science and engineering fields, with master‘s

[17] Siegel, D., D. Waldman, and A. Link.2003. ―Assessing the impact of organization practices on the relative productivity of university technology transfer offices: An exploratory study." *Research Policy* 32: 27-43.

degree or doctorate representing 15.6% of those degrees. When the number of degrees per 1,000 residents is compared to EPSCoR and the United States, Maine is below U.S. and EPSCoR averages (**Figure 3.15).**

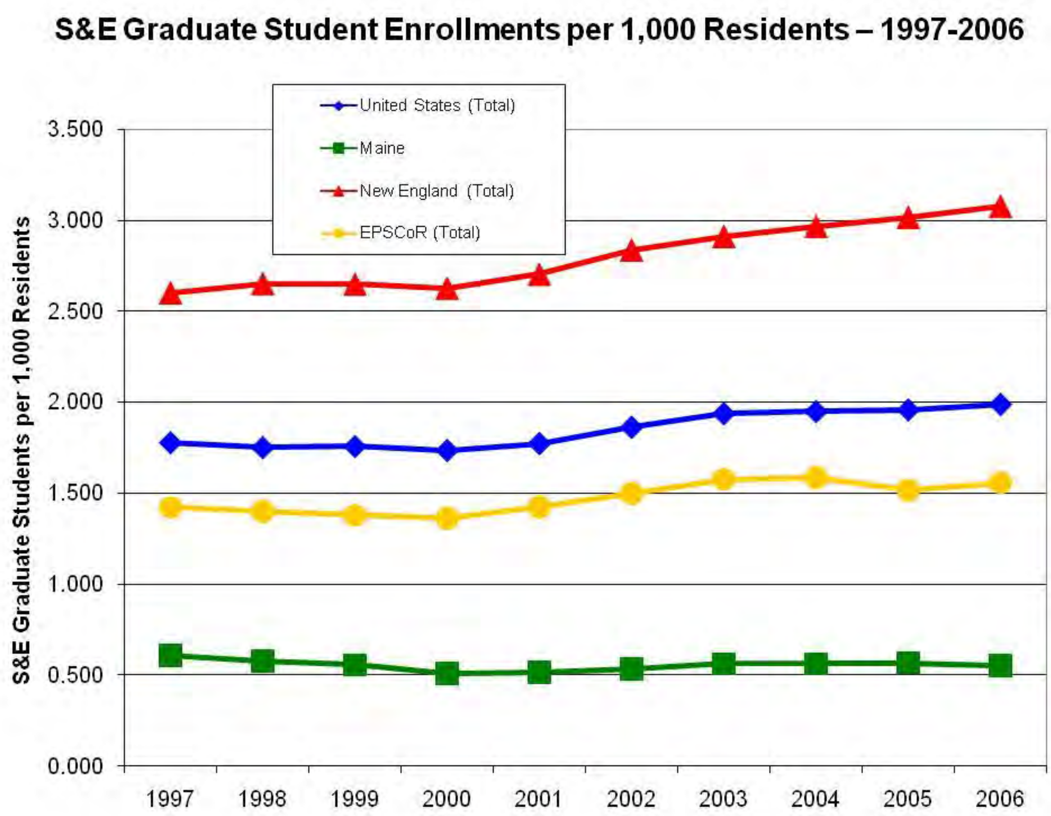
Figure 3.15.



Source: S&E Degrees Awarded – Extracted from NSF WebCASPAR Database System, http://webcaspar.nsf.gov, based on the Higher Education General Information Survey and Integrated Post-Secondary Education Data System, National Center for Education Statistics, U.S. Department of Education, www.nces.ed.gov. (Data for 1999 was unavailable.)

While Maine's performance in terms of overall science and engineering degrees awarded almost keeps pace with other states, graduate-level study is much less competitive. As shown in **Figure 3.16**, the number of students enrolled in graduate-level science and engineering fields expressed per 1,000 residents has remained flat over recent years and at levels two to three times lower than EPSCoR or U.S. averages.

Figure 3.16.

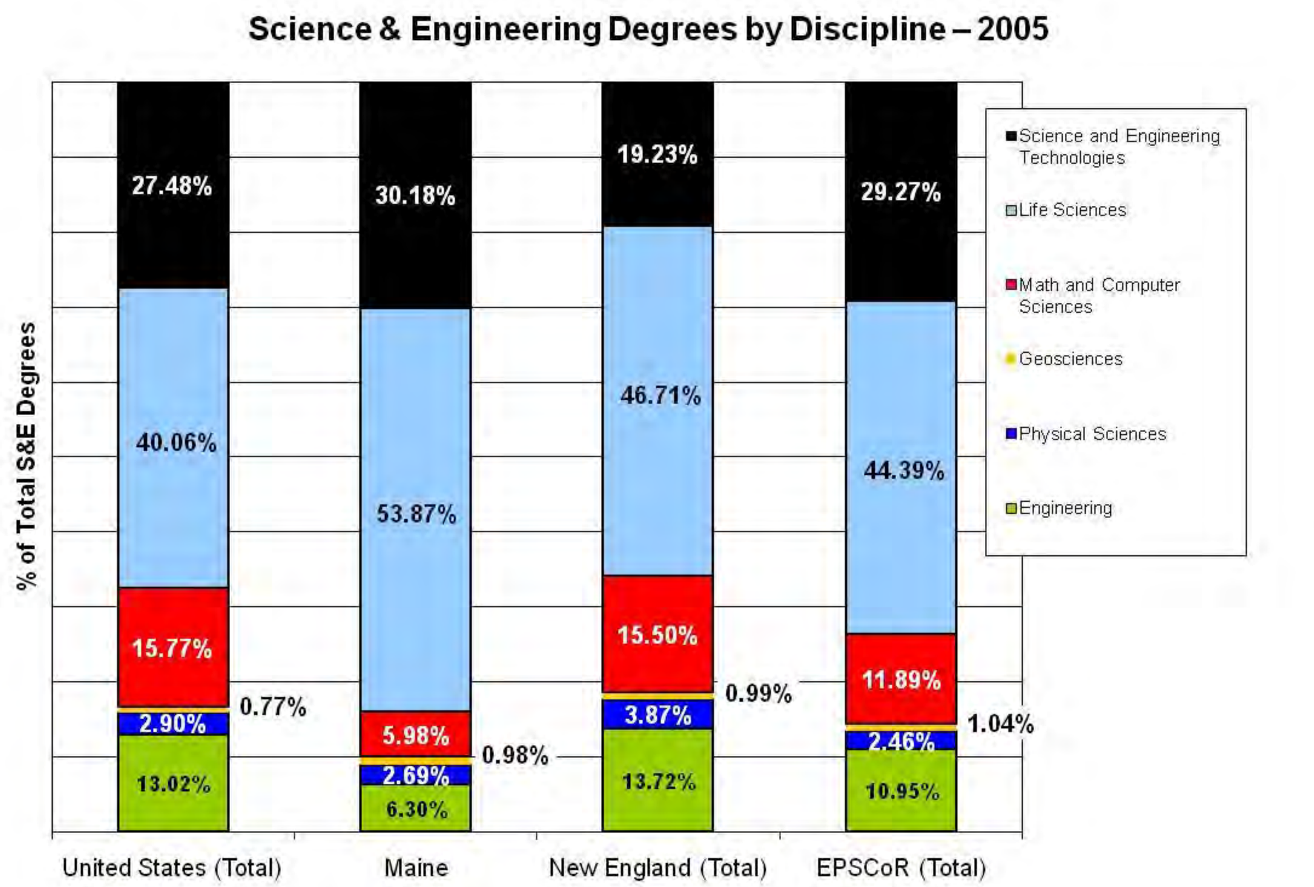


Source: S&E Graduate Students – NSF WebCASPAR Database System based on "Survey of Graduate Students and Postdoctorates in Science and Engineering," National Science Foundation and National Institutes of Health. http://webcaspar.nsf.gov

Based on the 2006 data reported to NSF, Maine's colleges and universities had 728 graduate enrollments in S&E programs. More recent data from the institution survey conducted for this evaluation suggests an increasing trend with 735 enrollments in 2007 and 750 in 2008.

Preparation for Maine's workforce can be enhanced when science and engineering degrees are consistent with the types of industries employing these graduates. **Figure 3.17** indicates that Maine is producing a large number of life sciences graduates, but a small number of engineers, mathematicians, and computer scientists. This may be problematic given the concentration of engineering and information technology firms in the state.

Figure 3.17.



Source: S&E Degrees Awarded – Extracted from NSF WebCASPAR Database System, http://webcaspar.nsf.gov, based on the Higher Education General Information Survey and Integrated Post-Secondary Education Data System, National Center for Education Statistics, U.S. Department of Education, www.nces.ed.gov. (Data for 1999 was unavailable.)

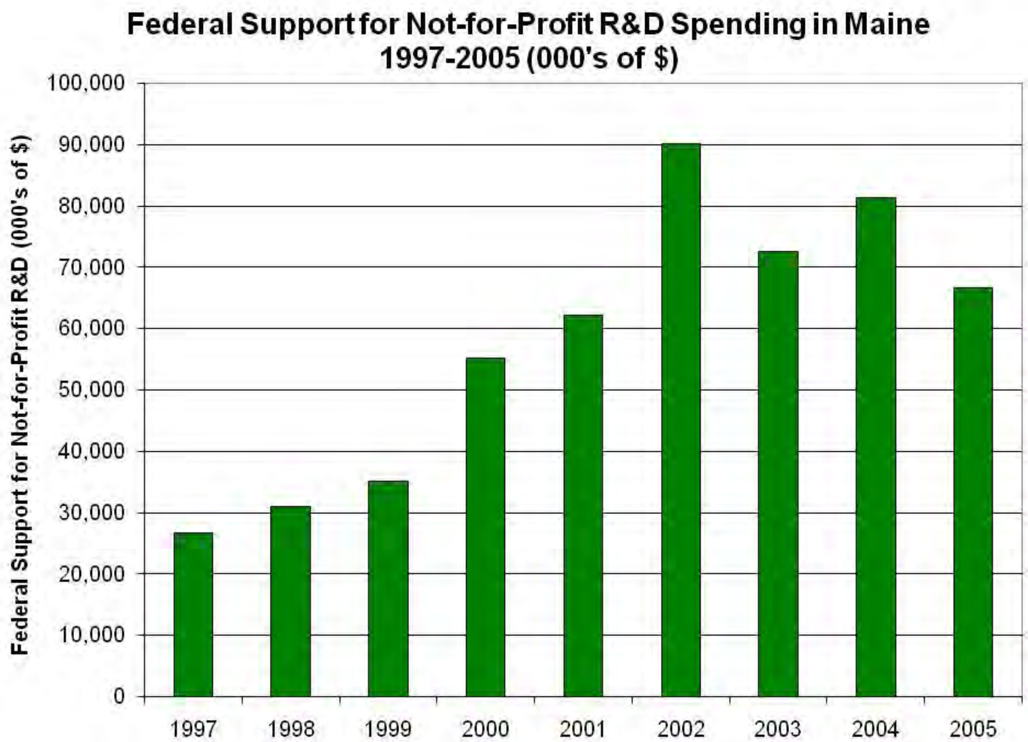
3.3 Maine's Nonprofit Research Institutions

Are Maine's investments in nonprofit research institutions broadening their impact on Maine's economy?

Bottom Line: The scale of research at nonprofit institutions remains above US averages, yet much research is not being commercialized or connected to Maine's industries in a way that maximizes economic value to the state.

In terms of absolute dollars reported by NSF, as indicted in **Figure 3.18,** federal funding for not-for-profit R&D performance in Maine increased from $23 million in 1995 to more than $81 million in 2004, but decreased to a little less than $67 million in 2005, a decrease of 18.1 percent from 2004[18].

Figure 3.18.



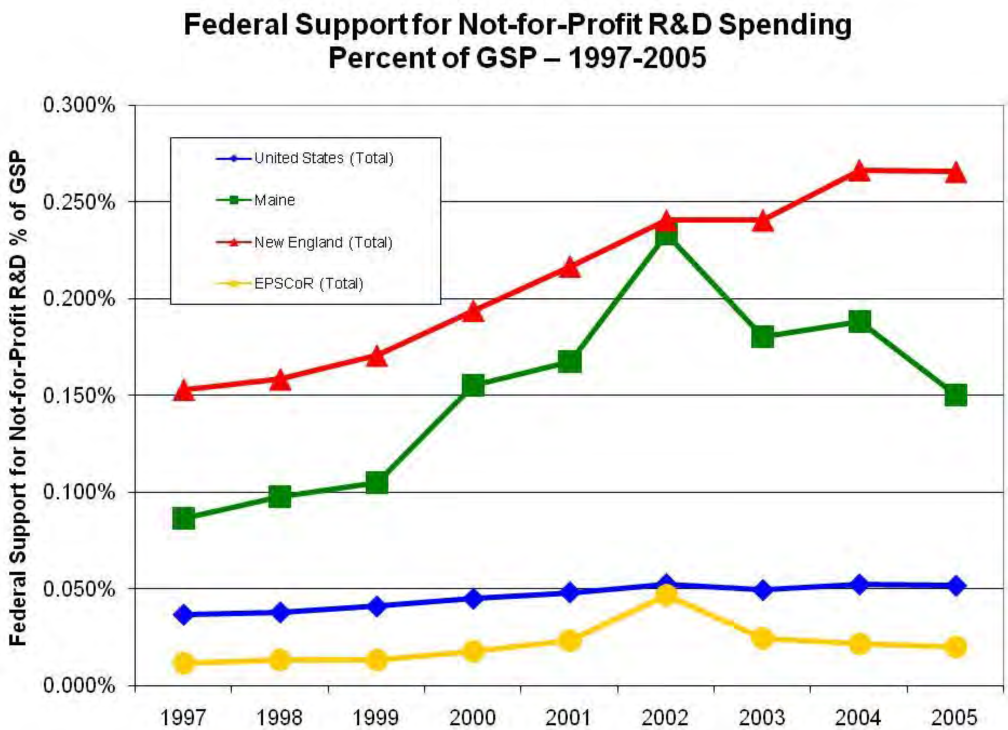
Source: Not for Profit R&D Performed - 1987-2001 from National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 Data Update, derived from Survey of R&D Funding and Performance by Nonprofit Organizations; 2002 & 2003 from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, and 2005; http://www.nsf.gov/statistics

Based on R&D spending as a percent of gross state product, as indicated in **Figure 3.19**, Maine continues to be a national leader in R&D performed by not-for-profit research laboratories, however the trend indicates the state‘s competitive advantage is declining. From 1995 to 2002, R&D performed at Maine‘s not-for-profit research labs from federal sources of funding grew dramatically, from 0.084 percent in 1995 reaching 0.234 percent of GSP in 2002. In 2003 Maine_s level dropped to 0.181 percent and increased slightly to 0.188 percent in 2004 but then dropped to 0.150 for 2005. Even with this decrease,

[18] NSF only reports expenditures related to federal funding for nonprofit research institutions and therefore this data understates the total R&D expenditures at Maine‘s nonprofit research institutions.

Maine remained significantly above the level of the nation as a whole at 0.052 percent and the EPSCoR states combined at 0.020 percent of GSP.

Figure 3.19.



Sources: Not for Profit R&D Performed - 1987-2001 from National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 Data Update, derived from Survey of R&D Funding and Performance by Nonprofit Organizations; 2002 & 2003 from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, and 2005; http://www.nsf.gov/statistics

Gross State Product - Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997-2007; http://www.bea.gov/regional/gsp/; 1997-2007 is based on NAICS while 1980-1996 is based on SIC industry classification

In the past five years, FY 2004-05 through 2008-09, Maine has invested nearly $33 million in its nonprofit research institutions, representing about 19% of all state R&D investment during that period. The following institutions received funds from various state-supported programs and were included in the survey to nonprofit institutions:

- Bigelow Laboratory
- Downeast Institute for Applied Marine Research
- Foundation for Blood Research
- Gulf of Maine Research Institute

- Jackson Laboratory
- Maine Institute for Human Genetics and Health
- Maine Medical Center Research Institute
- Mount Desert Island Biological Laboratories
- Wells National Estuarine Research Reserve

Maine's investment in this sector continues to benefit the institutions involved, but has not made the hoped-for broader impacts on Maine's technology industry. Inputs into nonprofit research (dollars and equipment) continue to increase, while the economic development related outcomes (industry contracts, intellectual property, spin-off companies) have been much slower to develop.

In 2008, Maine's nonprofit research institutions reported the following R&D expenditures and outcomes[19]:

- $96 million in R&D expenditures, up slightly from $93 million in the previous year
- $199 million in new research equipment investments, an increase of $7 million from the previous year
- 345 new extramural proposals submitted for a total of $184 million, down from 352 proposals and $260 million in the dollar value compared to the previous year.
- 299 full-time equivalent research jobs, representing a 9% decrease from 2007 level of 330 jobs
- The 508 scientific and peer-reviewed journal articles, books, and book chapters, representing a 4% decrease from 2007
- 113 new federal grants and contracts received for a total of $67 million, representing an increase over 2007 of 18% in the number of awards and a decrease of 24% in the dollars awarded
- 20 industry contracts valued at $590 thousand, down from the 2007 level of 33 contracts valued at $2.6 million
- Mixed performance in the development of intellectual property: 22 disclosures (30 in 2007); 21 patents applications, (11 in 2007), and no patents granted, (2 in 2007)
- 14 licenses granted in 2008 (13 in 2007) with no licenses were granted to Maine companies
- $896,000 in licensing revenue, up from the 2007 level of $485,0000

[19] The institution survey findings are included in **Attachment B**.

- No new spin-off companies or jobs

Our concern with this sector remains its limited impact on Maine's economy beyond the direct jobs and research it provides. Since this sector has minimal interactions with the private, research-intensive companies in the state as evidenced by spin-offs, industry contracts, and licenses, the opportunity for economic impact is diminished.

3.4 Maine's Research-intensive Companies

Is Maine fostering the growth of research-intensive companies, increasing private sector R&D activity, and building a technology-based entrepreneurial community?

Bottom Line: Maine's overall private sector R&D remains low; however companies receiving state investment in R&D are showing positive results.

In the past five years, FY 2004-05 through FY 2008-09 Maine's investment in private sector programs has been approximately $30 million or nearly 17% of state funding. The majority of funds have been allocated to three programs:

- Maine Technology Institute (MTI)
- Maine Biomedical Research Fund
- Maine Patent Program

In addition, previous state appropriations continue to help private sector companies through:

- Advanced Technology Development Centers (ATDC)
- Finance Authority of Maine (FAME)
- Maine Aquaculture Innovation Center (MAIC)
- Maine Space Grant Consortium (MSGC)
- Small Enterprise Growth Fund (SEGF).

The private sector survey data reveal that Maine continues to support the growth of research-intensive companies through these programs. 855 companies have received assistance from one of these entities in the last five years, and 22% have worked with more than one of these stakeholders. Forty-eight percent of the companies responded to the annual survey.[20]

As in previous years, the respondent companies are primarily new and quite small (81% have 10 or fewer employees), with 26% started since 2005 and over 60% since 2000.

[20] The company survey findings are included in **Attachment A**.

They are close to evenly distributed by sector, ranging from 3.5% classified as other to 19.9% precision manufacturing. The companies are located in all counties in Maine, with the predominant number in southern Maine (38.0%). Most of the companies who responded (71.7%) have annual revenues of less than $500,000.

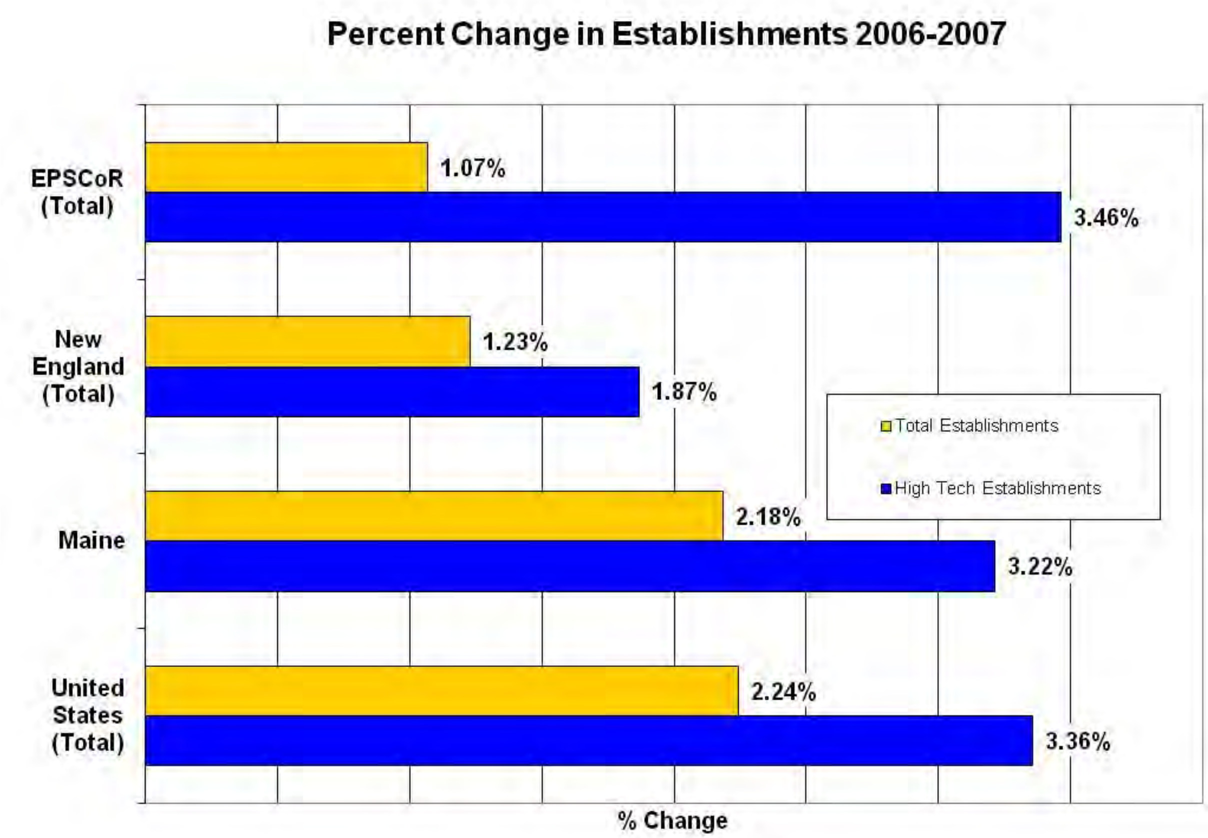
Companies participating in state R&D programs create new wealth for Maine. Approximately 42% of the companies reported having at least 50% of their sales occurring outside the state of Maine.

