

Maine Comprehensive Research and Development Evaluation 2009

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

SUBMITTED TO:

Maine Office of Innovation
Department of Economic and Community Development
www.maineinnovation.com

PREPARED BY:

PolicyOne Research, Inc.
www.policyoneresearch.com



EntreWorks Consulting
www.entreworks.net



Scruggs & Associates, LLC
www.patscruggs.com



February 2010

Contents

1.	Introduction.....	1
2.	Summary of Findings and Recommendations	3
2.1	Summary of Findings.....	5
2.2	Recommendations.....	13
3.	Evaluation Results	25
3.1	Maine’s Competitive Position	25
3.2	Maine’s University Research Capacity.....	39
3.3	Maine’s Nonprofit Research Institutions	49
3.4	Maine’s Research-intensive Companies	53
3.5	Competitiveness of Maine’s Strategic Technology Industries	63
3.6	Institutional Results of the Maine Technology Asset Fund.....	67
3.7	Results from the 2009 Case Study	69
	Attachment A: Data from Private Sector Survey.....	A-1
	Attachment B: R&D Institutions Survey Data 2002-2009	B-1
	Attachment C: Definition of High Technology	C-1

1. Introduction

In 2001, the Maine Legislature enacted 5 MRSA §13122-J and 13122-K, which called for an annual evaluation of Maine’s public investment in R&D. 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, EntreWorks Consulting, and Scruggs & Associates for design, data gathering, analysis, and reporting.

The evaluation is guided by “A Science and Technology Action Plan for Maine,” developed in 2005¹ and the evaluation methodology updated in 2006-07². 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 comprehensive evaluation of R&D programs that receive funding from the state. The evaluation considers all of these programs combined and 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.

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?

¹ 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/>

² The “Science and Technology Action Plan for Maine” was updated in January 2010. Future evaluations will be based on that plan.

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

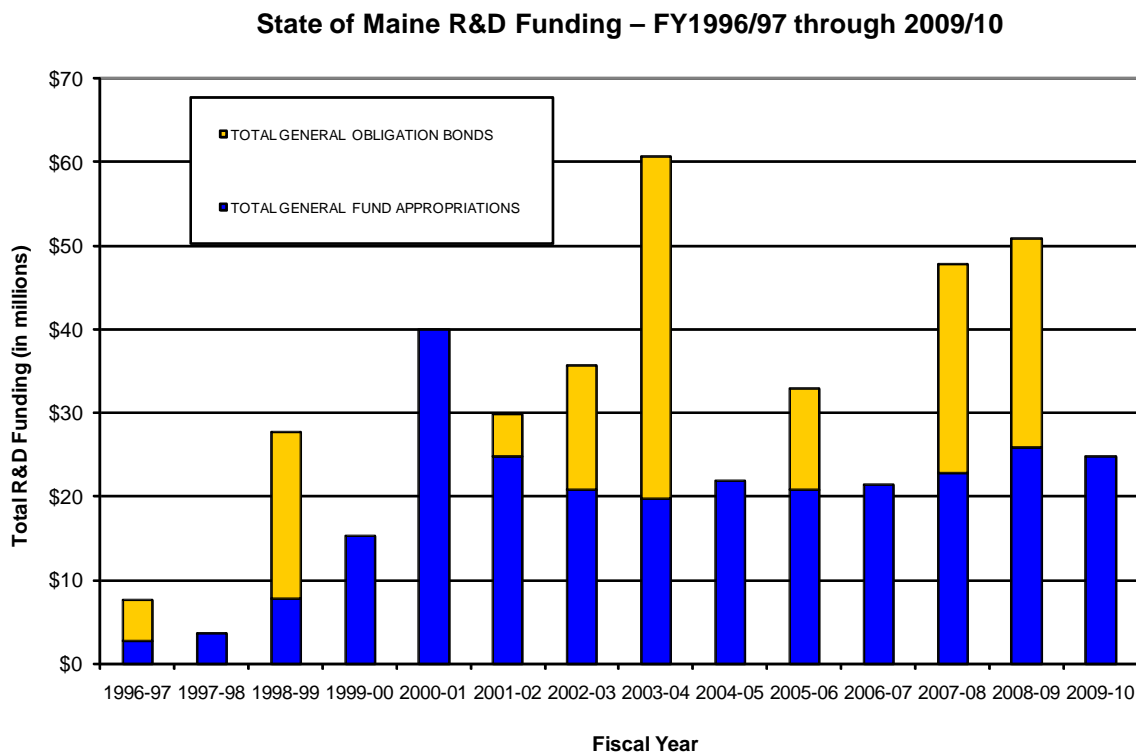
Information used in this evaluation was collected in multiple ways to both provide an understanding of Maine's performance to be compared to other benchmark states and provide in-depth details regarding performance within Maine among state supported companies and research institutions. The comparison data is drawn from a companion report to this evaluation: *Maine Innovation Index: 2010*. For this data Maine is compared in performance to the US, New England States, and States that are part of the Federal EPSCoR program (Experimental Program to Stimulate Competitive Research³). While efforts are made to use the latest comparison data available, much of it is several years old meaning 2006, 2007, or 2008 may be the latest years that data has been collected and reported for all states. Therefore, readers of this evaluation must not correlate the most recent state budget for R&D with the comparison indicators listed in this report. This data lag may also affect some performance findings, as the impact of much R&D investment requires several years to appear in subsequent performance outcomes. The in-depth state data is collected through annual surveys of companies and research institutions conducted specifically for this evaluation. Additionally this data is combined with federal and university technology transfer data sources.