Entrepreneurial Environment: State investments in R&D and innovation are intended, among other things, to spur the formation or growth of new companies. In the survey results of private sector firms receiving awards from state R&D programs, 26% had been established from 2005–2008 and 35% from 2000–2004.

In previous years in which this evaluation was conducted, Maine has performed well in terms of establishments of high tech businesses. As shown in **Figure 3.20,** based on the latest data available (2006-2007), Maine (3.22% growth) has lagged the EPSCoR states (3.46) and the U.S.(3.36) but outpaced New England(1.87) in terms of growth in the number of high technology business establishments[21].

[21] Definition of High Technology is from the U.S. Department of Commerce, based on 39 NAICS codes corresponding to high-technology industries. The industries are listed in Attachment E to this report

Figure 3.20.

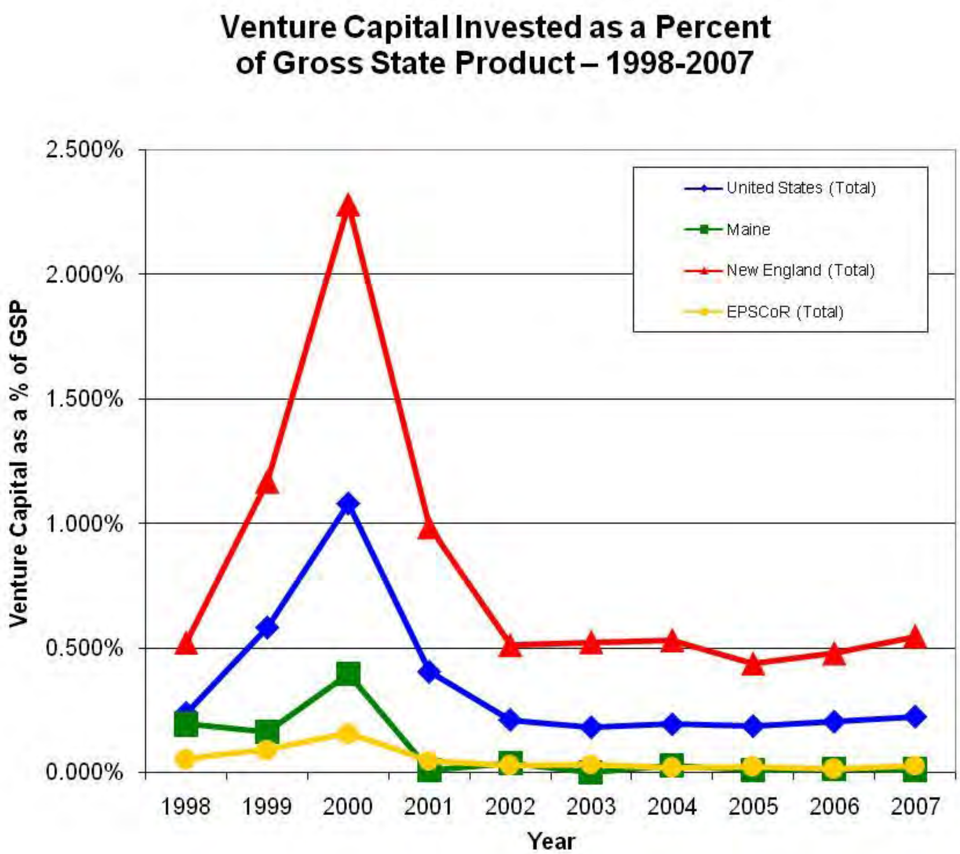


Sources: High Technology Establishments - based on special data tabulations from the County Business Patterns, U.S. Census Bureau, U.S Department of Commerce, provided by the Center for Business and Economic Research, University of Southern Maine; Total Establishments - based on special data tabulations from the County Business Patterns, U.S. Census Bureau, U.S Department of Commerce, provided by the Center for Business and Economic Research, University of Southern Maine

Another measure of the viability of the research-intensive sector in Maine is the ability of the companies to attract new capital, either debt or equity. From 2006 to 2007, the number of venture capital deals increased from four to eight in Maine; however the total investment dropped from $7.6 million in 2006 to $6.6 million in 2007.

Figure 3.21 indicates the level of venture capital investment (as a percent of gross state product) in Maine companies as reported to the MoneyTree Venture Capital Survey. The performance of venture financing by states like Maine, tend to be a fraction of the U.S. average since the national average is skewed by a small fraction of states receiving the vast majority of venture funding. On this indicator, Maine and the EPSCoR states lagged that of the U.S, and New England. In 2007, eight deals occurred within the industry classes of biotechnology, computers & peripherals, consumer products & services, financial services, industrial/energy, medical devices & equipment and telecommunications.

Figure 3.21



Source: Venture capital investments data are from MoneyTree Venture Capital Profiles by State; based on PricewaterhouseCooper/Venture Economics/National Venture Capital Association Surveys; http://www.venturexpert.com/VxComponent/static/stats/2008q3/0MAINMENU.html; Data Current as of September 2008. Venture Capital Invested in Maine by Industry Sector is from http://www.pwcmoneytree.com/. Gross state product is from Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997-2007; http://www.bea.gov/regional/gsp/; 1997-2007 is based on NAICS while 1980-1996 is based on SIC industry classification.

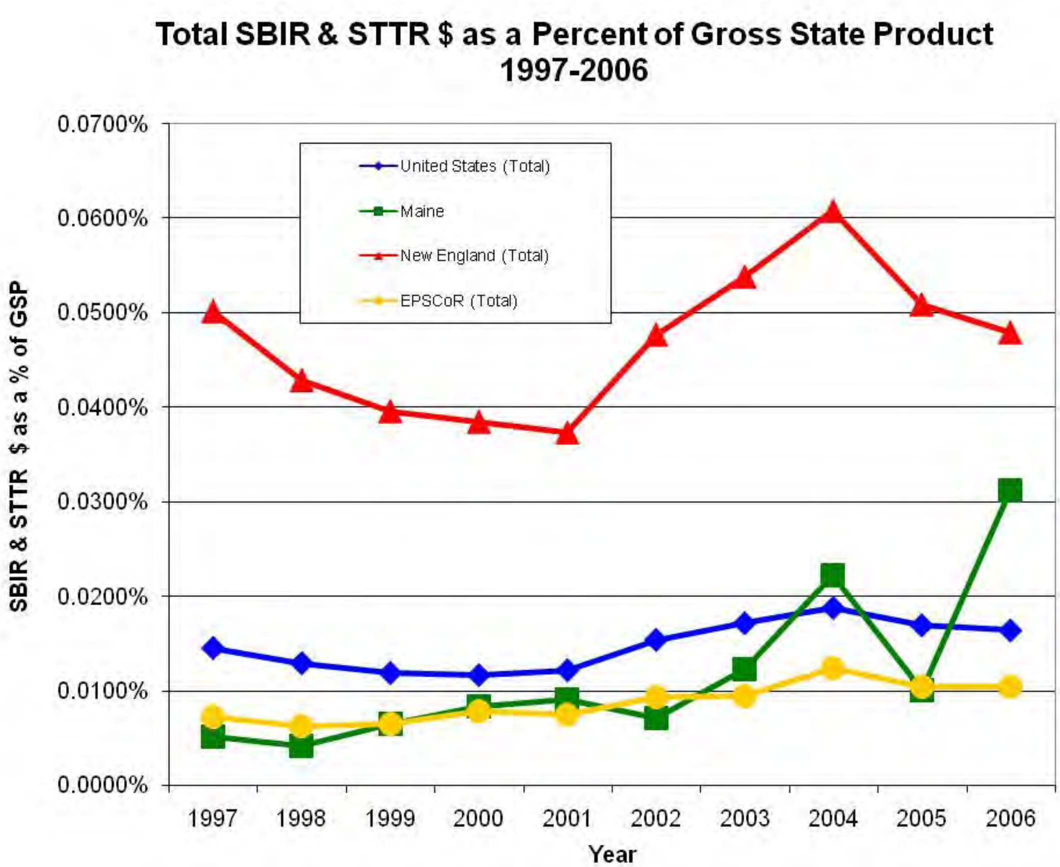
The companies participating in Maine R&D programs have also seen a drop in equity investments. The 32 participating companies indicated that they received angel and venture funding reported that they attracted just under $32 million of new equity in 2008 compared to $41 million in 2007. Worth noting however is that while a small percent of all companies receive equity funding (nationally, the average is less than 2–3%), approximately 7.7% of Maine survey respondents received equity funding from angel, venture, or state seed funds.

In terms of debt financing, 14.5% of the Maine survey respondents accessed new debt financing in 2007 compared to 16.8% in 2007. However, the amount of funds obtained by the surveyed Maine companies grew from $26 million in 2007 to $78 million in 2008

The federal government provides grants to small businesses performing R&D through its Small Business Innovation Research (SBIR) program. In 2002, Maine received just $2,658,734 in SBIR awards, and in 2006 (the last year reported), that number jumped more than 416% to $13,719,740. This funding went to 22 different Maine companies to commercialize research.

Figure 3.22 shows that Maine's share of SBIR/STTR funds as a percent of gross state product has increased since the MTI programs began in 1998 and grew past the U.S. average in 2004 and again in 2006.

Figure 3.22.



Source: U.S. Small Business Administration, http://www.sba.gov/aboutsba/sbaprograms/sbir/index.html

The survey respondents spent $46 million in R&D in 2008, which was more than five times the amount of state R&D assistance provided to these companies.

The firms that responded to the survey are producing and protecting their IP. Fifty-three percent indicate that they intend to use some form of intellectual property protection (Patents, Trade Secrets, Licensing, Copyrights, Trademarks, or other). Thirty-one percent of the respondents report that they plan to file or have filed patent protection for the innovations developed through state funding. Fifty-seven companies reported that they were granted a total of 101 U.S. patents in 2008. Another 36 foreign patents were granted to the respondent companies this year. Thirty-seven of the companies surveyed had registered for trademark protection in 2008; 11 have registered copyrights. Seventy-two of the responding companies reported that they have licensed or intend to license their IP.

Table 3.3 highlights U.S. and foreign patents reported by Maine's targeted industry sectors. Biotechnology has the most with 43, followed by marine and aquaculture with 38.

Table 3.3. Patent Data by Industry Sector, 2008 Private Sector Survey

Patents Granted by Industry Sector - from Private Sector Survey

Industry Sector	# of Companies in Survey	U.S. Patents Granted	Foreign Patents Granted	Total Patents Granted
Advanced Materials & Composites	43	8	0	8
Advanced Tech for Forestry & Agri.	42	5	1	6
Biotechnology	39	30	13	43
Environmental Technology	41	9	8	17
Information Technology	66	17	8	25
Marine Technology & Aquaculture	41	26	12	38
Precision Manufacturing	79	13	2	15

Source: 2008 Private Sector Survey conducted by authors for this evaluation
Note: totals may add up to more than the actual total because some companies were coded in more than one sector. Sector codes form some companies were unknown

Importance and Satisfaction with State Programs:

Companies responding to the private sector survey were asked to rate the importance of the assistance they received from the state as well as their overall satisfaction with that assistance. As indicated in **Table 3.4**, on a scale of 1-5 with 5 being critically important, the mean score for importance of assistance received was 3.8, close to very important. Additionally, 42.0% of respondents indicated that the support they received was either very important or critically important.

Table 3.4

Importance of State Assistance to Companies in Private Survey

	All Respondents 2008 - 2009	
How Important?	**# of Companies**	**Percent**
Critically important (5)	95	25.9%
Very important (4)	59	16.1%
Frequently important (3)	18	4.9%
Occasionally important (2)	35	9.5%
Not important (1)	17	4.6%
n/a *	143	39.0%
Total	367	100.0%

Source: 2008 Private Sector Survey conducted by authors for this evaluation

As indicated in **Table 3.5** the mean score for satisfaction with assistance received was 4.3, above Satisfied. Additionally 49.7% of respondents indicated that they were either satisfied or very satisfied.

Table 3.5

Satisfaction with State Assistance by Companies in Private Survey

	All Respondents 2008 - 2009	
How Satisfied?	**# of Companies**	**Percent**
Very Satisfied (5)	113	30.7%
Satisfied (4)	70	19.0%
Somewhat satisfied (3)	20	5.4%
Unsatisfied (2)	7	1.9%
Very unsatisfied (1)	5	1.4%
n/a *	153	41.6%
Total	368	100.0%

Source: 2008 Private Sector Survey conducted by authors for this evaluation

3.5 Competitiveness of Maine's Strategic Technology Industries

To what extent are these investments increasing the competitiveness of Maine in its key strategic technology and industry areas?

Bottom Line: While overall R&D capacity has grown in the state, there is limited evidence that shows here a systematic link between academic, nonprofit and industry investments. The benefits of increased R&D spending are not yet generating large-scale economic benefits for the wider economy.

<u>Growth of Technology Industries</u>: The number of jobs, new businesses, and wealth creation due to state-funded R&D programs has been consistently growing. There were 855 companies that have received assistance from one of these programs in the last five years, and 22% have worked with more than one of these stakeholders. Of the 413 companies that responded to the evaluation survey, the growth picture is mixed and includes the following highlights:

- The job growth rate for those companies decreased by 3.3% reflecting the national trend in job loss. The respondents reported a total of 9,271 employees in the survey year, which was down 317 employees by these same companies from the previous year level of 9,588
- Total wages and salaries paid was $389,950,070. Wages for these companies averaged $42,061 annually approximately 24% higher than the average state wage of $33,962.[22]
- Compared to the previous year, firms reported a 36.7% growth in overall revenues and a 41.4% growth in revenue per employee. Over 95% of revenues came from sales of products or services compared to grants or contracts, indicating the commercial value and potential for these companies.

In terms of strategic industry clusters, we provide a snapshot of their relative strengths based on the respondents to the annual survey. As shown in **Table 3.6** environmental technology, marine technology, information technology experienced increases while all others experienced declines in employment from 2007-208.

Table 3.6

Employment by Industry Sector - from Private Sector Survey

Industry Sector	# of Companies in Survey	2007 Employment	2008 Employment	Employ Chg #	Employ Chg %
Advanced Materials & Composites	43	1,585	1,545	-40	-2.5%
Advanced Tech for Forestry & Agri.	42	1,913	1,779	-134	-7.0%
Biotechnology	39	548	519	-29	-5.3%
Environmental Technology	41	642	705	63	9.8%
Information Technology	66	300	328	28	9.3%
Marine Technology & Aquaculture	41	161	174	13	8.1%
Precision Manufacturing	79	382	363	-19	-5.0%

Source: 2008 Private Sector Survey conducted by authors for this evaluation
Note: totals may add up to more than the actual total because some companies were coded in more than one sector. Sector codes form some companies were unknown

As shown in **Table 3.7** all sectors experienced increased revenues from 2007-09 except for advanced technologies for forestry and agriculture and precision manufacturing.

[22] 2007 state wage of $33,962 reported by the Bureau of Labor Statistics, Quarterly Census of Employment and Wages

Table 3.7

Revenue by Industry Sector - from Private Sector Survey

Industry Sector	# of Companies in Survey	2007 Revenue	2008 Revenue	Revenue Chg #	Revenue Chg %
Advanced Materials & Composites	43	322,358,632	343,110,738	20,752,106	6.4%
Advanced Tech for Forestry & Agri.	42	575,349,969	535,951 070	-39,398,899	-6.8%
Biotechnology	39	85,028,743	107,476,815	22,448,073	26.4%
Environmental Technology	41	80,583,221	98,802 088	18,218,867	22.6%
Information Technology	66	19,926,321	26,115,174	6,188,853	31.1%
Marine Technology & Aquaculture	41	17,766,109	18,852,435	1,086,325	6.1%
Precision Manufacturing	79	79,703,239	78,933,671	-769,569	-1.0%

Source: 2008 Private Sector Survey conducted by authors for this evaluation
Note: totals may add up to more than the actual total because some companies were coded in more than one sector. Sector codes form some companies were unknown

Connections between Industry and University/Nonprofit Research: While industry R&D is up significantly, the interface between industry and university/nonprofit research continues to show a relative mismatch. Compared to other EPSCoR states, Maine‘s university research is heavily concentrated in environmental services and social sciences, 19% and 17.7% respectively, compared to 8% and 3.4% for other EPSCoR states. While Maine has a growing environmental sciences industry, it still composes a very small percent of the state‘s employment. On the other hand, employment in engineering-based industries (composite materials, paper and wood products, information technology, electronics, and precision manufacturing) represent more than eight times the size of the environmental industry yet account for less than 15% of all university research. This mix of research, combined with declining industry contracts at universities, indicates a real opportunity for improvement.

4. Case Study: Technology Transfer Capacity and Start-up Activity

4.1. Introduction

The case study this year focused on two areas important to the innovation cycle: technology transfer capacity and new venture formation, specifically from Maine universities and nonprofit laboratories. Questions we sought to answer included:

> *Is the capacity in place to support the innovation/commercialization activity demonstrated or expected in the State of Maine? If not, what is needed?*
>
> *In the last 10 years, how many new ventures were created from Maine institutions? What were the triggers that led to venture formation? What enabled the ventures to form and grow?*

Nearly 40 individuals from 19 different organizations (start-up companies, universities, nonprofits, and state organizations) were interviewed via in-person and phone interviews. Key findings and suggested policy and programmatic changes are found below.

RTI interviewed the following organizations:

AIKO Biotech

Bar Harbor Biotech (BHB)

Bigelow Laboratory for Marine Science

Foundation for Blood Research (FBR)

Gulf of Maine Research Institute (GMRI)

Intelligent Spatial Technologies

Jackson Labs (JAX)

Mount Desert Island Biological Labs (MDIBL)

Maine Marine Manufacturing

Maine Medical Center Research Institute (MMCRI)

Maine Patent Program (MPP)

Mainely Sensors

Maine Technology Institute

Orono Spectral Solutions

University of Maine, Orono (UME)

University of New England–Portland (UNE)

University of Southern Maine (USM)

USM Center for Law and Innovation

Zeomatrix4.2. Technology Transfer Capacity

4.2. Technology Transfer Findings

In this study we define technology transfer capacity as the necessary elements to stimulate and efficiently move new innovations from discovery in the lab to a successful license and/or new venture. Those key elements include 1) clear policies related to intellectual property and the disclosure and licensing of new innovation; 2) well-defined processes for identifying and managing invention disclosures and related intellectual property; 3) resources (human and financial) to lead and manage these processes; 4) support from top administration; and 5) an educated staff who understand the process and know their role.

4.2.1 Technology Transfer Observations

Based on the interviews conducted for this case study, and review of various policies and procedures, RTI notes the following observations:

Observation 1: The technology transfer capacity at Maine institutions varies greatly by institution. A few institutions have made great progress and have sufficient capacity for technology transfer. The rest either lack capacity or have significantly constrained capacity.

Establishing technology transfer capacity is an evolutionary process that begins with growing a research base of activity and then extends to establishing policies, procedures, resources, and staffing to support the technology transfer function in an organization. Maine‘s institutions are at various stages of this evolution. The institutions interviewed fit into the following categories:

Beginning – Organizations at this stage are focused on establishing a research base from which innovations can be developed and transferred.

USM, FBR, UNE, GMRI, MDIBL, Bigelow

Emerging – A small but growing research base is in place, and the organization is now forming the processes and support for technology transfer.

None of the institutions visited are in this category. UNE may be here soon based on Tim Ford's vision to rapidly grow their research function.

Functioning – Proper resources and procedures are in place and are used on a regular basis to move innovations out via licensing or new venture formation.

MMCRI, Jackson Labs, UMaine (Orono)

Two institutions in Maine stand out as models for comparison with regard to what can be accomplished in Maine:

- Jackson Labs – two licensing officers, clear policies and procedures (P&P), dedicated patent budget, faculty educational programs in place. Their performance expressed as numbers of licenses and royalty income has taken a major leap in the past few years.
- University of Maine, Orono – one licensing officer, clear P&P, dedicated patent budget, faculty working closely with industry and generating new IP. Strong track record of start-up activity.

Many of the constraints identified are common across multiple institutions:

- Most institutions have IP policies in place but have not established recurring faculty training and awareness-raising processes on technology transfer and IP opportunities.
- Only three institutions interviewed have a dedicated patent budget. The remainder are forced to search for funding when a patent filing need arises, or worse, not support patenting activity (directly or indirectly) because of a perceived lack of funds.
- Very little evidence of upper administration support for technology transfer and entrepreneurial activity is seen outside of University of Maine (Orono), MMCRI, and Jackson Labs. Most of the other institutions are focused on growing a research base, and have not begun to focus on the commercialization opportunities of the growing research. Many institutions have recently experienced, or are about to experience, changes in top administration, so the opportunity exists to begin changing cultures from the top down.
- Most of the institutions in Maine, in particular the nonprofit laboratories, have relatively small levels of research activity. The likelihood of commercialization outcomes is directly linked to the amount and type of research being conducted (applied versus basic, collaborative with industry, in fields of new scientific discovery and dynamic market activity). Is it reasonable to expect significant technology transfer outcomes from these institutions in the near future? The level and type of research conducted alone may be a constraint.
- In contrast, at a university with high levels of research and collaborative activity—University of Maine (Orono)—there is a need to establish additional manpower to support the level of innovation coming from research groups.

Observation 2: The state's investments in certain resources and programs in the state are adding value in two important areas of the technology transfer process: patenting support and gap funding.

> The Maine Patent Program and Maine Technology Institute's funding programs are widely recognized by many key stakeholders as critical in the support of the technology transfer process. These programs have been noted as well run and providing much-needed value at critical points in the technology transfer and start-up formation processes.

Observation 3: For institutions at the beginning of this process, a shared resource in the form of experienced technology transfer professionals is a good idea.

This approach has been used in Maine in the past few years and appears to have worked thus far. Recently, several institutions and MTI contributed funds to share access to a single technology transfer expert. This can be a very flexible and productive way to support technology transfer at multiple institutions. It seems successful at this time, according to many of the institutions visited. The downside is that no institutional memory is established if/when that person leaves that role.

Additional concerns about this approach were also noted. The level of commitment by all institutions to the shared resource is a current concern, as is the reduced level of interaction and use of the shared resource. In addition, there appear to be additional needs that can be addressed by expanding the roles and responsibilities of a shared resource. Some suggestions to sustain this model are provided below.

4.2.2 Technology Transfer Recommendations

Based on these observations, RTI makes the following recommendations to improve capacity for technology transfer, which should lead to increased levels of technology transfer and commercialization activities:

1. Create an expanded role for a shared resource that focuses on a wider range of support activities. In addition to the traditional patenting and licensing support provided thus far, the following support should be provided in this new role:
   - Conduct regular training and mentoring on technology transfer and intellectual property to both institutional management and research staff.
   - Work closely with institutional management to encourage promotion of technology transfer and entrepreneurial activities and create reward and incentive programs that encourage participation.

- Begin a proactive effort to build relationships with faculty who may have commercially attractive inventions but have not realized it yet, and provide subsequent assistance with crafting invention disclosures to the institution.
- These first three additions will subsequently lead to more disclosures needing review and approval for patenting and marketing activities, thus the level of these and follow-on activities should be expected to increase as well.

2. Explore alternative funding models for this new role, ranging from establishment of a part-time or full-time state government position, to creating a ―fee for service" pay-as-you-go model. The current retainer model may still work as this expanded offering may entice institutions to recommit.
3. Consider creation of a statewide patent fund that invests in protecting innovative ideas from Maine institutions. Funds should be matched by Maine institutions as an incentive for them to begin their own dedicated patent budgets. An impartial review board should be established to review patent fund applications. This fund could be managed through the OOI.
4. The University of Maine, Orono needs additional staff to support the level of activity taking place through the Office of Research and Economic Development. This campus has the right elements to spur technology commercialization: applied research centers, strong ties to industry, and the most experience in technology transfer and start-up formation in the state. Almost everyone interviewed who has interfaced with this campus stated that their support is great but spread too thin. Investment in this institution, in the form of additional licensing and start-up support personnel, should generate even higher levels of activity.

4.3 Start-up Activity

RTI identified 22 start-up companies formed from Maine institutions since 1998. For this project, start-up companies are defined as new ventures formed around research initiated at a Maine university or nonprofit laboratory. Typically, a license agreement is executed between the institution and the new venture so that the new venture can attempt to commercialize technology developed at the institution.

Of the 22 identified, 15 came from the University of Maine, Orono. The companies break out as follows:

Table 4.1. Maine Institution Start-ups (1998–2008)

Maine Institution	Number of Start-ups
U Maine, Orono	15
MMCRI	3

Jackson Labs	1
Bigelow Labs	1

Source: RTI Interviews

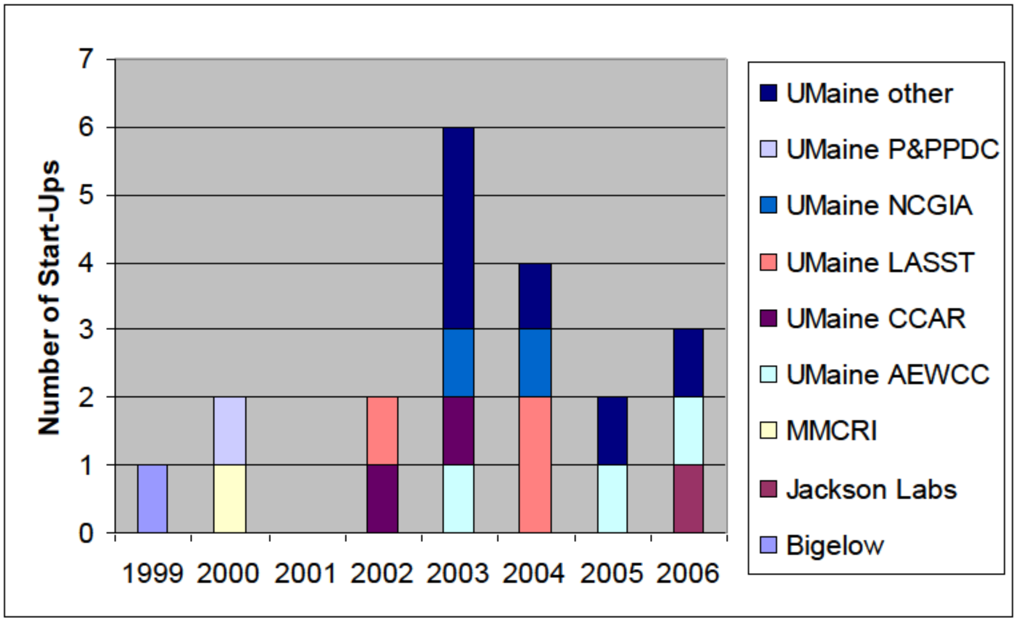
Table 4.2. Start-up Activity from Maine Universities and Nonprofit Labs 1999–2006

Company Name	Affiliated With	Research Center	Year Formed
Fluid Imaging Technologies	Bigelow		1999
Bar Harbor Biotech	Jackson Labs		2006
Maine Molecular Quality Controls Inc	MMCRI		2000
Engineered Materials of Maine	U Maine	AEWCC	2003
Maine Secure Composites, LLC	U Maine	AEWCC	2005
Atlantic Defense Group	U Maine	AEWCC	2006
Seabait Maine	U Maine	CCAR	2002
Maine Halibut Farms	U Maine	CCAR	2003
Stillwater Scientific Instruments, LLC	U Maine	LASST	2002
Orono Spectral Solutions, LLC	U Maine	LASST	2004
Mainely Sensor, LLC	U Maine	LASST	2004
Intelligent Spatial Technologies, LLC	U Maine	NCGIA	2003
Milcord Maine, LLC	U Maine	NCGIA	2004
Tethys Research LLC	U Maine	P&PPDC	2000
Saltwater Marketing	U Maine		2003
Sea and Reef Aquaculture	U Maine		2003
Maine Coral	U Maine		2003
Cerealus, LLC	U Maine		2004
Zeomatrix, LLC	U Maine		2005
GUDMUSE	U Maine		2006

Source: RTI Interviews

Figure 4.1

Start-up Activity from Maine Universities and Nonprofit Labs 1999–2006



Source: RTI Interviews

4.3.1 Start-Up Observations

Based on interviews with Maine entrepreneurs, RTI developed two observations.

Observation 1: Three factors were noted as playing the greatest role in establishing and growing high-tech companies:

- Institutional support – Defined as support from university or nonprofit lab administration, support from the licensing function of the institution, access to specialized equipment, and assistance from researchers and students.
- Funding support from MTI – MTI was repeatedly noted as critical to the launch and growth of new companies. MTI seed grants and development awards have had a positive impact on the launch and expansion of Maine's start-ups.
- Federal funding – Many of the companies interviewed have successfully used federal funding, such as SBIR/STTR, and pursued federal contracts to sustain their companies through technology development stages in preparation for revenue from sales.

Observation 2: Four areas in particular were noted as lacking or needing improvement:

- Access to capital (other than MTI) – Concerns were expressed about Maine-based angel investors and their discomfort with high-tech; the distance thus disconnect to Boston area angels/VCs; and the requirement for matching by just about every state funding program. Funding at key points in a company's development cycle (specifically the transition from research to sales, known as product development) was also noted as missing or very hard to find.
- Incubator system – The current technology incubator system was described as spread too thin, misplaced, and off-target. There was a consistent desire for flexible incubator space, able to handle a variety of technologies ranging from IT to physical science to chemistry.
- Maine networks -- Maine is too small to attempt to be self-sufficient. A repeated theme throughout many interviews was a desire for the state to build better and stronger connections throughout New England, specifically from Maine to Boston. Expanded networks with improved connections to angel and venture investors, businessmen, entrepreneurs, and support infrastructure (such as accountants, banks, attorneys) accustomed to working with high-tech start-up companies is greatly desired by many of the entrepreneurs interviewed.
- High-tech workforce – Difficulties in finding local talent and recruiting out-of-state talent into Maine were expressed by the large majority of companies interviewed. University faculty and students have met some of the demand, but many talented students end up leaving Maine because there are not enough jobs to keep them in state.

4.3.2 Start-up Activity Recommendations

Based on the feedback from these interviews, the following recommendations are offered:

1. Expand SBIR support beyond Phase 0 Grants and technical consulting, and include matching funds for SBIR Phase I and Phase II awards. (This type of program also can spur industry R&D, providing a benefit to both start-ups and existing companies, and is further described in Section 6)
2. Consider revamping current incubator system to better match regional needs versus a pure technology approach. Changes should include more flexible multi-use space in each incubator so that a wider range of technology development can take place.
3. State organizations such as MTI, MPP, and OOI should undertake specific activities to build networks into larger New England and Boston areas. Better connections into these networks can lead to increased deal flow, more and better

opportunities for Maine start-ups, and support from experienced accountants, bankers, and attorneys who are used to working with start-up companies.

4. Explore methods to increase willingness of local angels to invest in high-tech. A combination of training / mentoring coupled with funding models to de-risk angel investment in high-tech could expand and further enable this source of funding.

Interview Participants

The following individuals participated in the meetings, either by phone or in person:

Leonard Agneta – Maine Patent Program	Joe Migliaccio – Maine Technology Institute
Betsy Biemann – Maine Technology Institute	David Packhem – Maine Marine Manufacturing
Peter Brooks – MMCRI	Don Perkins – GMRI
Roger Brooks – Maine Technology Institute	Robert Phelps – Bar Harbor Biotech
Tim Ford – UNE	Gabriele Proetzel– Jackson Labs
Chris Frank – Intelligent Spatial Technologies	Steve Rockwood – Jackson Labs
Bob Friesel – MMCRI	Derry Roopenian – Jackson Labs
Nicholas Gere – UNE	Dan Shaefer – Bar Harbor Biotech
Jill Goldthwait – Jackson Labs	Jane Sheehan – Foundation for Blood Research
Patricia Hand – MDIBL	Graham Shimmield – Bigelow Laboratory for Marine Science
Rita Heimes – Center for Law and Innovation	Rob Taft – Jackson Labs
Chuck Hewett – Jackson Labs	Barbara Tennent – Jackson Labs
Mike Hyde – Jackson Labs	Carl Tripp – Orono Spectral Solutions
Robert Lindyberg – University of Maine, Orono	John Vetelino – University of Maine, Orono and Mainely Sensors
Todd Keiller – MMCRI	Jake Ward – University of Maine, Orono
Joan Malcolm – Jackson Labs	Peter Wells – Jackson Labs
Nancy Martz – USM	Michael Wiles– Jackson Labs
Susan MacKay – Zeomatrix	Janet Yancey-Wrona – AIKO Biotech

5. Entrepreneurship in Maine

5.1 Entrepreneurship Findings

In past editions of the Maine Innovation Index, Maine has performed quite strongly in terms of entrepreneurial activity. For example, in 2008, Maine had higher levels of entrepreneurial activity than the US average, the New England average, and the average among EPSCoR states.23 In this year‘s version, Maine remains on pace with the EPSCoR average, but its entrepreneurship levels fall below both national and New England averages.

While any drop in performance should be a cause for concern, Maine‘s one-year dip on this metric does not represent a significant decline. Maine‘s score on the KIEA dropped from 0.36 to 0.30 between 2006 and 2007.24 This means that in 2007, for every 100,000 adult Mainers, 6 fewer people started a business in 2007, when compared to 2006.

A small dip in one measure is not a cause for panic, yet a number of other data sources indicate Maine does suffers from several shortcomings when it comes to nurturing entrepreneurial start-ups and high-growth ventures. Consider the following data points from recent national benchmarking reports.

- Maine ranks 7th in Entrepreneurial Intensity25
- Maine ranks 3rd in the US in the proportion of the workforce that is self-employed26
- Maine ranks 42nd in the US in a ranking of the presence of high growth firms27
- Maine ranks 45th in the creation of ―gazelle jobs"28
- Maine ranks 32nd in business churning[29]

As these statistics suggest, the entrepreneurship equation consists of two parts: support for new business start-ups, and the nurturing of these start-ups into high-growth ventures, often known as gazelles. Both pieces of the puzzle are essential, but, from an economic development standpoint, the ability to develop high growth ventures is critical. These

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[23] Maine Office of Innovation, Maine Innovation Index 2009. Augusta, ME:: Maine Office of Innovation, 2009.

[24] Robert Fairlie, *Kauffman Index of Entrepreneurial Activity, 1996-2007*, Kansas City, MO: Kauffman Foundation, 2008.

[25] Information Technology and Innovation Foundation and the Kauffman Foundation, *State New Economy Index 2008.* Washington, DC: ITIF, 2008. Hereafter referred to as *New Economy Index.*

[26] Small Business Association of Michigan, *Entrepreneurship Scorecard for Michigan, 2007-2008.* Available at www.sbam.org.

[27] Data from Inc. and Deloitte Touche

[28] *New Economy Index*

[29] *New Economy Index*

firms are the real engines of the American economy, accounting for roughly 2/3 of net new job creation.

Unfortunately, our data indicates that Maine presently excels at only one part of the entrepreneurship equation: the spawning of new start-ups. It performs less well in turning new start-ups into high-performance businesses.

The strong entrepreneurial propensities of Mainers can be a real asset for the state. Mainers are willing to look for opportunities in the marketplace, and are willing to take the ―entrepreneurial leap." Both the US and Maine have seen significant recent growth in self-employment over the past few decades. Between 1969 and 2004, the number of self-employed in the US tripled, while the number of full and part time wage and salary workers grew by 77 percent. If present trends continue, one US worker in four will be self-employed by 2010.30 Self-employment can provide many benefits, but it is also the case that the average self-employed individual earns approximately $10,000 less than the average wage and salary workers. Based on these figures, the average self-employed individual earns roughly 75% of the average salaried worker.

Self-employment can lead to better incomes, better employment opportunities, or more successful companies, but only if the business owner succeeds in building a stronger business or in identifying other opportunities. Maine lags on this front. The data cited earlier suggest that Maine does not generate many high-growth or gazelle businesses. Mainers start businesses at higher than average rates, but these firms often stagnate as the business cannot achieve higher growth rates.

Other research confirms this pattern. For example, using the new National Establishment Times Series (NETS) database, the Edward Lowe Foundation is able to track what they call ―second stage companies."31 Second stage companies are firms with anywhere from 10 to 99 employees, with annual revenues in the range of $1 to $50 million. While not all second stage companies achieve fast growth, they are an indicator of a company‘s maturity and growth as it shifts from start-up mode to full-scale professional management. The development of second-stage companies is one indicator of company growth as it tracks how many new start-ups are able to gain early success in the marketplace.

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[30] Stephen J. Goetz, ―The Place-Based Structural Determinants and Effects of Self-Employment," Paper Prepared for the Kauffman Foundation, September 29, 2006.

[31] The Edward Lowe Foundation describes second state companies in this way: ―Second-stage companies are those that have grown past the startup stage but have not grown to maturity. They have enough employees to exceed the comfortable control span of one owner/CEO and benefit from adding professional managers, but they do not yet have a full-scale professional management team." See www.edwardlowe.org

Using this taxonomy, we can gain an interesting perspective on company growth in Maine. The NETS data shows that Maine does a poor job of ―graduating” companies. In other words, few firms are able to move to the next level in terms of company growth and employment. In fact, in the latest period (2006-2007), only 21 Maine establishments were able to move from Stage 1 (1 to 9 employees) to Stage 2 (10 to 99 employees). During that same year, more than 4,600 establishments started in the state.

5.2 Causes of Entrepreneurship Challenges in Maine

What explains this lagging performance in the creation of high-growth gazelle businesses? More research is needed to fully answer this question, but several factors may be at work. First, Maine‘s start-up entrepreneurs may lack the critical skills and knowledge needed to take their companies to the ―next level.” Second, these companies may lack access to critical supports, such as equity capital investments or sophisticated consulting assistance that helps fuel fast growth. Finally, Maine‘s newer businesses may face challenges in accessing growing markets, both in the US and overseas.

These challenge areas align with various stages of a company‘s lifecycle, from initial start-up through growth to maturity. At each phase, it is essential that Maine‘s business owners can easily obtain access—from public, private, and non-profit sources---to the support tools, information, and connections that they need to succeed.

At the initial start-up phase, new entrepreneurs must focus on developing key skills. Some entrepreneurs naturally develop such skills, but many need support and assistance to develop critical business skills. These skills represent a diverse mix. For many microenterprises, business owners need help with financial literacy and basic accounting, such as the use of bookkeeping software. Other entrepreneurs, especially those in innovation-based industries, need assistance with commercializing technologies and assessing markets, developing high growth business plans, accessing capital, or finding key management and technical talent with industry-specific knowledge.

As firms move beyond the initial start-up phase, their support needs become more sophisticated. Business in the growth phase is a new world for many entrepreneurs. They can no longer simply do it all themselves, and they must shift from a founder-entrepreneur role to one as a business manager. New challenges emerge--such as accessing equity capital and building a world-class workforce. Business owners often access these support tools from public sources, like state and local economic development agencies, but they often find it easier and more helpful to obtain information from other entrepreneurs, mentors, and business partners.

Finally, more mature businesses need better access to growing markets. Because of Maine‘s small size, local companies cannot thrive even if they dominate the local market.

Fast growth requires accessing markets outside of Maine, both in the US and overseas. Our economic benchmarks indicate that Maine lags all benchmark states and regions in terms of international export activity. For the US as a whole, exports grew by more by 10.9 percent between 2002 and 2007. Meanwhile, Maine‘s exports grew by only 6.8 percent.

Data from the R&D survey also warrant further attention. Firms that utilized Maine R&D program funding appear to do a good job of selling outside of Maine. Thirty-eight percent of surveyed companies obtain more than half of their business outside of Maine. However, many Maine firms still appear to struggle in selling overseas as only 3.3 percent do more than half of their business outside of the US.

5.3 Maine's Entrepreneurial Infrastructure

Many of the support tools for new businesses and microenterprises are already in place in Maine. Programs such as the Maine Small Business Development Center (SBDC) Network serve thousands of Mainers each year with business counseling and training workshops. This work is supplemented by dozens of local and regional organizations, such as the members of Maine Micronet microenterprise network or the state‘s five economic development districts.

In terms of supporting new start-ups and aspiring business owners, Maine‘s programs are relatively robust. And, new business owners appear to be using them. This year‘s private sector survey indicates that very small and relatively new companies are the primary users of Maine‘s R&D-related programs. Eighty percent of all program customers have less than ten employees, and nearly 72% have annual revenues below $500,000. Furthermore, 61% are relatively new, having opened since 2000.

Two potential gaps exist in Maine‘s support structure for early stage companies. While many programs for business owners are available in Maine, some business owners—especially those in rural areas---may face unique challenges in accessing them. Previous research from the Maine Entrepreneurship Working Group indicated that many of Maine‘s business owners did not find it easy to use and access existing programs.32 In addition, it appears that Maine‘s entrepreneur may be interested in more specialized support as opposed to basic entry-level support for business planning and other purposes. Our private sector survey results offer further potential evidence on this front, as many of the organizations providing more basic business assistance services scored lower on measures of the importance of provided assistance.

[32] Jay A. Kayne, Brian Dancause, and Yvonne Davis, ―Entrepreneurship Development in Maine," Paper Presented at Federal Reserve Bank of Kansas City Conference, ―Main Streets of Tomorrow," April 28-29, 2003.