³ 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. This description is from the EPSCoR Web site at: www.ehr.nsf.gov/epscor/start.cfm

2. Summary of Findings and Recommendations

To understand the impact of Maine’s R&D efforts, it is important to understand how much Maine has invested in R&D related programs. Since 1996, the State of Maine has allocated over \$420 million: roughly \$20 million of general fund dollars each year (\$272,984,282 in total from 1996/97 through 2009/10 budget) and nearly \$148 million in general obligation bonds (see **Figure 1.1**). During this period, several trends emerge including –a capacity ramp-up in general fund allocation between 1997 and 2001; followed by a relatively consistent general fund appropriations and periodic influx of obligation bonds, with the largest bond amount occurring in 2003.⁴

Figure 1.1



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

⁴ In the 2002-03 fiscal year, there was a curtailment of \$533,219 to appropriations to R&D funding, the largest of which was to the Maine Technology Institute (MTI) in the amount of \$500,000. Additionally, cuts to MTI for the biennium starting in July 2010 are proposed that range between \$1.5 and 2.1 million.

2.1 Summary of Findings

For this evaluation we have assessed and presented our findings in alignment with the five questions defined by the Office of Innovation. Below are the major findings related to each question.

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: *While state investment increases in the late 1990's and early 2000's did improve Maine's competitive position with regard to total R&D performance, Maine has not made significant progress since 2002, and therefore has not had the impact hoped for in its "Science and Technology Action Plan."*

The 2005 "Science and Technology Action Plan for Maine" set a goal of \$1 billion in total R&D performed activity by 2010. As of 2006, the latest year for which comprehensive data is available, Maine has reached only \$450 million in total R&D performed. The 2010 Science and Technology Action Plan for Maine includes the following goal: "**Maine's R&D activity will equal \$1.4 billion by 2015, (3%) of Gross State Product**". Based on the 2006 data, Maine has attained a level of 0.971% of gross state product. Therefore, Maine will have to significantly and consistently increase its R&D efforts to attain this new goal.

Maine's ranking among states for total R&D has flattened after a period of growth. In 1997, Maine ranked 49th among all states in total R&D as a percent of gross state product (GSP). In 2002, Maine improved its ranking to 38th and improved again in 2005 to 35th. However, in 2006, the latest year for which comparable data is available, Maine's ranking returned to 38th.

There has been no increase in technology sector employment (as a whole). Between 2007 and 2008, total average employment in Maine's targeted technology sectors was flat, as was the overall employment for Maine. The five-year period from 2004 to 2008, shows the total average employment in Maine's targeted technology sectors declined by 3.0 percent, whereas the state employment grew by less than one percent. **However, the decline in tech employment was primarily a result of job losses in a few key sectors, with other sectors showing growth in this time period (see Question #5 for details).**

The output from the technology sector accounts for a significant portion of the state's gross state product (GSP), so tracking overall GSP provides an indication of the overall economic climate for the tech sector. Between 1999 and 2008, Maine's gross state product (GSP) grew by 49.00 percent. This growth rate is higher than the overall GSP growth for New England (45.70%) during the same period, yet is below the 60.90% growth rate for EPSCoR states and the 53.95% growth rate for the United States. From 2007–2008, Maine experienced a growth rate of 3.52% while New England GSP grew at 2.98%, EPSCoR states at 4.62%, and the United States at 3.28%.

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:** In the past five years, Maine has gained ground in terms of academic R&D expenditure performance but commercialization metrics are not increasing at a similar rate. The consistently low level of Science and Engineering graduate students also remains a concern.*

Overall investment picture: Over the past five years, FY 2005-06 through FY 2009-10, Maine has allocated over \$81 million in revenues from bonds and appropriations (or 46% of state R&D investments) in direct support of the University of Maine System (UMS). Additional state funds were received by UMS and the state's other higher education institutions through other R&D support programs, such as those managed by the Maine Technology Institute.

Maine's academic institutions, led by the University of Maine, still lag in R&D performance but have been slowly closing the gap. Maine's academic institutions have increased their R&D spending from \$99 million in 2004 to slightly more than \$128 million in 2008. When R&D spending at academic institutions is expressed as a percent of gross state product, Maine lags the benchmark groups including the EPSCoR states. However, in the past five years, the state has been closing the gap. Between 2004 and 2008 growth in academic R&D spending in Maine equaled 29.2 percent outpacing the growth experienced on average in the U.S (20.0 percent) and New England (13.6 percent), and the EPSCoR states (20.5 percent). Like Maine, all of these benchmark groups witnessed a decline in R&D performance in 2008.

It should be noted that Maine's R&D performed by universities and colleges is heavily influenced by the University of Maine, Orono. In 2009, UMaine-Orono represented 50 percent of all research related employment and 56 percent of R&D expenditures among all universities and colleges in Maine.

While overall R&D expenditures have increased at fairly rapid pace for universities in the past five years, improvements in the commercialization of research have been slower. The 2009 survey figures for these indicators tend to place Maine in the lower tier of university technology transfer performance when compared to other US states. In this year's (2009) survey to universities, 28 invention disclosures (up from 20 in 2008), three patents awarded (down from 6 in 2008), and one start-up firm were recorded. Invention disclosures and issued patents were about half of what might be expected from this volume of research. License agreements were weak. 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.

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.

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 averages, yet much research is not being commercialized or connected to Maine's industries in a way that maximizes economic value to the state.*

Overall investment picture: In the past five years, FY 2005-06 through 2009-10, Maine has invested nearly \$33 million in its nonprofit research institutions, representing about 19% of all state R&D investment during that period. After years of continual increases between 1998 and 2002, federal funding for not-for-profit R&D performance in Maine has achieved a relatively steady state of anywhere from \$65-\$85 million per year.

When ranked in terms of non-for-profit R&D spending as a percent of gross state product, Maine continues to be a national leader. However, this competitive advantage appears to be eroding over the past several years. From 1995 to 2002, Federal support R&D performed at Maine's not-for-profit research labs grew dramatically, from 0.084 percent in 1995 reaching 0.234 percent of GSP in 2002. Since 2002, Federal support has decreased to levels between 0.150 percent and 0.188 percent of GSP and the 2007 level was 0.155 percent. Even with this decrease, Maine in 2007 remained significantly above the level of the nation as a whole at 0.051 percent and the EPSCoR states combined at 0.019 percent of GSP.

The performance of Maine's not-for-profits research institutions is driven primarily by one major institution, The Jackson Labs, which in 2009 accounted for 63 percent of R&D expenditures and 74 percent of all research related employment among all Maine not-for-profit institutions.

Maine's nonprofit research cluster is sizable and its improved performance in R&D expenditures, grants, and publications indicate a strong national reputation. Yet, if the 1,710 jobs were better connected to industry, this research sector could prove to be a major catalyst for economic development. These connections, however, still appear to be weak when one compares the US average performance of nonprofits research in regard to metrics such as patents, spinoffs, industry sponsored research, and invention disclosures.

The 2009 research institution survey conducted for this evaluation, indicated that the performance of Maine's not-for-profit research institutions was similar to the previous year: a slight increase in R&D expenditures, a small decrease in equipment investments, an slight increase in extramural proposals, similar levels of publications, a very small decrease in jobs (1%), and a slight increase in the dollar value of federal grants and contracts. One area with considerable improvement was industry contracts: in 2009, there were 37 industry contracts valued at \$4.0 million, up from 2008 level of 20 contracts valued at \$590,000.