In addition to the business development services provided by government agencies and non-profits, educational institutions, including K-12 and higher education, can also serve as critical entrepreneurial asset. But, unfortunately, the state has few educational institutions that have made a major commitment to supporting entrepreneurship education. A recent inventory prepared for the Maine Quality of Place Council identified only a small handful of these programs operating in Maine, arguing that ―opportunities for entrepreneurship training . . . appear to be limited." 33

As these data indicate, Maine's current entrepreneurial support programs are heavily weighted toward early stage start-ups and microenterprises. For firms at this stage of the business cycle, Maine provides an array of support programs and initiatives.

While policy makers can be heartened by the small business usage of support programs, they should also recognize the other part of entrepreneurial support equation: turning these new companies into successful growth-oriented ventures. As businesses move toward high-growth, the prospects for finding assistance in Maine become less straightforward. Business needs become more sophisticated and demand grows for more specialized services. Much of this support requires unique industry knowledge that cannot be provided by business ―generalists." In addition, growth-oriented ventures rely to a large extent on strong entrepreneurial networks where they can gain access to peers, mentors, and other business connections.

Like many smaller states, Maine lacks easy access to many of these more sophisticated support efforts. In particular, three primary gaps appear to be present in Maine's entrepreneurial support systems. First, Maine lacks programs that provide in-depth, hands-on, and customized support for growth-oriented entrepreneurs and their companies. These support services, which can be provided by public, private, or non-profit sources, go beyond a simple counseling session or access to workshops or training.

Second, Maine does not have a strong base of private entrepreneurial networks, especially for technology and innovation based firms, where entrepreneurs can gain easy and regular access to peers, mentors, and other business resources. Some initial efforts to build networks, such as TechMaine, are underway. These promising initiatives must be expanded across Maine if the state hopes to build a strong base of growth-oriented ventures.

Finally, Maine's entrepreneurs would benefit from closer linkages to other regional and national resource providers. Because of its relatively small size and large base of rural

[33] Amanda Rector, ―Entrepreneurship Education and Training in Maine," Paper Prepared for the Maine Quality of Place Council, September 17, 2008. Available at: http://maine.gov/spo/specialprojects/qualityofplace/documents/entrepreneurshipdevelopment_final.pdf

entrepreneurs, Maine may lack the size, scale, and density to create the entire range of needed entrepreneurial support services. However, most of these needed supports are located nearby—in the Boston metro area or elsewhere in New England. When and where possible, Maine‘s entrepreneurs should be more closely linked to these regional resource networks.

5.4 Creating Customized Support Services

As Maine seeks to create a more comprehensive and sophisticated set of entrepreneur support services, it can learn from other states and regions that have put such systems in place. These support systems take multiple forms. Many are operated by non-profits, but some states, such as Pennsylvania and Oklahoma directly fund these efforts. Their service offerings often differ, but they share a number of characteristics:

- Entrepreneurs receive a customized assessment of their own skill sets, and their company plans, management structure, market strategies, technology risk and operations.
- The entrepreneur is linked into a collaborative set of support services, some provided by traditional service provides, some accessed via entrepreneurial networks (see below).
- The efforts seek to support high-growth ventures. While the programs do encourage all business start-ups, more sophisticated (and costly) services are restricted to ventures with intentions and potential to achieve high-growth.

Some examples from other states may offer relevant lessons for Maine‘s policy makers. In Kansas, several different initiatives provide this customized support. Network Kansas (www.networkskansas.com) serves as the primary entry point for Kansas‘ entrepreneurs. Network Kansas brings together more than 200 state, regional, and local network partners who provide services and support to entrepreneurs. It operates a website, a live chat site, and an 800-line where aspiring entrepreneurs and business owners can access support. Network Kansas operates as a network hub. It manages some business lending and community grant programs, but its primary role is to refer businesses to customized support services.

The Kansas Technology Enterprise Corporation (KTEC) operates an even more customized support effort through its new KTEC Pipeline (www.ktecpipeline.com) program. Pipeline operates in a manner similar to various leadership or fellowship programs. Each year, it identifies and recruits a ―class" of ten technology entrepreneurs who have built successful businesses that are poised to achieve high-growth. These entrepreneurs then receive intensive training, coaching, and mentoring with the objective of helping them to build a world class venture in Kansas.34

Pennsylvania‗s Ben Franklin Technology Partners (www.benfranklin.org) also provides a comprehensive set of support services. The program operates around four regional centers, each with a distinctive set of program offerings. However, each center seeks to provide a comprehensive and customized set of support tools. For example, the Ben Franklin Technology Partners of Southeastern Pennsylvania (BFTP-SEP) (www.sep.benfranklin.org) focuses on providing access to support in three broad areas: knowledge, capital, and networks. Via ―Knowledge," BFTP-SEP links entrepreneurs to advisors who assist firms with product planning, design, manufacturing, and marketing. Via ―Capital," entrepreneurs gain access to various public and private funding programs. In addition, funded companies gain access to consulting support for marketing and other purposes. Finally, ―Networks" link entrepreneurs to the wide range of entrepreneurial networks in the Philadelphia region, many of which are targeted to leading technology sectors such as nanotechnology, life science, or green industries.

5.5 Recommendations for Maine

Maine should begin efforts to develop a more comprehensive and customized system of support services for innovation-based entrepreneurs. A fledgling effort to develop this system began in 2003, but never gained traction among business service providers or entrepreneurs. Maine‗s business support providers should revisit this effort, and expand the role of private sector partners in leading a new initiative.

5.5.1 Networks

Networks are a critical and under-appreciated part of the entrepreneurship puzzle.35 Entrepreneurs regularly report that access to networks is a key ingredient to business success. They learn better from fellow entrepreneurs, and use these networks to access peers, mentors, partners, suppliers, and customers. Most successful regions are home to a variety of entrepreneurial support networks, and researchers point to these networks as critical contributors to regional prosperity.36

[34] At the time of this report‗s publication, the KTEC Pipeline program had been proposed for elimination by Kansas Governor Kathleen Sebelius.

[35] Erik R. Pages and Shari Garmise, "The Power of Entrepreneurial Networks," The Economic Development Journal, Vol. 2, No. 3 (Summer 2003), pp. 20-30.

[36] Council on Competitiveness, Asset Mapping Roadmap: A Guide to Assessing Regional Development Resources. Report Prepared for US Department of Labor, October 2006.

The most effective entrepreneurial networks are created and managed by entrepreneurs themselves. The US' largest entrepreneurial network, North Carolina's Center for Entrepreneurial Development (www.cednc.org) represents a typical model. CED began operations in 1984, and has never received government funding. Today, it has more than 5,500 active members, and an annual budget of roughly $2 million. Over its nearly twenty-five years of operation, CED has focused almost exclusively on three activities:

- Providing training to entrepreneurs through workshops, and courses as the FastTrac curriculum.
- Providing networking opportunities.
- Providing investment screening by linking entrepreneurs to investors and training entrepreneurs on how access outside funds.

More recently, North Carolina's economic development leaders have sought to expand this networking model to other parts of the state. CED has sponsored an affiliate network in Wilmington (The Coastal Entrepreneurial Council/www.cec-nc.org), and similar unaffiliated networks operate in Charlotte (http://www.bigcouncil.com) and Greensboro (www.pten.org). In addition, the North Carolina Rural Economic Development Center (www.ncruralcenter.org) has invested funds and provided technical support to seed networks in more rural parts of the state.37 Pilot networks are now operating in Boone, Elizabeth City, Pembroke, and Rocky Mount.

Wisconsin has taken a more hands-on approach to seeding networks. Through its Inventor and Entrepreneur Club program (http://www.wenportal.org/ieclub%5Fgrants/), Wisconsin provides small grants to help seed county-level entrepreneurship networks where entrepreneurs can regularly gather to discuss new business ideas. More than 40 such networks now operate across the state.

State leaders can support networks through other tools as well. In particular, many states use prizes and competitions as a means to help build a ―culture" of entrepreneurship and to encourage entrepreneurs to build closer connections. Today, a majority of states sponsor some type of ―Entrepreneur of the Year" award program. These efforts, which are typically managed from the Governors office or from the Department of Economic Development, provide an excellent means to honor local business leaders and send a public message of support for entrepreneurship.

The use of business plan competitions is also gaining adherents across the US. Nearly every state has a business plan competition in place, often set up under the leadership of a

[37] *Hello, My Business Name Is:" A Guide to Building Entrepreneurial Networks in North Carolina,* Published by North Carolina's Council for Entrepreneurial Development as a part of North Carolina's Entrepreneurial Development Systems Project. 2007.

local university. For example, the University of Southern Maine has managed a student competition for many years. Arkansas operates an interesting competition via the Reynolds Cup, one of the US' most lucrative student business plan contests (http://www.dwrgovernorscup.org/). Managed by Arkansas Capital Corporation, the competition now includes teams from three states: Arkansas, Nevada, and Oklahoma. It also includes awards from undergraduate and graduate teams, and has recently incorporated a statewide business plan competition for 6th grade students based in Arkansas.

Many states are shifting business plan competitions off campus and including all businesses. For example, Pennsylvania's Ben Franklin Partners just concluded a statewide ―Big Idea" business plan contest (http://www.cnp.benfranklin.org/vif/100k) that will pay $100,000 to the winning company. In Iowa, the John Pappajohn Business Plan competition pays $25,000 to the statewide winner.

Maine's policy makers should consider several steps to help build local networks and strengthen the state's ―culture" of entrepreneurship. The state should consider provide seed funding to stimulate the creation of such local networks, and also provide technical assistance and training on how to start and manage these organizations. Given the current difficult funding environment, DECD may need to consider alternative approaches to funding this effort. CDBG funds may provide one tool in this regard as other states, such as North Carolina, have deployed Federal funds for this purpose. In addition, Maine should consider establishing a Governor's Entrepreneur of the Year award and a Governor's Cup Business Plan Competition. Both of these efforts offer a low-cost means to send the message that Maine is an ―entrepreneur-friendly" state.

5.5.2 Links to Other Resources

While many entrepreneurs and economic development leaders recognize that business does not respect state borders, few states and regions have done a good job in terms of building linkages between local entrepreneurs and resources that exist in other regions, states, or countries. Nonetheless, a number of interesting experiments, most led by non-profits, indicate the potential usefulness of these strategies. For example, the Chico, California-based Golden Capital Network (www.goldencapital.net) was established to help link local business owners (based in Northern California and Nevada) to sources of financing and support based in the Bay Area. Similarly, San Diego's CONNECT (www.connect.org) was first established as an entrepreneurial network for the San Diego region. It has since spun off the Global CONNECT network (http://globalconnect.ucsd.edu/) that links dozens of entrepreneurial networks in both the US and overseas.

Other national organizations provide vehicles to link local business owners to other sources of entrepreneurial support. Various national business competitions, such as the Inc. 500 and Inc. 5000, the Deloitte & Touche Fast 50 Awards, and the Ernst & Young Entrepreneur of the Year Awards, all offer excellent vehicles to connect entrepreneurs to national role models. In addition, other networking groups such the Entrepreneurs Organization (www.eonetwork.org) or the MIT Enterprise Forum can also serve this purpose (http://enterpriseforum.mit.edu/).

Maine's entrepreneurs will benefit greatly from access to sources of expertise, assistance, and funding that are located outside of the state. Maine's proximity to the Boston metropolitan area, one of the nation's leading centers of entrepreneurship, provides Maine with a potential competitive advantage on this front. Where possible, Maine existing and emerging entrepreneurial support efforts should strive to build closer connections to these outside resources.

6. Promoting Industry R&D in Maine

6.1 Industry R&D in Maine - Introduction

Industry R&D is an important aspect of an innovation economy because it provides the most concentrated means of continually developing new products and services that act as the foundation for new jobs and businesses. Nationally, industry R&D outpaces the combined total of university and nonprofit R&D by a scale of over two-to-one in funding, patents and other economic outcomes. Not only does industry R&D provide over two-thirds of all research, the vast majority of that research is funded directly by the private sector with less than 15% coming from federal awards38. In other words, industry R&D tends to be a sustained model of reinvestment, rather than one-time funds.

The level of industry research and development, however, continues to be a key concern for Maine's innovation economy. The state consistently lags national averages and peer states in terms of the amount of R&D that is conducted by various industry sectors.

While some innovation factors like venture capital are concentrated in just a few, larger regions, industry R&D is much more widely distributed among states, and many top performers include smaller states. According to the 2008 State New Economy Index of the top states for industry R&D, Delaware was ranked #1, Rhode Island ranked #3, Minnesota ranked #6, New Hampshire ranked #8, and Oregon ranked #11. By comparison, Maine ranked #38 in the index in terms of industry R&D per $100,000 of GSP.

Perhaps one reason smaller states can be competitive in industry R&D is the fact that small companies performing R&D spend more per employee than their larger counterparts, and have a greater percent of the workforce in R&D functions. For a state like Maine where science and technology companies tend to be small, pursuing strategies to increase the R&D activities for these firms would be very beneficial and would increase the level of current R&D that appears to be limited to just a handful of companies in the state.

[38] National Science Foundation, U.S. Business R&D Expenditures, August 2008

Table 6.1

R&D Performance for companies performing industrial R&D, 2006 national data

Company Size (employees)	Company R&D ($ m)	Domestic Employment (1,000)	Percent Employment	Percent of all R&D Scientists/ Engineers	R&D per employee
5-24	$ 6,087	243	1%	6%	$ 25,049
25-49	$ 6,485	241	1%	4%	$ 26,909
50-99	$ 8,360	482	3%	4%	$ 17,344
100-249	$ 12,101	689	4%	5%	$ 17,563
250-499	$ 7,944	665	4%	4%	$ 11,946
500-999	$ 12,482	1087	7%	6%	$ 11,483
1,000-4,999	$ 36,019	2393	15%	16%	$ 15,052
5,000-9,999	$ 19,776	1393	9%	8%	$ 14,197
10,000-24,999	$ 35,049	2270	14%	16%	$ 15,440
25,000+	$ 78,082	6835	42%	29%	$ 11,424

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2006.

6.2 Growth in Industry R&D

From 1995 to 2006, industry in the U.S. increased its R&D by almost 90%. Other smaller states including New Hampshire, Oregon and Rhode Island grew industry R&D by 156-361% during the same time period. Maine long-term industry R&D has experienced the opposite pattern, decreasing by 12% from 1995 levels. When the state‘s performance is benchmarked against smaller states that have developed a more robust environment for private sector research, it can illustrate the potential Maine has for enhancing industry R&D.

Table 6. 2

Funds for industrial R&D performed in the United States, by selected state ($ Millions):

State	1995	1997	1999	2001	2003	2005	2006	% change, 2005–06	% change 1995-2006
United States	132,103	157,539	184,129	202,017	200,724	226,159	247,669	9.5	87%
Colorado	1,865	2,248	3,266	3,082	3,543	4,299	4,657	8.3	150%
Delaware	1,077	1,009	1,295	1,232	1,298	1,511	1,446	-4.3	34%
Maine	286	83	208	249	200	350	253	-27.7	-12%
Maryland	1,075	1,425	2,020	3,682	3,118	3,706	3,421	-7.7	218%
Minnesota	2,636	3,116	3,695	4,355	5,003	6,340	6,296	-0.7	139%
New Hampshire	472	652	1,157	1,339	1,349	1,435	1,774	23.6	276%
North Carolina	2,226	3,590	3,754	4,437	4,423	5,158	5,486	6.4	146%
Oregon	741	1,102	1,408	2,677	2,956	3,252	3,419	5.1	361%
Rhode Island	520	704	1,317	1,134	1,203	1,387	1,330	-4.1	156%

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2006.

6.3 Sector Distribution of Industry R&D

Just over two-thirds of Maine‘s industry R&D (approximately $171 million) comes from manufacturing sectors. This is consistent with national averages. Like many other states, industry R&D tends to be concentrated in just a few sectors. Over 75% of manufacturing R&D was concentrated in three sectors: computers and electronics accounted for $60 million, pharmaceuticals and medicine for $45 million and transportation equipment for $25 million. Non-manufacturing industries accounted for $82 million of industry R&D lead by efforts in architecture and engineering services, information services, and computer systems.

A recent report, Maine‘s Technology Sectors and Clusters: Status and Strategy, clearly indicated the state‘s research strength in a number of areas related to the seven targeted clusters of biotechnology, composites and advanced materials, environmental technologies, forest products and technologies, Information technology, marine sciences and aquaculture, and precision manufacturing. Much of the research and expertise listed in the report was provided by the state‘s universities and nonprofit research institutions. Yet when these clusters are compared to reported industry R&D, there is a mismatch between the level of research at universities and the spillover to selected industry.

While on a national scale, scientific services (which include R&D for environmental technologies, marine sciences and other bio and life sciences) accounted for 38% of all professional and technical services R&D, it made up just 22% of Maine‘s professional and technical R&D funding. In other cases, such as composites and advanced materials, IT, and precision manufacturing there is a strong connection between levels of academic and industry R&D. Biotechnology appears to the majority of industry R&D in pharmaceuticals. The state should learn why manufacturing industries appear to have made the connection between industry and academic R&D, while life and physical sciences do not appear to have a strong public-private link.

Table 6.3

Industry R&D by Sector and Selected States

	Companies	U.S.	CO	DE	ME	MD	MN	NH	OR
All industries	44,266	247,669	4,657	1,446	253	3,421	6,296	1,774	3,419
Manufacturing industries	**18,677**	**171,814**	**3,175**	**D**	**171**	**1,732**	**5,113**	**1,334**	**2,792**
Food	728	2,720	19	1	*	84	277	2	8
Beverage and tobacco products	39	547	D	*	*	*	*	*	*
Textiles, apparel, and leather	505	594	*	*	3	D	3	D	D
Wood products	329	195	*	D	*	D	D	*	7
Paper, printing, and support activities	573	D	9	D	19	26	D	5	7
Petroleum and coal products	107	1,432	D	*	*	D	D	*	*
Chemicals	1,921	46,329	141	D	51	777	321	13	21
Pharmaceuticals and medicines	*483*	*38,901*	*132*	*D*	*45*	*723*	*162*	*6*	*8*
Plastics and rubber products	1,236	2,245	17	9	1	6	83	3	D
Nonmetallic mineral products	398	1,014	6	1	*	2	9	4	1
Primary metals	236	651	*	D	*	3	11	D	68
Fabricated metal products	2,417	1,499	37	6	1	9	D	8	16
Machinery	3,114	9,848	37	4	3	91	332	94	85
Computer and electronic products	2,795	56,773	1,180	51	60	381	2,239	1,133	2,155
Computers and peripheral equipment	*289*	*D*	*405*	*0*	*0*	*19*	*448*	*44*	*D*
Semiconductor and other electronic components	*728*	*18,888*	*352*	*D*	*55*	*30*	*136*	*50*	*1,873*
Navigational, measuring, electromedical, & control instruments	*1,103*	*18,300*	*129*	*47*	*4*	*234*	*1,600*	*D*	*186*
Electrical equipment, appliances, and components	986	2,281	6	2	*	6	34	5	47
Transportation equipment	1,129	D	1,368	11	25	220	311	7	111
Furniture and related products	421	D	D	*	*	*	16	*	4
Miscellaneous manufacturing	1,741	5,150	138	27	6	105	337	26	30
Medical equipment and supplies	*923*	*4,098*	*119*	*D*	*5*	*103*	*326*	*23*	*21*
Nonmanufacturing industries	**25,590**	**75,855**	**1,481**	**D**	**82**	**1,689**	**1,183**	**441**	**628**
Mining, extraction, and support activities	142	D	30	*	*	*	D	*	*
Utilities	175	248	D	1	4	1	1	*	D
Construction	795	1,379	16	1	1	20	10	2	5
Wholesale trade	3,276	2,072	38	5	2	41	26	4	48
Information	3,138	26,883	689	12	19	169	332	256	316
Publishing	1,816	D	487	2	11	122	276	249	266
Software	*1,581*	*D*	*476*	*2*	*D*	*D*	*272*	*249*	*262*
Telecommunications	162	D	89	1	5	7	3	1	3
Internet service providers, Web search portals, and data-processing	774	4,029	106	8	2	26	47	5	43
Finance, insurance, and real estate	1,021	1,969	51	3	1	26	14	2	4
Professional, scientific, and technical services	10,856	38,049	625	48	52	1,419	780	167	D

Architectural, engineering, and related services	*2,444*	*6,579*	*143*	*9*	*23*	*275*	*76*	*14*	*69*
Computer systems design and related services	*5,316*	*14,841*	*198*	*19*	*14*	*394*	*572*	*72*	*44*
Scientific R&D services	*2,268*	*14,525*	*260*	*16*	*11*	*711*	*98*	*77*	*D*
Other professional, scientific, and technical services	*829*	*2,105*	*24*	*5*	*3*	*39*	*34*	*5*	*14*
Health care services	1,945	992	3	D	2	3	4	1	3

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2006.

6.4 Industry R&D Recommendations

Industry R&D is not only responsible for the largest portion of research, the applied nature of the research creates new products and services which continually grow new jobs and businesses and enables a continuous cycle of reinvestment back into the state. Given the private sector survey results, industry R&D data, and other indicators of Maine's innovation economy in the private sector, two specific recommendations are suggested:

- **Connecting Industry to University and Nonprofit Research**: Developing a statewide and integrated system of focused information and targeted technical assistance that connects entrepreneurs and businesses to university and nonprofit R&D facilities and expertise.
- **Increasing Industry Supported R&D:** Enhancing public policies that provide incentives for Maine companies to expand and reinvest in ongoing R&D in the state.