There was mixed performance in 2009 related to the development of intellectual property. Institutions reported 17 invention disclosures (22 in 2008); 18 patents applications, (21 in 2008), and 3 patents granted, (0 in 2008). Given the level of R&D funding, these metrics are well below national averages. Licenses were one metric with similar performance to US averages; 19 licenses were granted in 2009 (14 in 2008), however, no licenses were granted to Maine companies. The license revenue also

increased with \$1.4 million in licensing revenue in 2009, up from the 2008 level of \$896,000. Nonprofit institutions reported no spin-off companies or associated jobs in 2009.

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: *On many industry indicators, Maine's trends reflect that of the national economy—declining financing, job loss, and relatively flat outputs of innovation (patents, trademarks, etc.) Yet, the amount of industry R&D is still below the average of most states, and the emergence of high-growth innovation-based companies remains limited, indicating that companies may start, but tend to stagnate after a relatively short period of time.*

In 2007, Maine's industry spent \$265 million on R&D. **Overall, Maine's industry R&D expenditures have been relatively flat since 2000**, with a single year spike in 2005. This translates into Maine's ranking of 38th in industry R&D spending as a percent of gross state product. While industry R&D in the US averages over 73% of all R&D, it only accounts for 56% of Maine's R&D expenditures. This relatively weak performance is a potential concern as industry R&D is generally considered to have higher direct economic impact and commercialization potential.

In 2007, industry R&D in Maine represented 0.55 percent of gross state product (GSP). This was slightly lower than the EPSCoR level of 0.58 and more significantly lower than the U.S. at 1.96 and New England at 4.29. Maine's increased slightly on this indicator but its ranking remained the same at 38.

Employment growth in targeted technology sectors is lagging Maine's overall average, while firm growth in tech sectors has been above state averages. Over the five-year period from 2004 to 2008, the total average employment number in Maine in the targeted technology sectors declined by 3.0 percent. This compared to an increase in total employment in Maine of 0.8 percent. More recently, between 2007 and 2008, total average employment in Maine's targeted technology sectors declined by 0.06 percent, compared to a decline in total employment in Maine of 0.04 percent. Over the same period, tech sectors experienced an overall increase in establishments of 6.7 percent, compared to the state average of 2.9 percent. Between 2007 and 2008, the number of firms in the targeted technology sectors decreased by 0.8 percent while firms overall in Maine grew by 1.4 percent.

Access to funding and capital is a concern: A measure of the viability of research-intensive companies in Maine is the ability of the companies to attract new capital, including venture capital. From 2007 to 2008, the number of venture capital deals remained the same at four in Maine; however the total investment increased from \$6.6 million to \$16.0 million.

The federal government provides grants to small businesses performing R&D through its Small Business Innovation Research (SBIR) program. From 2000 through 2004, Maine experienced annual increases in the amount of SBIR awards. Since 2004, the amount of annual awards received in Maine has decreased. In 2004, Maine received 29 SBIR awards with a total value of \$9.6 million. In 2007, 16 awards totaled \$3.8 million, and in 2008 (the last year reported), 14 SBIR awards totaled \$4.7 million. Maine's share of SBIR/STTR funds as a percent of gross state product has increased slightly since 1999 with large spikes in 2004 and again in 2006 before dropping off in 2007 and staying relatively unchanged in 2008.

Maine's companies responding to the survey noted similar issues with financing. Only 37 companies, or 10.2% of survey respondents, accessed new debt financing during their most recently completed fiscal year, down from 16.5% the prior year. More importantly, bank financing levels dropped dramatically, forcing firms to seek other forms of debt financing. There was less venture capital raised, yet more angel investment deals were completed by surveyed companies. This pattern may also indicate a move toward different types of financing vehicles as a result of the economic downturn. **Intellectual property indicators are lagging:** In 2008, 136 patents were issued to Maine-based individuals and organizations, including industry, universities and nonprofit research centers. The total number of patents has increased slightly from a year earlier (126 patents in 2007), and remained similar to the amount five years earlier (138 patents in 2004). Over the past ten years, Maine's trends for patenting—as expressed on a per 1,000 resident basis—have been relatively flat. On this indicator, Maine significantly lags the US as a whole.

In the past five years, FY 2005-06 through FY 2009-10, Maine has invested \$31 million (17% of all state R&D funding) in programs targeted to support private sector research and development. Over this time period, over 860 businesses were served by the various programs that support R&D.

Additionally, the profile of the 363 companies responding to this year's survey indicate the following about businesses using state R&D related services:

- The respondents reported a total of 3,786 employees—down by an average of 3% from the previous year. The number of employees per firm remains consistent at an average of 13.4 employees. Payroll and wage data also showed improvements. The average wage of this year's employee was \$43,292, compared to last year's average wage of \$42,061.
- Firms report average revenue of \$3,066,331, an increase of 12.6% from the previous year average level of \$2,722,765 per firm. Productivity of companies indicated a moderate increase over last year - revenues per employee were \$243,784 this year, compared to last year's average of \$209,765 per employee.
- By their nature, innovation-based companies tend to have a significant portion of their sales out of state. However, 50% of survey respondents reported less than 25% of their sales outside the State of Maine, and only 12% reported more than 10% of their sales were international in nature.
- R&D Expenditures: Companies in this year's survey report spending over \$31.47 million on R&D - approximately \$106,321 per company. This figure is down from last year's average of \$141,190 per company, however, is consistent with national reporting of R&D expenditures.
- Many of the firms that responded to the survey are producing and protecting their intellectual property (IP). Fifty percent indicate that they intend to use some form of intellectual property protection (Patents, Trade Secrets, Licensing, Copyrights, Trademarks, or other). Thirty-five percent (up from 31% reported by the 2008-2009 survey respondents) of the respondents report that they plan to file or have filed patent protection for the innovations developed through state funding. Total U.S. and foreign patents granted represented 0.31 per all respondent companies in 2009-2010 compared to 0.28 per respondent company in 2008-2009.

The importance and satisfaction with Maine's R&D support programs among businesses served is declining: When asked to assess the importance of the assistance received from the state, 31.9% of respondents in the current survey indicated that the assistance they received was very important or critically important---compared to 42% in 2008. Regarding satisfaction with assistance received, only 39.1% of respondents in the current survey indicated that they were either very satisfied or satisfied compared to 49.7% in the previous year.

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

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

In the past five years, employment performance among Maine's technology sectors has been mixed. Based on 2004-2008 data from the Maine Department of Labor, Maine's targeted technology sectors had a net decline of 1,610 jobs. This net loss was the result of a loss of 3,148 jobs in the sectors of biotechnology, marine technology and aquaculture, and forest products and agriculture. Among these sectors, forest products and agriculture accounted for 84 percent of the job loss. During this period, 1,538 combined jobs were gained in the sectors of environment and energy; engineering and scientific/technical services; information technology; precision manufacturing, and composites and advanced materials. Of the jobs gained, the three sectors of environment and energy; engineering and scientific/technical services; and information technology accounted for 82 percent of jobs gained.

Technology sector wages are higher than wages in other sectors. The average wage of all of Maine's targeted technology sectors in 2008 was \$49,053 which was higher than Maine as a whole at \$36,317 and the U.S. total average of \$45,563.

Based on the companies that responded to the 2009 evaluation survey, the sectors of advanced materials and composites, biotechnology, and marine technology and aquaculture experienced employment increases between 2008-2009 while advanced technologies for forestry and agriculture, environmental technology, information technology, and precision manufacturing experienced declines.

The survey also indicated that all **sectors experienced increased revenues** from 2007-09, with the exceptions of environmental technology, and marine technology and aquaculture. The largest revenue percent increases were experienced in biotechnology and advanced materials and composites. In addition, surveyed firms reported that wages remain high in comparison to Maine averages, and continue to show a steady increase over time.