6.4.1 Connecting Industry to University and Nonprofit Research

Research partnerships between education and industry have been very effective in building a critical mass in specific research and technologies that are hard to duplicate in other regions. These unique partnerships provide the resources to be competitive in areas that any one partner alone cannot accomplish. To underscore this point, studies at the University of Illinois in Chicago indicate that academic R&D plays a significant role in the development of industry patents and SBIR awards39.

States with robust industry R&D, especially smaller states, appear to have strong programs or initiatives that systematically connect industry to the university and non-profit research facilities and expertise. While there are pockets of such coordination in Maine, much of it appears to be either program or university specific, resulting in an ad-

[39] *Do State R&D Tax Credits matter for Innovative and Economic Outputs?* Yonghong Wu, University of Illinois at Chicago.

hoc network for businesses. Examples of statewide business-university-nonprofit research connections that could serve as models for Maine are described below.

Georgia Research Alliance - Industry Partnership Grants and Venture Lab Program

The Georgia Research Alliance (GRA) acts as a ―deal-maker" for Georgia's research universities to grow Georgia's economy through university-based research. GRA recruits enterprising scholars to Georgia, fuels the launch of companies, strengthens centers of research so that they break new ground on discovery, and brokers working partnerships between businesses and industries.

The Alliance is a public-private partnership of the state's leading research universities, business and state government. The operations of the Alliance are funded through grants from private foundations and industry. The investments that the Alliance makes in its programs are part of the budget of the Office of the Governor of Georgia and are approved by the Georgia Legislature. Among its commercialization efforts, GRA offers industry partnership grants and manages the Venture Lab Program.

In 2007, the Georgia Research Alliance (GRA) provided grants to fund university-industry partnerships in targeted technology areas. Grants were made up to an amount of $100,000 and all investments required the involvement of at least one active industry partner. Projects had to be within three targeted technologies areas including: advanced communications, computing and content, bioscience, nanoscience and advanced materials. The program provided targeted focus on state strengths while fostering university and industry relationships. www.gra.org

GRA also supports the VentureLab (http://www.edi.gatech.edu/gra-venturelab/) program. According to GRA, VentureLab helps create early-stage businesses that are ready to advance into traditional technology business incubators. Venture Lab reduces both the costs and risks associated with technology transfer in one-stop centers that serve as advocates for faculty researchers through:

- Technology assessment. VentureLab looks for timely innovations that will mesh with marketplace needs. In addition, staff members help faculty determine the best route for commercialization – be it licensing the technology to an existing company or forming a startup.
- VentureLab Fellows. The program connects faculty researchers with experienced entrepreneurs and professional managers who serve as coaches and drive the commercialization process forward.
- VentureLab commercialization grants. Funding is available to bridge the gap between research and commercial product.

i2E (ideas to enterprise), Oklahoma

i2E is a nonprofit organization with a mission to launch science and technology companies in Oklahoma and to enhance the commercialization of research from the state's universities and nonprofit research institutions. The organization's core offering is a customized service that assesses each company's expertise and stage of development, and then provides one-on-one business expertise, coaching and referrals based on these needs. Services include technical feasibility and IP assessments, market research, risk assessment, business modeling, capital formation strategies, team building, and exit strategies. Staff is comprised of executives and investors with tech-based experience. The program has a very tight connection to university tech transfer and research offices, angel and venture groups, and state and regional economic development programs—not just providing a referral contact, but bringing parties together to help broker how each partner can add value to the client company. -www.i2e.org

Recommendation for Maine: *The state should foster the development of a statewide system to connect entrepreneurs and businesses to university and nonprofit R&D facilities and expertise. Best practices in other states include a comprehensive information system of university and nonprofit R&D resources, a brokering function to help the private sector more easily connect with these resources, and assistance connecting university-industry research with seed funds and other resources for commercialization. The goal is a well coordinated portal of services from the perspective of the business as the primary customer and user of the system.*

Maine's research institutions have a critical role to play in promoting industry R&D that not only provides valuable services to businesses, but also accelerate the commercialization and economic value of their own R&D efforts. The following university programs serve as examples for what Maine could do on a system-wide basis.

University of Washington - LaunchPad Program

In an effort to catalyze the creation of new ventures based on promising University technologies and innovations, the Technology Transfer Office at the University has developed the LaunchPad to serve industry throughout the state. Once an entrepreneur expresses an interest in starting a company based on their UW innovation, the staff reviews the case, works with entrepreneurs to develop a detailed start-up plan, and additionally supports the entrepreneur through:

- Managing start-up project plans

- Identifying next steps and milestones
- Finding community mentors and advisors
- Coaching team members
- Facilitating communication and networking with business and investment professionals
- Linking the project team to needed resources

http://depts.washington.edu/techtran/uwcommunity/uw_starting_working_with_techtran.php

University of Michigan, Ann Arbor, Business Engagement Center

Since businesses tend to view the university setting as unapproachable, the University of Michigan created The Business Engagement Center (BEC) in 2007 to bridge this gap and facilitate business access to the University. The Center creates a ―business friendly" environment for entrepreneurs to access the University's research discoveries, new technology, faculty expertise, student and alumni talent, and continuing education programs. This is accomplished through technical assistance as well as programs and events that network businesses with university personnel and faculty. While not all of their programs and activities are technology transfer focused, the Center makes it easier for entrepreneurs and faculty to establish relationships which eventually lead to technology transfer. http://bec.umich.edu/index/

Georgia's Intellectual Capital Partnership Program

Georgia's Intellectual Capital Partnership Program (ICAPP) is the University System of Georgia's economic development program. ICAPP connects the intellectual resources of Georgia's public colleges and universities to the state's business community in innovative ways. ICAPP staff and a team of economic development leaders from each campus help Georgia businesses to tap into the University System of Georgia to recruit college-educated employees, access the latest research, and access business and operations advice. The program helps industry connect to research through a variety of mechanisms. www.icapp.org

- Database of research centers to search more than 400 entries in the ICAPP Catalog of USG Centers, Institutes and Special Programs to find expertise in a wide range of areas.
- Industry-directed research - working with businesses to conduct research that meets industry needs through a wide range of programs.

- The regional offices of Georgia Tech Enterprise Innovation Institute help companies improve productivity and quality, reduce costs, plan expansions, start new operations, and implement proven manufacturing technologies.
- Advanced Technology Development Center (ATDC) provides intensive hands-on assistance to help technology-based companies rapidly bring new innovations to market. ATDC has four locations in Atlanta, Savannah and Warner Robins, Georgia. The Target Technology Center in Orono appears to be one of the few applied technology development centers in Maine with a similar level of service.

Recommendation for Maine: *Maine's university system should also enhance its support for industry R&D by adopting a more systematic approach to technology transfer as described in Section 4. While some universities work hand-in-hand with programs like MTI or the Maine Patent programs, this relationship is not consistent among universities. Universities should proactively share information about research efforts, especially applied and translational research, with business assistance and tech-based industry organizations.*

6.4.2 Promoting Industry R&D in Small Companies

Getting small businesses to take the leap into R&D can be time consuming and costly. Recently, states have begun to provide additional incentives for companies that pursue R&D activities. One type of program which appears to have significant results is an SBIR match program that goes beyond the traditional Phase 0 assistance for writing grants and matches the R&D funds a company receives from the federal government. Three such programs are described below.

Kentucky SBIR/STTR Match Program

State matching funds are awarded to companies that win grants in Phases 1 and 2 of the federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) programs. Kentucky is the first state to match both phases of the federal grants, dollar for dollar, doubling the value and impact of federal funding.

The announced matching grants are up to $100,000 per company for their Phase 1 research. Kentucky also has started matching federal awards for Phase 2 research and development, during which a company aims at making the technology ready for commercialization. The maximum state match for Phase 2 federal awards is up to $500,000 per year for up to two years. The opportunity for recipients of Phase 1 and Phase 2 federal awards to earn up to $1.1 million in matching funds from Kentucky has drawn attention to the nationally advertised program from high-tech firms in other states that are interested in relocating to Kentucky. The funding for the program comes from the state general fund and is provided on a first-come, first-served basis and have assisted more than 20 businesses each year. Initial results indicate a dramatic increase in SBIR applications and awards for Kentucky businesses, which ranks among the lowest of all states for industry R&D. http://www.thinkkentucky.com/DCI/SBIR/SBIRSTTR.aspx

The One North Carolina Small Business Program

This program provides grants to reimburse qualified North Carolina businesses for a portion of the costs incurred in preparing and submitting Phase I proposals to the federal government‘s SBIR/STTR Programs. It also provides matching grants to qualified North Carolina businesses that have been awarded a federal Phase I SBIR/STTR: 100% of the federal SBIR/STTR Phase I award up to a maximum of $75,000. (http://www.ncscitech.com/oncsbp)

Wisconsin Technology Bridge Grants

Introduced as part of the state‘s Grow Wisconsin Initiative, the Technology Bridge Grant program provides funding to businesses with fewer than 100 employees, which have received early-stage financing from the federal government (e.g., SBIR award) or another source and are waiting for follow-on sourcing. Funds granted under this program may only be applied to necessary costs related to maintaining research and basic business operations until the company‘s follow-on funding or federal grant application is approved or denied. http://www.commerce.state.wi.us/bd/BD-Act255-technologybridgegrants.html

Recommendation for Maine: *In 2005, 18 companies received SBIR awards totaling less than $3 million because 15 of those companies received Phase I awards which are limited to $100,000. By comparison in 2006, 15 SBIR awards to Maine companies totaled approximately $10.6 million due to eight companies receiving the Phase II awards for up to $750,000 each. Many of the companies receiving Phase I awards in 2005 went on to receive Phase II awards in 2006.*

If Maine adopted a SBIR match program similar to other states, the cost to the state would range between $1 million and $10 million per year depending on the phase and amount matched for each phase. For example, a state fund of $5 million per year could support a combination of up to 15 grants to match Phase I awards at 100% of the federal amount, and up to 10 grants for Phase II awards matched at 50% of the federal award amount.

6.4.3 Private R&D Funding

In addition to seeking funds from state and federal sources, private sector investment can also be a source of industry R&D. While there are a variety of entrepreneurial network models that seek to connect start-ups with professional and technical resources, a few are going the extra mile and hosting focus events to connect start-ups and small businesses with emerging technologies to private sector equity investors

Oregon Entrepreneurial Network and Seed, Angel and Venture Forums

The Oregon Entrepreneurial Network (OEN) is the state's nonprofit membership organization with a mission of promoting the start-up and growth of high value companies in Oregon. OEN helps improve the flow of ideas, services, and capital to entrepreneurs and helps connect companies to expertise and other resources they need to grow their businesses. Privately funded, this organization began holding a venture forum in 1996 to connect companies with investors. Today, the organization has three forums that systematically connect each level of funding: a seed, angel and venture forum. www.oen.org

- OEN's Venture Northwest (formerly Venture Oregon) is the premier forum for new and emerging investment opportunities in exciting companies from Oregon, Washington, and throughout the Pacific Northwest. This annual conference draws institutional investors and investment bankers from across the western U.S. who are interested in the emerging companies that the Northwest has to offer. Companies that have presented at Venture Oregon have raised over $1.3 billion in venture capital since 1996 and over $68 million in angel investment. More than 50 investors from 35 venture capital firms attended the conference in 2007.

- OEN's Angel Oregon brings together Oregon and Southwest Washington's brightest entrepreneurial talent with qualified angel investors. Seven companies were showcased in 2008 at the conference. (http://eth0.cpq066.bea1.oen.easystreet.com/blogs/oen/2008/03/06/endoutdoor-wins-top-honors-at-angel-oregon-2008)

- Seed Oregon is a unique competition for Oregon and Southwest Washington seed-stage companies who are seeking capital within the range of $100,000 to $2,000,000. Coaching is provided to finalists.

6.4.4 Industry R&D Tax Credit

Economists have found that the private sector invests in research and development (R&D) about half the amount that is optimal for society.40 R&D tax credits help to lower development costs for R&D-intensive companies competing intensely in global markets. A recent study by Yonghong Wu at the University of Illinois, Chicago found ~~-t~~that the establishment of state R&D credit programs is effective in stimulating more industrial R&D expenditure. In addition, state services in higher education and R&D-targeted programs also matter in private decision of R&D investment. This policy assessment sends a positive message to state policymakers because it shows the great potential in using R&D policy instruments to promote innovation-based economic development." Dr. Wu's work also found empirical evidence that state R&D tax credits has significant and positive effects on SBIR awards and patents within the state.

There have been various comparisons of state R&D tax credits which evaluate success factors of various programs.41 Among the various elements of R&D tax credits there appear to be several factors that influence the rate of industry R&D:

- The importance of the R&D tax credit being available to all taxpayers, rather than limiting the credit to specific sectors of qualified businesses. Since the maximum benefit of innovation comes from the spillover effect one industry has on another, limiting the industries that receive any tax credit have been shown to limit industry R&D.
- Increasing the effective rate of the tax credit. When most states adopted R&D tax credits the typical credit was 5%. As time progresses, states began to increase this limit. Rhode Island has a credit of 22.5 percent for the first $111,000 of qualifying expenditures and 16.9 percent for investment above $111,000. California provides a 15% credit to incremental R&D spending, and 24% to basic research expenditures. Arizona has a tax credit of 24% on the first $2.5 million and 15% on additional research.
- Increasing the limit on which the tax credit is applied to reflect the needs of R&D intensive industries. Many states limit their R&D tax credit to the first $500,000 of research. States like Oregon and Arizona raised their limits for R&D tax credits which are now applied to the first $2 million and $2.5 million.
- A portion or all of the R&D tax credit is applied to the total R&D expenditures in a given year, not just the increased expenditure. Hawaii's credit applies to all

[40] *Expanding the R&D Tax Credit to Drive Innovation, Competitiveness and Prosperity, Dr. Robert Adkinson, April, 2007*

[41] *Hawaii High Technology Research & Development Tax Credit Survey, Grant Thorton LLP, 2007*

approved R&D expenditures, matches the federal tax credit, is refundable, and is also among the highest R&D tax credits in the nation (20%). Utah‘s recently passed HB223 provides a hybrid approach that allows for a 5% tax credit without regard to the base amount, plus 7% credit on 50% of new R&D expenditure (an effective rate of 8.5%).

- Other R&D tax credit options include Hawaii‘s and Minnesota‘s application to the franchise tax as well as income tax and a limited amount of R&D tax credit to be refunded. At least one state, Massachusetts, provides a more generous credit for company research expenditures at universities. It provides a 10 percent credit for company expenditures, but a 15 percent credit for company expenditures on basic research at universities in the state.

Recommendation for Maine: *Since many of Maine's R&D companies are small and incremental investments are difficult, the state should investigate two options to modify its existing R&D and Super R&D tax credit. First, allow a limited amount of tax credit to be applied to all research, not just incremental research expenditures (this could be limited to the first $500,000 of research spending). Second, increase the tax credit rate on incremental R&D spending and basic research to be competitive with other states (at least 15%).*

6.4.5 The Use of Other Tax Credits

Maine has two other tax credits which could be modified to increase the growth of the state‘s science and technology industries.

High Technology Investment Tax Credit is available to business primarily engaged in high-tech including the design, creation, and production of computer software, computer equipment, supporting communications components, and Internet or advanced telecommunications services. The credit is for eligible equipment placed in service in Maine less any lease payments and cannot exceed $100,000 in any one year; income must be increased by any credit base amount claimed as a business expense.

Recommendation for Maine: *Expand the tax credit to be applied to other science and technology industries including those targeted clusters such as environmental sciences, alternative energy, and biotechnology.*

Jobs & Investment Tax Credit (JITC) is available to any business, other than a public utility, that invests at least $5 million in a taxable year in qualifying types of personal property in Maine and creates 100 new jobs over the ensuing two-year period. The credit is limited to tax liability or $500,000, whichever is less. The credit cannot be carried back, but can be carried forward up to seven years. It appears that this tax credit is not widely used in its current form and could be modified to better serve the needs of innovation-based companies.

Many states passed similar tax credits in the 1980s and 1990s as a means to recruit large companies to a state. In recent years, the number of large relocations has dropped significantly and the majority of job and business growth has come from smaller businesses. If the purpose of these tax credits is to spur job growth, then such credits need to reflect the current industry composition of the targeted sectors.

Recommendation for Maine: *Modify the tax credit to reduce the personal property investment to at least $1m and job requirement to at least 20 employees for those companies that pay 50% more than the average wage in the county in which the business is located or are engaged in science and technology related activities. This will target those businesses with 10-100 employees that have the greatest opportunity for growth.*

6.4.6 Enhancing Other Existing Programs

Over the past decade, Maine has put into place multiple programs which are multi-year survey data indicate are accelerating the rate of innovation in the state. It is prudent for the state to ensure that successful programs are funded at a scale to be competitive. In times of state budget constraints, this can mean reallocating funds from low performing programs to those with higher returns on investments.

Maine Patent Program – Services of this program are rate high by entrepreneurs in state and appears to be closely connected to MTI programs like the seed fund. The assistance provided to inventors (start-up entrepreneurs) has been successful, however it is unclear as to the amount of resources the program has to work with existing businesses seeking to commercialize new ideas. Being able to serve new start-ups and existing businesses can help strengthen the industry competitiveness in Maine.

Maine Technology Asset Fund: Recently, the state passed a $50 million bond to promote growth in the state‘s innovation-based industry clusters. In the first round of funding (just over $29 million), a large portion of those funds went to universities, were industry partners were engaged as part of each project. While this funding should help to strengthen the university-industry connections that are lacking in the state, there should also be continued pressure on the universities to use the dollars from the Asset Fund for commercialized research activities directly related to industry competitiveness and growth. The second round of awards should be more focused on industry-led collaborative for R&D.

6.4.7 Summary

Maine‘s industry R&D capacity is essential for economic development of well paying jobs that compete in a global environment. During the past decade and especially in recent years, the state has focused much attention on building R&D capacity at universities and nonprofits institutions and supporting Maine‘s science and technology industries. In addition, the state has enhanced its efforts to build stronger networks and working consortiums for its industry clusters (e.g. Cluster Initiative Program). Now it is time to connect these two key elements of R&D infrastructure and industry sector work to significant improve the ongoing R&D provided by the private sector.

More focus needs to be directed to private sector projects. An enhanced R&D tax credit, a SBIR matching funds, more direct industry investments from the Asset Fund, and expanded use of other incentives are all ways to accelerate the level of R&D in Maine companies. Maine should strive for stronger and more direct connections between industry and academic research as witnessed by other states. Investments made to universities and nonprofit institutions with the intent of commercializing research needs to result in higher rates of industry collaboration and economic outputs. With many pieces in place, the good news is that enhancing R&D in Maine may be an issue more of focus and expectations than large, new programs.

7. Economic Impact Analysis of Maine R& D Companies

7.1 Highlights

- The surveyed companies, which represent a small fraction of Maine‘s technology economy, pack a big punch. Together, these 262 firms generated more than $2 billion in statewide economic activity in 2008.
- Maine‘s technology sector is growing. In 2008, surveyed firms enjoyed annual revenue growth of 7% and job growth of 4%. This rate far outpaces Maine‘s overall recent rate of job growth that was roughly 0.3 percent per year over the 2000-2007 timeframe.
- The technology sectors growth is highly concentrated. A relatively small number of firms account for the bulk of revenue growth and new job creation.
- While pockets of the technology sector are enjoying strong growth, much of the industry is losing jobs and mainly treading in place.

7.2 Methodology

To measure the economic impact resulting from Maine‘s R& D companies and institutions a commercially available input-output model developed by the Economic Modeling Specialist, Inc. was used. The model was run and findings prepared for PolicyOne Research by Council for Community and Economic Research (www.c2er.org). The EMSI‘s Economic Impact Regional I/O model produces regional multipliers for each industry at the six-digit level of NAICS codes. The multiplier values allow analysts to estimate the outcomes of jobs and sales generated from additional inputs into the regional economy. Different from the IMPLAN model, the EMSI‘s multiplier values represent the combination of both indirect and induced impacts.

The analysis is based on the survey conducted by the Maine‘s Office of Innovation, partnering with PolicyOne Research Inc. A total of 413 R&D companies and institutions responded to the survey. However, since the EMSI model tracks company revenues, this analysis excludes firms that failed to share revenue. Consequently, the following analysis is based on 262 companies (a response rate of 62%).

Each survey respondent was asked to identify a six-digit NAICS code that best described their business operations. For those companies that did not indicate the NAICS code on the survey, the researchers used the business database of ReferenceUSA to verify the information in order to assign an appropriate NAICS code to each respondent.

To estimate the impact of state investment on Maine's R&D companies, the research assumes that all new revenues generated or new workers hired in 2008 were impacted exclusively by state grants. No other variables or additional funding (i.e., federal money or state tax credits) were included in the estimates. In addition, we assumed the benefits of state investment might not occur at the same year. Often times, companies may not experience job growth or revenue increase until several years after they receive financial assistance. Therefore, we analyze the impact of state's R&D investment in two scenarios: one is the impact of state investment in 2008, and the other is the impact of state investments made between 2004 and 2008.

7.3 Findings

7.3.1 Economic Impact of Maine R&D Companies

The 262 companies in our sample generated $1.23 billion in revenues and employed 5,197 workers in 2008(see **Table 7.1**). Adding $697 million of indirect impact resulting from those companies, they have produced a total impact of nearly $2 billion in Maine for 2008. Over the last year, those companies have seen their revenues increase by $82.8 million, or a 7% increase. The increase of $82.8 million resulted in a total impact of 763 jobs between 2007 and 2008, accounting for 244 direct jobs created among those companies and 519 indirect jobs from other companies to provide goods and services. Consequently, this improved performance resulted in a total additional impact of $123 million to the state economy during the past year.