Table 2.1

Maine Innovation Index 2010 – Indicator Performance Summary				
Indicator	Maine 1-Year Trend	Maine 5-Year Trend	Maine Compared to EPSCoR Most Current Year	Maine Latest Year National Rank 1-51 with 1=best; (year)
Research and Development Capacity				
Total R&D Performance	↓	↔	↓	38 (2006)
Industry R&D Performance	↑	↔	↓	38 (2007)
Academic R&D Performance	↓	↑	↓	41 (2008)
Not-for-Profit Laboratory R&D Performance	↑	↓	↑	3 (2007)
Federal R&D Obligations	↓	↓	↓	25 (2006)
State R&D Investments	↓	↑	N/A	N/A
Innovation Capacity				
SBIR/STTR Funding	↑	↓	↑	26 (2008)
Venture Capital Investments	↑	↑	↑	32 (2008)
Patents Issued	↑	↓	↓	42 (2008)
Entrepreneurial Activity	↑	↓	↑	11 (2008)
Employment & Output Capacity				
Targeted Technology Sector Employment - % Change	↓	↓	N/A	N/A
Targeted Technology Sector Establishments - % Change	↓	↑	N/A	N/A
S&E Occupations in the Workforce	N/A	N/A	↓	44 (2006)
Ph.D. Scientists and Engineers in the Labor Force	↑	↑	↑	28 (2006)
Gross State Product - % Change	↑	↓	↓	25 (2008)
Per Capita Income	↑	↑	↓	34 (2008)
Education Capacity				
Math Skills of 8 th Grade Students	N/A	↑	↑	19 (2009)

Maine Innovation Index 2010 – Indicator Performance Summary

Indicator	Maine 1-Year Trend	Maine 5-Year Trend	Maine Compared to EPSCoR Most Current Year	Maine Latest Year National Rank 1-51 with 1=best; (year)
Science Skills of 8 th Grade Students	N/A	↔	↑	9 (2005)
Higher Education Enrollment among Young People – Chance for College by Age 19	N/A	↑	↑	13 (2006)
Science and Engineering Graduate Enrollments	↑	↑	↓	51 (2007)
Science and Engineering Degrees Awarded	↑	↑	↓	38 (2007)
Education Attainment - % of Population 25 and Older with Bachelor's Degree or More	↓	↑	↑	33 (2008)
Connectivity Capacity				
Household Connectivity	N/A	N/A	↑	30 (2007)
High Speed Internet Access	↑	↑	↓	42 (2007)
Classroom Connectivity	↑	↑	↑	2 (2006)

Ranking is among all states plus District of Columbia, 1-51 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

Maine has made steady and sustained investments in R&D since 1998. The level of investment has been significant given the state's small population and economy. A deeper look at annual trends reveals that state investment made between 1998 and 2003 quickly generated positive dividends. However, since that time, Maine's progress on many R&D metrics has since stalled.

Does this mean that Maine should give up on R&D investments? *Certainly not.* Innovation has become a lead driver in the economy; and will continue to do so into the future. Maine has established an array of programs to fill specific R&D gaps and to build R&D capacity in general. These steps were, and still are, essential. Past investments have helped Maine "get in the game;" new efforts must help Maine excel in the "game."

Maine's future focus may need to be taken to a level where **alignment, connection and leverage** are the key adjectives describing the state's efforts. This new focus will involve ensuring that programs are still needed and performing at their highest potential, connecting the dots among programs so entrepreneurs are getting the most out of state investments, and leveraging state finance programs to attract significant federal and private investment. In hard budget times like these, new investments are difficult, and existing investments need to generate maximum returns.

The thrust of our recommendations are consistent with Maine's recently released "*2010 Science and Technology Action Plan.*" It notes that:

"This plan describes a new phase of Maine's investment in an innovation economy, broadening the earlier focus on building research capacity to include investment into innovation and entrepreneurship as well as R&D. This is reflected in a new vision: Create an environment where science, technology, innovation and entrepreneurship stimulate Maine's economy."⁵

Additionally,

"In short, we have invested since the late 1990s in building research capacity, but have done little in terms of building our capacity for innovation and entrepreneurship. This means that we need to do better at converting ideas into products and processes, growing new, sustainable companies, and integrating new concepts into our traditional industries in a way that creates new jobs for Maine citizens."⁶

The State's 2010 plan call for three specific strategies which are consistent with the evaluation findings and recommendations. They are⁷:

⁵ *2010 Science and Technology Action Plan* – Page 1, January 2010

⁶ *Ibid* - Page 2

⁷ *Ibid* – Page 2

Strategy 2.1. Increase the rate at which new ideas become commercial products and processes.

Strategy 2.3. Build a supportive environment for high-growth, high-potential, innovation-based enterprises.

Strategy 2.4. Align and integrate Maine's innovation-based economic development strategy with the state's overall economic development strategy, recognizing that innovation has a critical role to play in making all enterprises in Maine more productive, efficient and competitive.