Table 7.1 - Direct & Indirect Economic Impacts of Maine R&D Companies

	Revenues (2008)	Revenues Change 2007-2008	Jobs (2008)	Jobs Change 2007-2008
Direct Impact	$ 1,234,437,569	$ 82,778,126	5,197	244
Indirect Impact	$ 697,221,505	$ 40,097,227	5,982	519
Total Impact	***$ 1,931,659,073***	***$ 122,875,354***	***11,179***	***763***

Among those 262 companies, 53 (20%) experienced job growth, while 74 (28%) reported job loss. Another 135 (52%) showed no change in employment levels over the last year (see **Table 7.2**). The fifty-three firms with job growth added a total of 1,431 jobs to the state economy between 2007 and 2008, accounting for 588 direct jobs and 843 indirect jobs. However, the revenues generated from those companies with job growth were much smaller than that of the companies with job loss or no job changes. This shows that the companies with job growth had a rather smaller impact on the overall state economy than those with job loss or no job changes during the past year. This type of pattern can often be found in R&D-intensive industries where productivity improvements may lead to increased revenues but may not lead to new hiring. In effects, these firms use technology—as opposed to labor---to generate improved company performance.

Nearly two-thirds of revenues were generated by the companies reporting job loss between 2007 and 2008, resulting in $52.9 million in direct impact and $26.8 million in indirect impact, for a total impact of nearly $80 million to the state economy. This indicates that the companies experienced job loss over the last year were the ones producing higher outputs to the state economy. If this performance is a result of significant productivity enhancements, retaining and expanding jobs within those companies would be beneficial to the overall state economy.

Table 7.1: Direct & Indirect Economic Impacts for Those R& D Companies Responded with Job Changes, 2007- 2008

	Job Loss	Job Growth	No Change	Total
No. of Companies Responded	74 (28%)	53 (20%)	135 (52%)	262
Revenues Change, 2007-2008 (in thousands)				
Direct Impact	52,941	3,873	25,964	82,778
Indirect Impact	26,829	(1,232)	14,501	40,097
Total Impact	***79,770***	***2,641***	***40,465***	***122,875***
Jobs Change, 2007-2008				
Direct Impact	-344	588	0	244
Indirect Impact	-324	843	0	519
Total Impact	***-668***	***1431***	***0***	***763***

Table 7.2: Direct & Indirect Economic Impacts of Top 10 Industry Sectors involved in R&D, 2008

	Revenues, 2008 (in thousands)			Jobs, 2008		
NAICS-Industry	Direct Impact	Indirect Impact	Total Impact	Direct Impact	Indirect Impact	Total Impact
322 - Paper Manufacturing	392,800	239,608	632,408	742	1,773	2,515
36 - Transportation Equipment Manufacturing	87,507	41,128	128,635	251	116	367
313 - Textile Mills	86,765	47,720	134,485	569	342	911
325 - Chemical Manufacturing	85,235	48,796	134,031	380	1,000	1,380
339 - Miscellaneous Manufacturing	72,576	40,793	113,369	393	200	593
541 - Professional, Scientific, and Technical Services	65,532	40,846	106,377	586	497	1,083
333 - Machinery Manufacturing	55,534	26,178	81,712	146	112	258
314 - Textile Product Mills	32,632	15,344	47,976	195	155	350
237 - Heavy and Civil Engineering Construction	25,450	17,051	42,501	65	57	122
311 - Food Manufacturing	22,915	15,904	38,819	292	359	651
Subtotal	926,945	533,368	1,460,313	3,619	4,611	8,230
Total of Companies Surveyed	1,234,438	697,222	1,931,659	5,197	5,982	13,945

Maine's R&D companies are concentrated in a few leading sectors. The top 10 industries contributed to nearly two-thirds of total revenues generated by Maine's R&D companies in 2008 (see **Table 7.3**). In particular, approximately 46 percent of total revenues were concentrated on three manufacturing industries - Paper Manufacturing, Transportation Equipment Manufacturing, and Textile Mills. Together, these sectors accounted for $567.1 million in direct impact and $328.5 million, for a total impact of $895.5 million to the Maine economy. These three industry sectors, representing only six companies, captured nearly one third of jobs in those Maine companies involved in R&D related activities.

Table 7.3: Direct & Indirect Impacts of Top 10 Industry Sectors with Largest Revenues Growth, 2007-2008

	Revenues Change, 2007 - 2008 (in thousands)			Jobs Change, 2007-2008		
NAICS - Industry	Direct Impact	Indirect Impact	Total Impact	Direct Impact	Indirect Impact	Total Impact
311- Food Manufacturing	23,274	13,102	36,376	(20)	(25)	(45)
335 -Electrical Equipment, Appliance, and Component Manufacturing	18,007	8,463	26,470	(5)	(7)	(12)
333 - Machinery Manufacturing	16,675	9,486	26,161	7	5	12
334 - Computer and Electronic Product Manufacturing	9,167	6,126	15,293	(6)	(7)	(13)
541- Professional, Scientific, and Technical Services	6,803	2,472	9,274	50	43	93
326 - Plastics and Rubber Products Manufacturing	6,135	3,843	9,979	3	1	4
237 - Heavy and Civil Engineering Construction	5,105	2,745	7,850	(5)	(4)	(9)
325 - Chemical Manufacturing	4,848	2,372	7,220	17	77	94
336 - Transportation Equipment Manufacturing	3,690	1,570	5,260	(26)	(12)	(38)
339 - Miscellaneous Manufacturing	3,562	2,200	5,762	(26)	(13)	(39)
Subtotal	97,266	52,378	149,644	(97)	(10)	(107)
Total of Companies Surveyed	82,778	40,097	122,875	244	519	763

The food manufacturing industry reported the largest revenue growth during the past year (see **Table 7.4**). This industry generated $23 million in direct impact and $13 million in indirect impact, for a total impact of $36 million to the state economy. The revenues increased by the top three industries – Food Manufacturing, Electrical Equipment, Appliance, and Component Manufacturing, and Machinery Manufacturing – accounted for 70 percent of total revenue growth between 2007 and 2008. However, a majority of those industries with revenue growth also reported job loss. Together, the top ten industries generated a loss of 97 direct positions and 10 indirect jobs, for a total impact of 107 job loss in Maine.

7.3.2 *Impact of Maine State Investment in R&D*

Table 7.2 shows the amount of state investment in R&D to private companies. Over the past five years, based on the companies used in the impact analysis Maine invested a total of $15,325,321 in 521 grants. The 2007 R&D investment made by the state was largest over the last five years, reaching a total of $3.4 million. Total 2008 R&D investment showed a 17 percent decline, accounting for total of $2.8 million.

Table 7.5: State investment in R&D to private companies

	2004	2005	2006	2007	2008
Total number of grants	71	93	111	131	115
No. of Companies received	62	79	92	104	98
State R & D Investment	$ 2,726,518	$3,268,420	$3,092,798	$ 3,407,353	$2,830,232

Because some state grantees have not provided full revenue or employment data in response to this survey, the research only tracks firms who provided complete data sets. As a result, of the 262 companies tracked in our overall survey, only 87 are included in 2008 while 172 companies are tracked over the 2004-2008 period.

As indicated in **Table 7.6** between 2004 and 2008, Maine invested $9.7 million in 172 companies. The investment resulted in $50 million of direct impact, $24 million of indirect impact, for a total impact of $74.3 million on the state economy. The ratio of state‘s return on investment was approximately 1:8 between 2004 and 2008. Thus, for every dollar of Maine state investment, eight dollars of benefits were generated for the Maine economy. As for job changes, the state investment resulted in 79 direct positions, 233 indirect jobs, for a total of 312 jobs among those 172 companies surveyed.

In 2008, the state made an investment of $2.2 million to 87 companies. The investment resulted in nearly $20 million of direct impact on their revenue growth, $8 million of indirect impact, for a total of $28 million on the Maine economy. The ratio of state‘s return on investment in 2008 was approximately 1:12, higher than that of the impact estimated for a longer time frame. The higher ratio in 2008 indicates that the greater benefit to the state economy is most likely to appear in the first year of state investment. The 2008 state investment resulted in 43 direct positions, 34 indirect jobs, for a total of 77 jobs added to the state economy.

Table 7.6: Impact of State Investment in R&D

			Revenues			Jobs		
Year	No. of Companies received grants	State Investments	Direct Impact	Indirect Impact	Total Impact	Direct Impact	Indirect Impact	Total Impact
2008	87	$2,262,903	$19,995,671	$8,076,716	$28,072,387	43	34	77
2004-2008	172	$9,711,028	$50,213,000	$24,149,921	$74,362,921	79	233	312

Attachment A

Data from Private Sector Survey

Findings from Private Sector Survey, 2008[42]

1. Survey Response

The total number of companies/entities surveyed in 2008–2009 is 855 (in comparison with 800 in the 2007 – 2008 survey). 413 companies/entities have responded for a response rate of 48.3%. This compares to 435 companies and a response rate of 54.4% for 2007 - 2008. The response rate for individual questions varies and is noted throughout the narrative.

2. Maine R&D Program Affiliation

855 total entities surveyed in 2008 – 2009, represented 1,163 State R&D programs, and the 413 total respondents to the survey represented 672 programs. Entities can receive assistance from multiple programs. On a program basis response, 2008 – 2009 survey rates range from a low of 34.9% for the Maine Patent Program (MPP) to a high of 100% for the Experimental Program for the Stimulation of Competitive Research (EPSCOR). The response rate for Maine Technology Institute (MTI) clients is 86.7%.

[42] Data reported herein are only for the questions that were asked of all respondents. Data for questions that were asked of only MTI clients are reported in the MTI evaluation report. For this reason, question numbers in this section do not correspond directly to question numbers in the survey itself.

State R&D Programs	All Respondents 2007-2008 Number	Percent	All Surveyed 2007-2008 Number	Percent	2007 - 2008 Program Response Rate
ATDC	65	9.3%	104	9.6%	62.5%
MAIC	22	3.1%	33	3.1%	66.7%
EPSCOR	1	0.1%	1	0.1%	100.0%
MPP	190	27.1%	485	44.9%	39.2%
MSCTCP	42	6.0%	56	5.2%	75.0%
MSGC	1	0.1%	1	0.1%	100.0%
SEGF	9	1.3%	12	1.1%	75.0%
MTI	370	52.9%	388	35.9%	95.4%
Total	700	100.0%	1080	100.0%	64.8%

State R&D Programs	All Respondents 2008-2009 Number	Percent	All Surveyed 2008-2009 Number	Percent	2008 - 2009 Program Response Rate
ATDC	58	8.6%	111	9.5%	52.3%
MAIC	14	2.1%	23	2.0%	60.9%
EPSCOR	2	0.3%	2	0.2%	100.0%
MPP	181	26.9%	519	44.6%	34.9%
MSCTCP	45	6.7%	75	6.4%	60.0%
SEGF	12	1.8%	18	1.5%	66.7%
MTI	360	53.6%	415	35.7%	86.7%
Total	672	100.0%	1163	100.0%	57.8%

Note: State R&D programs include:

ATDC: Advanced Technology Development Centers
MAIC: Maine Aquaculture Innovation Center
EPSCOR: Experimental Program for the Stimulation of Competitive Research
MPP: Maine Patent Program
MSGC: Maine Space Grant Consortium
MSCTCP: Maine Seed Capital Tax Credit Program
SEGF: Small Enterprise Growth Fund
MTI: Maine Technology Institute. The program includes Development Awards, Performance Grants, Small Business Innovation Research Phase 0 Grants, and the Seed Grant Program.

In a comparison between the 2007 – 2008 and 2008 – 2009 surveys, program response rates ranged from 4.3% (for the MPP) to 15% (for the MSCTCP) higher in the 2007 – 2008 survey, with the exception of the EPSCOR program, which had 100% response rate in both. The response rate for MTI clients decreased from 95.4 % to 86.7%, or 8.7%.

3. Company Headquarters

Of the 346 companies who responded to this question in the current survey, 334, or 96.5%, are headquartered in Maine.

Eleven companies are headquartered in the U.S., but outside of Maine. The other states represented are Alabama, Connecticut, Florida, Georgia, Massachusetts, Michigan, Ohio, Oregon, and Virginia. One company reported being headquartered outside of the U.S. and is located in England.

In the previous survey, 363 companies responded to this question, and 336, or 93%, were headquartered in Maine.

4. Geographic Breakdown

County Breakdown	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent	Number	Percent
No County Listed	77	17.7%	67	16.2%
Androscoggin	13	3.0%	13	3.1%
Aroostook	9	2.1%	11	2.7%
Cumberland	131	30.1%	120	30.0%
Franklin	5	1.1%	7	1.7%
Hancock	18	4.1%	16	3.9%
Kennebec	19	4.4%	20	4.8%
Knox	12	2.8%	11	2.7%
Lincoln	17	3.9%	14	3.4%
Oxford	8	1.8%	8	1.9%
Penobscot	34	7.8%	47	11.4%
Piscataquis	2	0.5%	1	0.2%
Sagadahoc	9	2.1%	9	2.2%
Somerset	7	1.6%	4	1.0%
Waldo	7	1.6%	6	1.5%
Washington	8	1.8%	11	2.7%
York	34	7.8%	37	9.0%
Other State	25	5.7%	11	2.2%
Total	435	100.0%	413	100.0%

Regional Breakdown	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent	Number	Percent
No County Listed	77	17.7%	67	16.2%
Central	77	17.7%	73	17.7%
Eastern	26	6.0%	27	6.5%
North	9	2.1%	11	2.7%
South	165	37.9%	157	38.0%
Western	56	12.9%	67	16.2%
Other State	25	5.7%	11	2.7%
Total	435	100.0%	413	100.0%

Central region: Androscoggin, Kennebec, Knox, Lincoln, Sagadahoc, and Waldo
Eastern region: Hancock and Washington
North region: Aroostook
South region: Cumberland and York
Western region: Franklin, Penobscot, Piscataquis, and Somerset

Comparing the 2007 – 2008 and 2008 – 2009 surveys, there are few changes of note. Penobscot County saw an increase of 3.6% in representation, from 7.8% to 11.4%, and representation from companies headquartered in other states decreased by approximately the same percentage. The increase in Penobscot County carried through to the regional level, increasing the Western regional representation by 3.3%.

5. Industry Breakdown

Industry Sector	All Respondents 2007 - 2008		All Surveyed 2007 - 2008	
	Number	Percent	Number	Percent
Advanced Materials & Composites	46	12.0%	49	10.5%
Advanced Technologies for Forestry & Agriculture	42	11.0%	53	11.4%
Biotechnology	42	11.0%	46	9.9%
Environmental Technology	41	10.7%	47	10.1%
Information Technology	70	18.3%	95	20.4%
Marine Technology & Aquaculture	56	14.6%	67	14.4%
Precision Manufacturing	79	20.6%	88	18.9%
Other	7	1.8%	20	4.3%
Total	383	100.0%	465	100.0%

Industry Sector	All Respondents 2008 - 2009		All Surveyed 2008 - 2009	
	Number	Percent	Number	Percent
Advanced Materials & Composites	43	12.0%	51	11.0%
Advanced Technologies for Forestry & Agriculture	42	11.8%	54	11.7%
Biotechnology	39	10.9%	46	10.0%
Environmental Technology	41	11.5%	51	11.0%
Information Technology	66	18.5%	95	20.6%
Marine Technology & Aquaculture	41	11.5%	57	12.3%
Precision Manufacturing	79	22.1%	92	19.9%
Other	6	1.7%	16	3.5%
Total	357	100.0%	462	100.0%

The 855 total entities surveyed in 2008 – 2009 represented 462 sector instances; the 413 total respondents to the survey represented 357 sector instances. Entities can be classified within more than one industry sector. Sectors were assigned by the research team based on information provided by the entities, website research, project categories, etc.

In a comparison between 2007 – 2008 and 2008 – 2009, there are few noteworthy changes, the largest being a 3.1 % decrease (from 14.6% to 11.5%) in respondents in the Marine Technology and Aquaculture sector between the previous and current surveys.

6. Year Organized

Years	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent	Number	Percent
Pre- 1980	26	7.2%	28	8.2%
1980 - 1984	23	6.4%	18	5.2%
1985 - 1989	24	6.7%	18	5.2%
1990 - 1994	32	8.9%	26	7.6%
1995 - 1999	56	15.6%	43	12.5%
2000 - 2004	128	35.6%	120	35.0%
2005 - 2008*	71	19.7%	90	26.2%
Total	360	100.0%	343	100.0%

* 2007 - 2008 survey category label is 2005 - 2007. 2008 - 2009 survey category label is 2005 - 2008.

In a comparison between the previous and current surveys, there is an increase of 6.5% (from 19.7% to 26.2%) between 2007 – 2008 and 2008 – 2009 in the percentage of category of youngest (or newest) companies represented.

7. Number of Employees (including employer)

Number of Employees	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent	Number	Percent
1 - 10	280	81.4%	278	80.8%
11 - 20	20	5.8%	23	6.7%
21 - 30	10	2.9%	11	3.2%
31 - 40	7	2.0%	5	1.5%
41 - 50	5	1.5%	7	2.0%
51 - 100	9	2.6%	8	2.3%
101 - 499	10	2.9%	9	2.6%
500+	3	0.9%	3	0.9%
Total	344	100.0%	344	100.0%

Total Number of Employees this year: 9,271
Total Number of employees last year: 9,588

Change in employment: 3.3% decrease / 317 fewer employees

The above table shows no noteworthy survey year-to-year differences.

8. Wages

Total wages and salaries paid this year: $389,950,070
Average wage and salary per employee this year: $42,061
Average wage and salary per employee last year: $37,140 (data based on 2007-2008 survey)

Change in average wage and salary per employee: 13.2% / $4,921

9. Revenues

	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
Company Revenues	Companies	Percent	Companies	Percent
$0	80	22.8%	75	22.5%
$1 - 49,999	81	23.1%	77	23.1%
$50,000 - 99,999	25	7.1%	34	10.2%
$100,000 - 499,999	64	18.2%	53	15.9%
$500,000 - 999,999	24	6.8%	25	7.5%
$1 million - 4,999,999	43	12.3%	40	12.0%
$5 million +	34	9.7%	30	9.0%
Total	351	100.0%	334	100.0%

Company revenues earned this year: $1,574,827,981
Company revenues earned last year: $1,151,933,808

Change in company revenue: 36.7% / $422,894,173

Revenue per employee this year: $169,866
Revenue per employee last year: $120,143

Change in revenue per employee: 41.4% / $49,723

Changes of possible note between the previous and current surveys includes an increase in the percentage of company revenues falling between $50,000 and $99,999 (from 7.1% to 10.2%, or an increase of 3.1%), and a decrease in the percentage of company revenues falling between $100,000 to $499,999 (from 18.2% to 15.9%, or 2.3%).

10. Sources of Revenue

Revenues	All Respondents 2007 - 2008 Dollars	Percent of Total
Sales of Products and Services	$ 1,614,644,419	94.3%
Grants and Contract	$ 76,859,475	4.5%
All Other Sources	$ 20,611,734	1.2%
Total	$ 1,712,115,628	100.0%

Revenues	All Respondents 2008 - 2009 Dollars	Percent of Total
Sales of Products and Services	$ 1,035,478,478	95.2%
Grants and Contract	$ 26,261,379	2.4%
All Other Sources	$ 25,461,171	2.3%
Total	$ 1,087,201,028	100.0%

Note: The totals in the previous revenue section do not match the totals here because respondents utilized different sources of data for the two sets of questions.

Comparing the previous and current surveys, the total revenues from the three categories of sources decreased 36.5%.

11. R&D Expenditures

The respondents spent $46,028,254 in R & D in the reporting period.
The respondents spent $49,512,716 in R & D in the previous year (data taken from 2007-2008 survey).

12. Corporate Income Tax Paid

The respondents spent $684,695 in Maine corporate income tax in the reporting period.
The respondents spent $639,176 in Maine corporate income tax in the previous year (data taken from 2007-2008 survey).

13. Tax Credits Claimed

Maine R&D Tax Credits Claimed?	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent of Total	Number	Percent of Total
No	326	94.2%	317	95.8%
Yes	20	5.8%	14	4.2%
Total	346	100.0%	331	100.0%

There are no noteworthy changes in tax credits claimed between the 2007 – 2008 and 2008 – 2009 surveys.

14. Where are Your Customers?

Percent of Sales in Maine	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent of Total	Number	Percent of Total
0 - 10	219	63.7%	195	59.3%
11 - 25	24	7.0%	26	7.9%
26 - 50	24	7.0%	20	6.1%
51 - 75	13	3.8%	16	4.9%
76 - 100	64	18.6%	72	21.9%
Total	344	100.0%	329	100.0%

Percent of Sales Outside of Maine, In U.S.	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent of Total	Number	Percent of Total
0 - 10	167	48.5%	166	50.5%
11 - 25	16	4.7%	13	4.0%
26 - 50	27	7.8%	25	7.6%
51 - 75	36	10.5%	33	10.0%
76 -100	98	28.5%	92	28.0%
Total	344	100.0%	329	100.0%

Percent of Sales Outside of U.S	All Respondents 2007 - 2008		All Respondents 2008 - 2009	
	Number	Percent of Total	Number	Percent of Total
1 -10	298	86.6%	285	86.9%
11 - 25	18	5.2%	19	5.8%
26 - 50	20	5.8%	13	4.0%
51 - 75	2	0.6%	5	1.5%
76 - 100	6	1.7%	6	1.8%
Total	344	100.0%	328	100.0%

A comparison of the above three tables between the previous and current surveys shows a noteworthy increase in the percentage of sales occurring in Maine between 2007 – 2008 and 2008 – 2009, but no changes of note in the percentages of sales outside of Maine, but in the U.S. There is a slight increase of 0.9% in the percentage of companies which have 51-75% of their sales outside the U.S, and a decrease of 1.8% in the companies that have 26-50% of their sales outside the U.S.

15. Debt Financing

60 companies or 14.5% (60 out of the 413 respondents who answered that question) accessed new debt financing during their most recently completed fiscal year.

In the previous survey year, 58 companies or 16.8% (58 out of 345 respondents who answered that question) accessed new debt financing.

Sources	All Respondents 2007 - 2008 Number of Transactions	Dollars of New Debt	Percent of Total New Debt
Bank	25	$ 14,985,129	57.1%
SBA Loans	1	$ 150,000	0.6%
Friends and Family	12	$ 1,564,001	6.0%
Other	24	$ 9,558,350	36.4%
Total	62	$ 26,257,480	100.0%

Sources	All Respondents 2008 - 2009 Number of Transactions	Dollars of New Debt	Percent of Total New Debt
Bank	30	$ 68,754,934	88.2%
SBA Loans	5	$ 790,000	1.0%
Friends and Family	13	$ 2,886,794	3.7%
Other	20	$ 5,485,685	7.0%
Total	68	$ 77,917,413	100.0%

Note: The total number of transactions is more than the 60 because there were multiple transactions at some companies.

In a comparison between the 2007 – 2008 and 2008 – 2009 surveys, bank financing has increased from 57.1% to 88.2%, a difference (increase) of 31.1% between the previous and current surveys. Financing from other sources has decreased from 36.4% to 7.0%, a drop of 29.4%.

16. Equity Financing

32 companies or 7.7% (32 out of the 413 respondents who answered that questions) accessed new equity financing during their most recently completed fiscal year.

	All Respondents 2007 - 2008		
Sources	Number of Transactions	Dollars of New Equity	Percent of Total New Equity
Venture Capital	8	$ 28,032,145	68.6%
State Seed Capital Funds	5	$ 806,410	2.0%
Angel Investors	13	$ 7,114,515	17.4%
Friends and Family	15	$ 2,413,658	5.9%
Other	10	$ 2,505,562	6.1%
Total	51	$ 40,872,290	100.0%

	All Respondents 2008 - 2009		
Sources	Number of Transactions	Dollars of New Equity	Percent of Total New Equity
Venture Capital	7	$ 21,700,000	68.3%
State Seed Capital Funds	4	$ 752,000	2.4%
Angel Investors	10	$ 6,012,570	18.9%
Friends and Family	11	$ 1,187,603	3.7%
Other	8	$ 2,097,370	6.6%
Total	40	$ 31,749,543	100.0%

Note: The total number of transactions is more than the 32 because there were multiple transactions at some companies.

There are no noteworthy changes between the two survey years.

17. Federal Awards

18 or 4.4% (18 out of 413 respondents who answered that question) of respondents received some type of Federal grant for R & D in the most recently completed fiscal year. The total of the awards was $22,626,391.

17 or 4.1% (17 out of 413 respondents who answered that question) of respondents received either an SBIR Phase I or Phase II award or a Small Business Technology Transfer (STTR) award during their most recently completed fiscal year.

Federal Award	All Respondents 2007 - 2008 Number of Awards	Total $ of Awards
SBIR Phase I or Phase II	13	$ 3,883,521
STTR	1	$ 149,906
Total	14	$ 4,033,427

Federal Award	All Respondents 2008 - 2009 Number of Awards	Total $ of Awards
SBIR Phase I or Phase II	15	$ 18,544,368
STTR	2	$ 300,000
Total	17	$ 18,844,368

Comparing the 2007 – 2008 and 2008 – 2009 surveys shows an increase of 367% in total of awards from the previous to the current survey year.

18. <u>Intellectual Property</u>

Did you or do you intend to use any form of intellectual property protection (Patents, Trade Secrets, Licensing, Copyrights, Trademarks, or other) for any of your discoveries?

Intellectual Property Protection	All Respondents 2008 - 2009 Number	Percent
Yes	200	52.9%
No	178	47.1%
Total	378	100.0%

Copyrights:
Did you or do you plan to use copyright protection?

Copyright Registration	All Respondents 2007 - 2008 Number of Companies	Percent	All Respondents 2008 - 2009 Number of Companies	Percent
Have Registered	41	10.4%	11	2.7%
Intend to Register	37	9.3%	53**	13.1%
Filed	n/a*	-	6	1.5%
Not Sure	131	33.1%	79	19.5%
No	187	47.2%	257	63.3%
Total	396	100.0%	406	100.0%

Note: For Question A34 of the 2008 - 2009 survey there were 406 valid respondents.

* The 2007 - 2008 survey did not include this category in Question A42.

** The 2007 - 2008 survey uses the category 'Intend to Register'. The 2008 - 2009 survey is not specific about whether the intent is to file or register.

The above table shows that 17.2% of respondents are in some aspect of actively pursuing copyright protection.

Comparing the previous and current survey years, the data show a decrease on a percentage basis in the companies that have registered, from 10.4% to 2.7%, or 7.7%, and an increase of 16.1% (from 47.2% to 63.3%) in the percentage of respondents who do not intend to file or register.

Licenses:

Did you or do you plan to enter into a licensing agreement?

Licensing Agreements	All Respondents 2007 - 2008 Number of Companies	Percent	All Respondents 2008 - 2009 Number of Companies	Percent
Yes	84	21.4%	72	37.1%
No	149	37.9%	43	22.2%
Not Sure	160	40.7%	79	40.7%
Total	393	100.0%	194	100.0%

License Locations	All Respondents 2007 - 2008 Number of Companies	Percent	All Respondents 2008 - 2009 Number of Companies	Percent
Maine	10	11.9%	44	22.7%
Some in Maine	13	15.5%	n/a*	-
Not in Maine	41	48.8%	59	30.4%
Not Sure	20	23.8%	91	46.9%
Total	84	100.0%	194	100.0%

* This category was not included in the 2008 - 2009 survey, Question A33.

In the two tables above, a comparison of the survey years shows an increase of 21.4% to 37.1%, or 15.7%, from 2007 – 2008 to 2008 – 2009 in the percentage of companies who either did or plan to enter into a licensing agreement. The data also show an increase of 10.8% (from 11.9% to 22.7%) in the percentage of companies for whom Maine is or will be the licensing agreement location. There is also a decrease of 18.4% and an increase of 23.1% in the companies who did or plan to enter into a licensing agreement in locations other than Maine, or are not sure, respectively.

Patents:

Did you or do you plan to file for patent protection for any of your discoveries?

U.S patent protection:

	2007 - 2008		2008 - 2009	
U.S. Patent Protection	**Number of Companies**	**Percent (out of 435)**	**Number of Companies**	**Percent (out of 413)**
Have Filed	72	16.6%	68	16.5%
Intend To File	33	7.6%	59	14.3%
Granted	32	7.4%	57	13.8%
Rejected	n/a*	-	5	1.2%
Total	137	31.5%	189	45.8%

* This category was not included in the 2007 - 2008 survey, Question A37.

A comparison of survey years in the table above shows slightly under a 100% increase from 2008 – 2008 to 2008 – 2009 in both the percentage of companies intending to file and those that have been granted U.S. patent protection.

U.S. Patent Protection	**Number of Patents 2007 - 2008**	**Number of Patents 2008 - 2009**
Have Filed	252	101
Intend To File	100	97
Granted	101	101
Rejected	n/a*	6

* This category was not included in the 2007 - 2008 survey Question A38.

Foreign patent protection:

Foreign Patent Protection	2007 - 2008 Number of Companies	2007 - 2008 Percent (out of 435)	2008 - 2009 Number of Companies	2008 - 2009 Percent (out of 413)
Have Filed	42	9.7%	34	8.2%
Intend To File	30	6.9%	35	8.5%
Granted	0	0.0%	15	3.6%
No/Not Sure	72	16.6%	n/a*	-
Rejected	n/a*	-	0	0.0%
Total	144	33.1%	189	45.8%

* This category not included in year specific survey.

The percentage of companies who have been granted foreign patent protection has increased from 0% to 3.6% from the previous to the current survey.

Foreign Patent Protection	Number of Patents 2007 -2008	Number of Patents 2008 -2009
Have Filed	122	104
Intend To File	157	133
Granted	50	36
Rejected	n/a*	0

* This category not included in 2007 -2008 survey, Question A40.

Trademarks:

Did you or do you plan to use trademark protection?

Trademark Registration	All Respondents 2007 - 2008 Number of Companies	All Respondents 2007 - 2008 Percent	All Respondents 2008 - 2009 Number of Companies	All Respondents 2008 - 2009 Percent
Have Registered	51	12.9%	37	9.1%
Intend to File	51	12.9%	58*	14.3%
Filed	19	4.8%	28	6.9%
Not Sure	127	32.2%	65	16.0%
No	147	37.2%	218	53.7%
Total	395	100.0%	406	100.0%

* The 2007 - 2008 survey uses the category 'Intend to File'. The 2008 - 2009 survey is not specific about whether the intent is to file or register.

The above table shows that 30.3% of respondents are in some aspect of actively pursuing trademark protection (compared to 30.6% in the 2007 – 2008 survey). Additionally, comparing the previous and current survey years, the data in the table above show a 50% decrease (from 32.2% to 16.0%) in the percentage of companies who are unsure about whether or not they will actively pursue trademark registration.

Trade Secrets:

Did you or do you plan to use trade secrets?

Trade Secret Usage	All Respondents 2007 - 2008 Number of Companies	Percent	All Respondents 2008 - 2009 Number of Companies	Percent
Yes	121	30.6%	77	39.9%
No	155	39.2%	43	22.3%
Not Sure	119	30.1%	73	37.8%
Total	395	100.0%	193	100.0%

There is a decrease of 16.9% (from 39.2% to 22.3%) in the percentage of companies who did not or do not plan to use trade secrets between the 2007 – 2008 and 2008 – 2008 survey years. There is a corresponding increase, from 30.6% to 39.9%, or 9.3%, in the percentage of companies who did or plan to use trade secrets.

Other Intellectual Property:

Did you or do you plan to use other intellectual property protection?

Utilization of Other Intellectual Property	All Respondents 2007 - 2008 Number of Companies	Percent	All Respondents 2008 - 2009 Number of Companies	Percent
Have Registered	n/a*	-	0	0.0%
Intend to File	9	2.3%	15**	3.7%
Filed	7	1.8%	4	1.0%
Not Sure	134	33.9%	115	28.3%
No	245	62.0%	272	67.0%
Total	395	100.0%	406	100.0%

* The 2007 - 2008 survey did not include this category in Question A46.
** The 2007 - 2008 survey uses the category 'Intend to File'. The 2008 - 2009 survey is not specific about whether the intent is to file or register.

The table shows that 4.7% of respondents in the current survey are in some aspect of actively pursuing other intellectual property protection. This compares to 4.1% in the 2007 – 2008 survey.

19. <u>Support Organizations</u>

The tables below show the support organizations that were used and a ranking of how important the services were to the participating companies (1 = ‗completely unimportant', to 5 = ‗critically important').

Approximately 73% of the 368 respondents who answered this question in the 2008 – 2009 survey received some level of support from MTI during the survey period. This percentage remained unchanged from the 2007 – 2008 survey (in which there were 392 respondents who answered this question). More than 53% of those recipients in the current survey year found the assistance to be ‗critically important‘, compared to 49.8% in the 2007 – 2008 survey year. Additionally, MTI received the highest mean score at 4.13 in the current year. MTI also received the highest mean score in the previous survey year at 3.91.

	All Respondents 2007 - 2008						
		Degree of Importance					
Support Organization	**Didn't Use**	**1**	**2**	**3**	**4**	**5**	**Mean Score (Sorted from High to Low)**
MTI	105	22	32	38	52	143	3.91
UMaine System	176	21	26	43	48	78	3.63
Maine Patent Program	190	24	34	37	37	71	3.48
Other firms outside Maine	169	22	44	44	58	55	3.36
Educational/Research outside Maine	237	16	37	36	32	34	3.20
Other Maine firms	186	24	44	57	47	34	3.11
MSBDC	219	33	27	44	29	40	3.09
ATDC	287	21	16	31	16	21	3.00
Trade Associations outside Maine	233	24	29	51	35	20	2.99
Nonprofit Research Institutes in Maine	268	22	25	36	25	16	2.90
MEP	256	27	27	41	22	19	2.85
Maine Trade Associations	214	37	34	52	40	15	2.79
Other Educational Insititutions in Maine	269	30	21	33	24	15	2.78
Maine Procurement Technical Assistance Center	298	26	18	23	11	16	2.71

Support Organization	All Respondents 2008 - 2009						
		Degree of Importance					
	Didn't Use	1	2	3	4	5	Mean Score (Sorted from High to Low)
MTI	99	11	19	39	55	145	4.13
Maine Patent Program	189	26	27	19	33	74	3.57
UMaine System	147	21	33	53	38	76	3.52
Other firms outside Maine	174	12	42	45	58	37	3.34
Other Maine firms	177	21	32	54	43	41	3.27
Trade Associations outside Maine	226	20	24	42	40	16	3.06
Educational/Research outside Maine	226	25	27	36	24	30	3.05
MSBDC	211	37	28	32	23	37	2.97
MEP	243	26	28	30	18	23	2.87
ATDC	272	21	19	26	12	18	2.86
Other Educational Insititutions in Maine	258	14	35	32	13	16	2.84
Nonprofit Research Institutes in Maine	260	17	33	27	15	16	2.81
Maine Trade Associations	207	26	47	45	25	18	2.76
Maine Procurement Technical Assistance Center	275	24	29	16	10	14	2.58

Note:
MTI: Maine Technology Institute
ATDC: Advanced Technology Development Centers
MSBDC: Maine Small Business Development Centers
MEP: Manufacturing Extension Partnership

Penetration rates for the current survey year range from a high of 73.1% for MTI to a low of 25.3% for the Maine Procurement Technical Assistance Center. These results are similar for the 2007 – 2008 survey. In the current survey, use of support from Maine Trade Associations was 43.8%, compared with 38.6%, the penetration rate of Trade Associations outside Maine. The results are similar in the previous survey. Penetration rates are a function of several variables, including the use of support among the companies who responded to this question. Although our function has included only the number of companies who did not use support, it can still provide some information about use of program support in a comparative basis. The higher the penetration rate, the greater the number of companies who used the specific program support tool.

Support Organization	2007 - 2008 Penetration Rates	2008 - 2009 Penetration Rates
MTI	73.2%	73.1%
ATDC	26.8%	26.1%
Other firms outside Maine	56.9%	52.7%
Maine Patent Program	51.5%	48.6%
Other Maine firms	52.6%	51.9%
UMaine System	55.1%	60.1%
Educational/Research outside Maine	39.5%	38.6%
Trade Associations outside Maine	40.6%	38.6%
MSBDC	44.1%	42.7%
Maine Procurement Technical Assistance Center	24.0%	25.3%
Nonprofit Research Institutes in Maine	31.6%	29.3%
MEP	34.7%	34.0%
Maine Trade Associations	45.4%	43.8%
Other Educational Insititutions in Maine	31.4%	29.9%

Support Organization	Mean Scores 2006 - 2008		
	2006	2007	2008
MTI	4.09	3.91	4.13
ATDC	3.14	3.00	2.86
Other firms outside Maine	3.44	3.36	3.34
Maine Patent Program	3.50	3.48	3.57
Other Maine firms	3.01	3.11	3.27
UMaine System	3.47	3.63	3.52
Educational/Research outside Maine	3.18	3.20	3.05
Trade Associations outside Maine	3.01	2.99	3.06
MSBDC	3.14	3.09	2.97
Maine Procurement Technical Assistance Center	2.86	2.71	2.58
Nonprofit Research Institutes in Maine	2.79	2.90	2.81
MEP	3.10	2.85	2.87
Maine Trade Associations	2.75	2.79	2.76
Other Educational Insititutions in Maine	2.90	2.78	2.84

Note for above tables:
MTI: Maine Technology Institute
ATDC: Advanced Technology Development Centers
MSBDC: Maine Small Business Development Centers
MEP: Manufacturing Extension Partnership

A visual comparison of the means in the table above shows a general steadiness in the importance of support, with some change from year-to-year. There are no consistent increases or decreases in the importance of support as a whole. Within programs, four programs have seen a year-to-year decrease in the importance of support, but these changes are not substantial from a business perspective about the ‗importance' of support, and have not been tested for statistical significance. These programs include ATDC, ―Other firms outside Maine," MSBDC, and the Maine Procurement Technical Assistance Center.

20. Importance of Assistance

How Important?	All Respondents 2007 - 2008 Number of Companies	Percent	All Respondents 2008 - 2009 Number of Companies	Percent
Critically important (5)	96	24.4%	95	25.9%
Very important (4)	90	22.9%	59	16.1%
Frequently important (3)	34	8.7%	18	4.9%
Occasionally important (2)	65	16.5%	35	9.5%
Not important (1)	108	27.5%	17	4.6%
n/a *	-	-	143	39.0%
Total	393	100.0%	367	100.0%

* Category not included in 2007 - 2008 survey, Question A53.

The mean score for importance of assistance received was 3.8 in the current survey year, compared to 3.0 in the previous survey. Additionally, 42.0% of respondents in the current survey (2008 – 2009) indicated that the assistance they received was either very important or critically important. In the previous survey (2007 – 2008), the comparable percentage was 47.3%.

21. Satisfaction with Assistance

How Satisfied?	All Respondents 2007 - 2008 Number of Companies	Percent	All Respondents 2008 - 2009 Number of Companies	Percent
Very Satisfied (5)	149	37.9%	113	30.7%
Satisfied (4)	138	35.1%	70	19.0%
Somewhat satisfied (3)	68	17.3%	20	5.4%
Unsatisfied (2)	16	4.1%	7	1.9%
Very unsatisfied (1)	22	5.6%	5	1.4%
n/a *	-	-	153	41.6%
Total	393	100.0%	368	100.0%

* Category not included in 2007 -2008 survey, Question A54.

The mean score for satisfaction with assistance received was 4.3 in the current survey year, compared to 4.0 in the previous survey. Additionally, 49.7% of respondents in the current survey indicated that the assistance they received was either very important or critically important. In the previous survey (2007 – 2008), the comparable percentage was 73.0%.

Attachment B

R&D Institutions Survey Data 2002–2008

2008 Combined University and Nonprofit Results

Research Institutions Capacity Survey	**2008**	
2008	Total for all Institutions	Attributable to State R&D Funding
Institutional Capacity		
a. Number (FTE) of enrolled science and engineering graduate students	761	70
b. Number of science and engineering graduate degrees awarded	204	9
c. Number of degree programs (deleted 2006)	0	0
d. Number (FTE) undergraduate students enrolled in science and engineering majors	5,107	512
e. Number (FTE) of undergraduate students participating in science and engineering programs	966	121
f. Number (FTE) of graduate students participating in science and engineering programs(Deleted in 2006)	0	0
g. R&D space	1,339,753	121,251
h. Current, depreciated, value of facilities and fixed equipment	598,378,604	20,273,097
i. Major (purchase price >$50,000) research equipment purchased this year.	6,481,544	3,939,650
j. Number of positions FTE	299	52
Faculty	1,327	194
Non-faculty PIs	1,241	253
Technical and professional staff	1,022	62
Students	166	613
Support personnel	2,221	81
Administrative	0	0
Total FTEs	0	0
Research and Development Outcomes		
A. Publications		
1. Number of scientific peer-reviewed journal articles published	695	218
2/ Number of scientific peer-reviewed book chapters published	77	3
3. Number of scientific peer-reviewed books published	27	0
4. Number of other papers published	1,384	42
5. Number of other papers not published (e.g. research reports for industry)	1,469	18
B. Research Proposals		
1. Number of peer-reviewed and/or competitive research proposal submitted	1,324	297
2. Dollar Value	502,595,336	150,277,569
3. Number of these proposals submitted jointly with other main institutions	157	34
Dollar Value	36,369,605	11,172,761

Research Institutions Capacity Survey	**2008**	
2008	Total for all Institutions	Attributable to State R&D Funding
4. Number of these proposals submitted jointly with non-Maine institutions only	170	60
Dollar Value	61,568,480	37,065,653
5. Number of these proposal submitted jointly with both Maine and non-Maine institutions	110	38
Dollar Value	80,298,833	19,181,243
C. Research Awards		
1. Number of new Federal research grants, contracts, subcontracts	634	124
Dollar Value	151,884,518	80,669,173
2. Number of these awarded under EPSCOR	11	9
Dollar Value	3,157,133	3,020,620
3. Number of these that were earmarked	9	8
Dollar Value	10,455,099	7,263,099
Total Expenditures for R&D in the Fiscal Year	234,543,989	80,279,270
Federal sources of funds for R&D expenditures	149,242,445	64,699,619
State sources of funds for R&D expenditures	10,297,349	1,487,141
Industry sources of funds for R&D expenditures	6,359,828	1,011,357
Individual and Foundations sources of funds for R&D expenditures	22,662,587	13,452,978
5. Number of industrial research grants, contracts and subcontracts awarded	336	303
Dollar Value	5,420,233	4,131,809
6. Number of these industrial research contracts awarded by Maine companies	154	151
Dollar Value	1,274,621	1,074,697
7. Number of new foundation grants and gifts	113	13,669
Dollar Value	17,101,718	8,706,164
D. Intellectual Property		
1. Number of disclosures made	42	37
2. Number of patents applied for	46	43
3. Number of patents awarded	6	6
4. Number of copyrights obtained	0	0
5. Number of plant breeder's rights obtained	0	0
6. Number of licensing agreements signed	19	19
7. Number of licensing agreements signed with Maine companies	4	4
8. License income received this year	1,023,806	1,020,707
E. Spin-off Companies		
1. Number of new companies formed	2	0
2. Number of jobs in these companies at spin-off	0	0

Research Institutions Capacity Survey	**2008**	
2008	Total for all Institutions	Attributable to State R&D Funding
Cautions: Numbers attributable to State R&D Funding in 2002 survey may not be accurate.		
Questions change significantly from 2002-2006		
The figure was headcount, changed to FTE's		

University Survey Results, 2002–2008

	University Research-based Institutions				
	2008 Total for University Institutions	**2007 Total for University Institutions**	**2002 Total for University Institutions**	**2007-2008 %Change for Universities**	**2002-2008 %Change for Universities**
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	750	735	1,099	2%	-32%
b. Number of science and engineering graduate degrees conferred	203	176	207	15%	-2%
c. DELETED (Number of degree programs)	0	0			
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	5,107	5,784	7,565	-12%	-32%
e. Number of undergraduate students science and engineering degrees conferred	966	1,065		-9%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)	0	0			
g. Total R&D space	969,251	968,321	633,778	0%	53%
h. Current, depreciated, value of facilities and fixed equipment	399,001,069	$317,769,678	$126,755,600	26%	215%
i. Major (purchase price >$50,000) research equipment purchased this year.	2,591,089	$2,404,052	$17,833,583	8%	-85%
j. Number of positions					
FTE	0	667	0	-100%	0%
Faculty	1,223	583	846	110%	45%
Research staff (non-	680	26		2515%	

	University Research-based Institutions				
	2008 Total for University Institutions	**2007 Total for University Institutions**	**2002 Total for University Institutions**	**2007-2008 %Change for Universities**	**2002-2008 %Change for Universities**
faculty)					
Professional staff	658	702	937	-6%	-30%
Students	117	125	671	-6%	-83%
Classified personnel	1,548	911	650	70%	138%
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	299	617	639	-52%	-53%
2/ Number of scientific peer-reviewed book chapters published	63	102	21	-38%	200%
3. Number of scientific peer-reviewed books published	26	27	70	-4%	-63%
4. Number of other scientific papers published	1,313	680	277	93%	374%
5. Number of other scientific papers not published (e.g. research reports for industry)	1,443	2,147	619	-33%	133%
B. Research Proposals					
1.a. Number of extramural research proposal submitted	979	859	715	14%	37%
1b. Dollars requested	319,092,892	$208,550,708	$175,226,589	53%	82%
2.a. Number of these proposals submitted jointly with other Maine institutions	127	47	37	170%	243%
2.b. Dollar Value	27,343,700	$13,014,375	$4,832,025	110%	466%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	106	35	61	203%	74%
3.b.Dollar Value	25,739,774	$10,899,706	$5,697,830	136%	352%

University Research-based Institutions					
	2008 Total for University Institutions	**2007 Total for University Institutions**	**2002 Total for University Institutions**	**2007-2008 %Change for Universities**	**2002-2008 %Change for Universities**
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	76	4	0	1800%	
4.b. Dollar Value	68,957,068	$1,073,919	$0	6321%	
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	521	442	428	18%	22%
Dollar Value	84,637,718	$63,990,437	$48,988,610	32%	73%
2. Number of these awarded under EPSCOR	9	4	4	125%	125%
Dollar Value	2,995,620	$2,430,067	$15,256,911	23%	-80%
3. Number of these that were earmarked	7	13	0	-46%	
Dollar Value	6,901,254	$4,104,424	$0	68%	
4.a. Total expenditures for research and development for FY06	138,929,747	$45,112,566		208%	
4.b. Sources of funds for R&D expenditures: federal	75,914,472	$29,169,510		160%	
4.b. State	8,195,221	$2,710,296		202%	
4.b.Industry	3,169,354	$82,574		3738%	
4.b. Individuals and foundations	7,563,701	$626,609		1107%	
5. Number of industrial research grants, contracts and subcontracts awarded	316	237	1	33%	31500%
Dollar Value	4,830,220	$2,790,365	$3,561,681	73%	36%
6. Number of these industrial research contracts awarded by Maine companies	153	185	0	-17%	
Dollar Value	1,262,121	$1,282,848	$0	-2%	
7. Number of new foundation grants & gifts	47	64	13	-27%	262%
Dollar Value	7,583,782	$4,902,023	$2,049,096	55%	270%

	University Research-based Institutions				
	2008 Total for University Institutions	**2007 Total for University Institutions**	**2002 Total for University Institutions**	**2007-2008 %Change for Universities**	**2002-2008 %Change for Universities**
D. Intellectual Property					
1. Number of disclosures made	20	19	10	5%	100%
2. Number of patents applied for	25	11	8	127%	213%
3. Number of patents awarded	6	3	0	100%	
4. Number of copyrights obtained	0	0	1	0%	
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	5	4	0	25%	
7. Number of licensing agreements signed with Maine companies	4	2	0	100%	
8. License income received this year	127,599	$500,027	$0	-74%	
E. Spin-off Companies					
1. Number of new companies formed	2	1	0	100%	
2. Number of jobs in these companies at spin-off	0	2	0	-100%	

Gray areas = no data or data question has changed significantly

Questions shift over time, so cannot analyze over time

Universities
Univ of Southern Maine
Univ of New England
UMaine Orono
UMaine Machias
Maine Maritime

Nonprofit Institutions Survey Results, 2002–2008

	Nonprofit Research Institutions				
	2008 Total Nonprofit Institutions	2007 Total Nonprofit Institutions	2002 Total Nonprofit Institutions	2007-2008 Percent Change for Nonprofits	2002-2008 Percent Change for Nonprofits
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	11	7	3	57%	267%
b. Number of science and engineering graduate degrees conferred	1	5	0	-80%	0%
c. DELETED (Number of degree programs)	0	0			
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	0	125	0	-100%	
e. Number of undergraduate students science and engineering degrees conferred	0	25		-100%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)	0	0			
g. Total R&D space	370,502	370,881	203,882	0%	82%
h. Current, depreciated, value of facilities and fixed equipment	$199,377,535	$192,680,384	$150,360,110	3%	33%
i. Major (purchase price >$50,000) research equipment purchased this year.	$ 3,890,455	$2,659,543	$4,798,467	46%	-19%
j. Number of positions FTE	299	330	0	-9%	

	Nonprofit Research Institutions				
	2008 Total Nonprofit Institutions	2007 Total Nonprofit Institutions	2002 Total Nonprofit Institutions	2007-2008 Percent Change for Nonprofits	2002-2008 Percent Change for Nonprofits
Faculty	104	211	58	-51%	81%
Research staff (non-faculty)	560.7	532		5%	
Professional staff	364.4	341	897	7%	-59%
Students	49.1	99	3	-50%	1537%
Classified personnel	672.7	608	257	11%	162%
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	396	392	222	1%	78%
2/ Number of scientific peer-reviewed book chapters published	14	16	20	-13%	-30%
3. Number of scientific peer-reviewed books published	1	1	0	0%	
4. Number of other scientific papers published	71	90	1	-21%	7000%
5. Number of other scientific papers not published (e.g. research reports for industry)	26	31	2	-16%	1200%
B. Research Proposals					
1.a. Number of extramural research proposal submitted	345	352	134	-2%	157%
1b. Dollars requested	$183,502,443.50	$259,653,997	$106,590,869	-29%	72%
2.a. Number of these proposals submitted jointly with other Maine institutions	30	30	6	0%	400%
2.b. Dollar Value	$ 9,025,904.50	$19,124,680	$2,170,689	-53%	316%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	64	52	22	23%	191%
3.b.Dollar Value	$ 35,828,706	$56,543,358	$11,559,016	-37%	210%

	Nonprofit Research Institutions				
	2008 Total Nonprofit Institutions	**2007 Total Nonprofit Institutions**	**2002 Total Nonprofit Institutions**	**2007-2008 Percent Change for Nonprofits**	**2002-2008 Percent Change for Nonprofits**
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	34	75	24	-55%	42%
4.b. Dollar Value	$11,341,765	$61,564,539	$13,093,005	-82%	-13%
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	113	96	64	18%	77%
Dollar Value	$ 67,246,800	$88,112,558	$66,049,383	-24%	2%
2. Number of these awarded under EPSCOR	2	0	1	0%	100%
Dollar Value	$ 161,513	$0	$600,000		-73%
3. Number of these that were earmarked	2	2	5	0%	-60%
Dollar Value	$ 3,553,845	$4,437,516	$3,851,260	-20%	-8%
4.a. Total expenditures for research and development for FY06	$ 5,614,241.96	$93,105,723		3%	
4.b. Sources of funds for R&D expenditures: federal	$ 73,327,973.33	$73,748,989		-1%	
4.b. State	$ 2,102,128.09	$1,950,507		8%	
4.b.Industry	$ 3,190,474	$2,908,757		10%	
4.b. Individuals and foundations	$15,098,886	$12,789,471		18%	
5. Number of industrial research grants, contracts and subcontracts awarded	20	33	33	-39%	-39%
Dollar Value	$ 590,013	$2,629,489	$2,176,807	-78%	-73%
6. Number of these industrial research contracts awarded by Maine companies	1	9	0	-89%	
Dollar Value	$ 12,500	$388,338	$0	-97%	
7. Number of new foundation grants and gifts	66	66	11	0%	500%

	Nonprofit Research Institutions				
	2008 Total Nonprofit Institutions	**2007 Total Nonprofit Institutions**	**2002 Total Nonprofit Institutions**	**2007-2008 Percent Change for Nonprofits**	**2002-2008 Percent Change for Nonprofits**
Dollar Value	$ 9,517,936.42	$12,719,448	$1,140,484	-25%	735%
D. Intellectual Property					
1. Number of disclosures made	22	30	6	-27%	267%
2. Number of patents applied for	21	11	4	91%	425%
3. Number of patents awarded	0	2		-100%	
4. Number of copyrights obtained	0	2	1	-100%	-100%
5. Number of plant breeder's rights obtained	0	0	0	0%	
6. Number of licensing agreements signed	14	13	2	8%	600%
7. Number of licensing agreements signed with Maine companies	0	3	0	-100%	
8. License income received this year	$ 896,206.70	$485,000	$150,000	85%	497%
E. Spin-off Companies	0				
1. Number of new companies formed	0	0	0		
2. Number of jobs in these companies at spin-off	0	0	0		

Gray areas = no data or data question has changed significantly

Questions shift over time, so cannot analyze over time

Non Profit
Bigelow
Maine Medical Center
Wells National
Jackson
MDIBL
Gulf of Maine
Downeast Institute
Maine Inst of Human Genetics and Health
Foundation for Blood Research

University Results Attributable to State Investment, 2002–2008

University Research-based Institutions					
	2008 Total Attributable to State Funding	**2007 Total Attributable to State Funding**	**2002 Total Attributable to State Funding**	**2007-2008 Percent Change for Universities**	**2002-2008 Percent change for Universities**
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	70	622	1,056	-89%	-93%
b. Number of science and engineering graduate degrees conferred	9	175	209	-95%	-96%
c. DELETED (Number of degree programs)					
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	512	3,784	7,258	-86%	-93%
e. Number of undergraduate students science and engineering degrees conferred	121	689		-82%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)					
g. Total R&D space	37,930	947,336	606,258	-96%	-94%
h. Current, depreciated, value of facilities and fixed equipment	0	$223,449,446	$121,251,600	-100%	-100%
i. Major (purchase price >$50,000) research equipment purchased this year.	2,404,089	$2,404,052	$16,074,033	0%	-85%
j. Number of positions FTE	0	0	0		0%
Faculty	153	20	432	665%	-65%
Research staff (non-faculty)	201	0	23	0%	774%
Professional staff	24	25	352	-4%	-93%
Students	600	36	198	1567%	203%
Classified personnel	2	2	207	0%	-99%

University Research-based Institutions	2008 Total Attributable to State Funding	2007 Total Attributable to State Funding	2002 Total Attributable to State Funding	2007-2008 Percent Change for Universities	2002-2008 Percent change for Universities
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	0	576	527	-100%	-100%
2/ Number of scientific peer-reviewed book chapters published	0	98	30	-100%	-100%
3. Number of scientific peer-reviewed books published	0	26	64	-100%	-100%
4. Number of other scientific papers published	0	674	332	-100%	-100%
5. Number of other scientific papers not published (e.g. research reports for industry)	2	2,147	768	-100%	-100%
B. Research Proposals	0				
1.a. Number of extramural research proposal submitted	79	59	574	34%	-86%
1b. Dollars requested	38,329,791	$19,810,377	$130,232,919	93%	-71%
2.a. Number of these proposals submitted jointly with other Maine institutions	11	10	43	10%	-74%
2.b. Dollar Value	6,176,327	$5,218,508	$9,943,894	18%	-38%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	15	6	66	150%	-77%
3.b.Dollar Value	8,100,256	$4,761,382	$10,482,110	70%	-23%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	4	3	0	33%	
4.b. Dollar Value	7,839,478	$872,560	$0	798%	

University Research-based Institutions

	2008 Total Attributable to State Funding	2007 Total Attributable to State Funding	2002 Total Attributable to State Funding	2007-2008 Percent Change for Universities	2002-2008 Percent change for Universities
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	48	414	429	-88%	-89%
Dollar Value	46,608,580	$56,156,164	$44,879,959	-17%	4%
2. Number of these awarded under EPSCOR	9	4	6	125%	50%
Dollar Value	2,995,620	$2,430,067	$2,278,125	23%	31%
3. Number of these that were earmarked	7	13	0	-46%	
Dollar Value	6,901,254	$4,104,424	$0	68%	
4.a. Total expenditures for research and development for FY06	$ 5,371,505	$ 1,818,988			
4.b. Sources of funds for R&D expenditures: federal	$ 3,954,000	$ 1,725,842			
4.b. State	$ 224,405	$ 2,419,500			
4.b.Industry	$ -	$ 76,151			
4.b. Individuals and foundations	$ 1,193,100	$ 804,184			
5. Number of industrial research grants, contracts and subcontracts awarded	301	207	0	45%	
Dollar Value	4,099,309	$2,609,261	$1,916,817	57%	114%
6. Number of these industrial research contracts awarded by Maine companies	150	158	0	-5%	
Dollar Value	1,062,197	$1,173,633	$0	-9%	
7. Number of new foundation grants and gifts	4	54	2	-93%	100%
Dollar Value	1,238,365	$2,005,462		-38%	
D. Intellectual Property	0				
1. Number of disclosures made	18	18	$6	0%	200%
2. Number of patents applied for	25	10	4	150%	525%
3. Number of patents awarded	6	3		100%	

University Research-based Institutions

	2008 Total Attributable to State Funding	2007 Total Attributable to State Funding	2002 Total Attributable to State Funding	2007-2008 Percent Change for Universities	2002-2008 Percent change for Universities
4. Number of copyrights obtained	0	0	0	0%	0%
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	5	4	0	25%	
7. Number of licensing agreements signed with Maine companies	4	2	0	100%	
8. License income received this year	127,500	$500,000	$0	-75%	
E. Spin-off Companies	0				
1. Number of new companies formed	0	1	0	-100%	
2. Number of jobs in these companies at spin-off	0	2	0	-100%	

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Questions shift over time, so cannot analyze over time

Non Profit
Bigelow
Maine Medical Center
Wells National
Jackson
MDIBL
Gulf of Maine
Downeast Institute
Maine Inst of Human Genetics and Health
Foundation for Blood Research

Universities
Univ of Southern Maine
Univ of New England
UMaine Orono
UMaine Machias
Maine Maritime

Nonprofit Results Attributable to State Investment, 2002–2008

	Nonprofit Research Institutions				
	2008 Attributable to State Funding	**2007 Attributable to State Funding**	**2002 Attributable to State Funding**	**2007-2008 Percent Change for Nonprofits**	**2002-2008 Percent Change for Nonprofits**
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	0	2	0		
b. Number of science and engineering graduate degrees conferred	0	1	0		
c. DELETED (Number of degree programs)					
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	0	0	0	0%	0%
e. Number of undergraduate students science and engineering degrees conferred	0	0		0%	0%
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)					
g. Total R&D space	83,321	90,118	9,755	-8%	754%
h. Current, depreciated, value of facilities and fixed equipment	$ 20,273,097	$19,946,839	$33,631,300	2%	-40%
i. Major (purchase price >$50,000) research equipment purchased this year.	$ 1,535,561	$1,189,644	$320,000	29%	380%
j. Number of positions FTE	52	54	0	-4%	
Faculty	41	73	0	-44%	
Research staff (non-faculty)	52	54	0	-4%	
Professional staff	38.3	27	52	44%	-26%
Students	13.1	19	0	-31%	
Classified personnel	78.8	12	9	568%	776%
Research and Development Outcomes					
A. Publications					

	Nonprofit Research Institutions				
	2008 Attributable to State Funding	**2007 Attributable to State Funding**	**2002 Attributable to State Funding**	**2007-2008 Percent Change for Nonprofits**	**2002-2008 Percent Change for Nonprofits**
1. Number of scientific peer-reviewed journal articles published	218	218	153	0%	42%
2/ Number of scientific peer-reviewed book chapters published	3	3	11	0%	-73%
3. Number of scientific peer-reviewed books published	0	1	1	-100%	-100%
4. Number of other scientific papers published	42	58	0	-28%	
5. Number of other scientific papers not published (e.g. research reports for industry)	16	16	0	0%	
B. Research Proposals					
1.a. Number of extramural research proposal submitted	218	217	106	0%	106%
1b. Dollars requested	$111,947,778	$159,674,827	$92,252,970	-30%	21%
2.a. Number of these proposals submitted jointly with other Maine institutions	23	26	1	-12%	2200%
2.b. Dollar Value	$ 4,996,434	$13,790,897	$8,218,269	-64%	-39%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	45	46	20	-2%	125%
3.b.Dollar Value	$ 28,965,397	$53,965,438	$35,698,533	-46%	-19%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	34	75	21	-55%	62%
4.b. Dollar Value	$ 11,341,765	$61,564,539	$43,916,802	-82%	-74%
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	76	70	41	9%	85%
Dollar Value	$ 34,060,593	$76,226,898	$47,176,309	-55%	-28%
2. Number of these awarded under EPSCOR	0	0	0	0%	0%
Dollar Value	25000	$0	$0		
3. Number of these that were earmarked	1	1	0	0%	
Dollar Value	$ 361,845	$1,245,516	$0	-71%	

	Nonprofit Research Institutions				
	2008 Attributable to State Funding	**2007 Attributable to State Funding**	**2002 Attributable to State Funding**	**2007-2008 Percent Change for Nonprofits**	**2002-2008 Percent Change for Nonprofits**
4.a. Total expenditures for research and development for FY06	$ 74,907,765	$ 73,318,961			
4.b. Sources of funds for R&D expenditures: federal	$ 60,745,619	$ 65,512,185			
4.b. State	$1,262,736	$ 1,620,066			
4.b.Industry	$ 1,011,357	$ 627,751			
4.b. Individuals and foundations	$ 12,259,878	$ 10,191,966			
5. Number of industrial research grants, contracts and subcontracts awarded	2	4	2	-50%	0%
Dollar Value	$32,500	$175,000	$175,604	-81%	-81%
6. Number of these industrial research contracts awarded by Maine companies	1	2	0	-50%	
Dollar Value	$12,500	$75,000	$0	-83%	
7. Number of new foundation grants and gifts	13665	27	20	50511%	68225%
Dollar Value	$ 7,467,799	$4,331,447		72%	
D. Intellectual Property					
1. Number of disclosures made	19	18	$2	6%	850%
2. Number of patents applied for	9	6	0	50%	added 9
3. Number of patents awarded	2	1		100%	added 2
4. Number of copyrights obtained	2	0	0	added 2	added 2
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	10	2	0	400%	added 10
7. Number of licensing agreements signed with Maine companies	1	0	0	added 1	added 1
8. License income received this year	$450,000	$136,472	$0	230%	added $450k
E. Spin-off Companies					
1. Number of new companies formed	0	1	0	-100%	0%
2. Number of jobs in these companies at spin-off	0	2.5	0	-100%	0%

	Nonprofit Research Institutions				
	2008 Attributable to State Funding	**2007 Attributable to State Funding**	**2002 Attributable to State Funding**	**2007-2008 Percent Change for Nonprofits**	**2002-2008 Percent Change for Nonprofits**
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Nonprofit					
Bigelow					
Maine Medical Center					
Wells National					
Jackson					
MDIBL					
Gulf of Maine					
Downeast Institute					
Maine Inst of Human Genetics and Health					
Foundation for Blood Research					

Attachment C

Definition of High Technology

Definition of High Technology is from the U.S. Department of Commerce, based on 39 NAICS codes corresponding to high-technology industries. All employment data is based on annual average levels. The 39 industries are:

High Technology Industries NAICS Codes

NAICS Code	Industry
32411	Petroleum Refineries
3251	Basic Chemical Manufacturing
3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing
3253	Pesticides, 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 & 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