The results of this year's R&D evaluation (the Innovation Index, R&D survey to companies and research institutions, and the case study on industry associations' role in promoting an innovation economy) indicated little change yearly and in five-year trends. Most indicators were flat or up only modestly, and most reflected similar trend lines across New England and the US. It told us that Maine is keeping pace with the nation; not falling behind and not moving ahead. Yet, our goals can and should be more ambitious. How can Maine move the needle in terms of supporting innovation, especially in poor economic times and when other states and other nations are pursuing similar goals?

Previous economic downturns have proven to be times of great innovation in the private and public sector. Entrepreneurs search for breakthroughs versus incremental improvements, and public programs take a serious look at what provides the best return on financial and human capital investment. Some of the most progressive public policies emerge at a time when money is scarce and results are needed more than ever.

To improve its competitive position, Maine must become very targeted and focused in terms of managing its R&D investments. While overall capacity is critical, it is not enough to simply have an assortment of institutions and companies performing research. Innovative practice research has shown that the economic impact of R&D reaches its peak when:

- Research becomes a differentiating asset—"the place to go" for specific knowledge and technologies. In these cases, **leveraged assets** of industry, academic and nonprofits create a sum that is greater than the parts.
- When there is an active and **well-connected** entrepreneurial climate where innovators can take ideas to strong and growing national and international markets. Inherent to this environment are intermediaries that serve as the node connectors for high impact companies, linking entrepreneurs to various public and private resources through start-up, growth and expansion stages.
- State policies and incentives are **aligned** with innovation outcomes and funding is **leveraged** with federal and private sources to accelerate the pace at which products are developed, brought to market, and taken to scale.

We use these innovative practice themes as a way to organize recommendations for how Maine can build on its existing R&D investments and improve economic outcomes for the state.

Innovative Practice: Research becomes a differentiating asset—“the place to go” for specific knowledge and technologies.

Differentiating or “signature” products or services set a business apart from others and offer a competitive advantage—it is no different with a state’s R&D assets. While Maine has identified a number of industry sectors with R&D needs and growth potential, it has not necessarily established a global reputation around a set of differentiating innovation assets.

Every state faces difficult decisions when it comes to allocating resources to key sectors and industry clusters. Successful state technology-based economic development (TBED) efforts, especially in smaller states with more limited resources, tend to focus on allocating public funds toward fewer, larger and strategic R&D and cluster efforts (rather than multiple unconnected projects). While many of these strategies do provide R&D funding for smaller opportunities, they also include funds for sustained and larger focused efforts where the state can establish a national ‘signature’ asset. These projects not only have strong connections between the private sector and academic or nonprofits institutions, but they also make strategic plays for national and international markets where their expertise or technology is a key or differentiating asset. While these efforts build internal connections within the state, they also recognize that the customers and drivers of their success rely on external connections to markets outside the state.

Examples of these programs include Oregon where the state is focusing on a very limited number of comprehensive efforts that cut across multiple industries and disciplines and build on their reputation for sustainability and technology. Due to their collaborative nature and widespread market potential, each of these projects receive several million dollars of funding per year from the state, which in turn leverages at least three to ten times that amount in private and federal funds.

California’s Institute for Quantitative Biosciences (www.qb3.org) is one of the US’ more innovative state-backed research initiatives. It funds research in cross-disciplinary areas where physics, engineering, and biological sciences interact. QB3 researchers work in a host of cutting-edge research areas such as the production of biofuels from plant waste or the use of bacteria to help stimulate the production of solar cells in plants.

Maine has the potential to develop signature assets and there are several examples that illustrate where Maine, through state support and planning is taking this approach:

Maine Wind Industry Initiative - www.mainewindindustry.com. This initiative is a collaborative among the Maine Composites Alliance, E2 Tech Industry Council, Maine Port Authority, and the Advanced Structures and Composites Center at the University of Maine. Their stated mission is to “Unify and network the wind industry in Maine to expand our contribution to the world market.” They are listed here as an example because they are industry driven, are organized around an opportunity that cuts across multiple sectors and clusters, and are leveraging multiple sources of funding including private, state, and federal.

Forest Bioproducts Research Initiative - www.forestbioproducts.umaine.edu - This effort combines world class research with Maine industry partners to capitalize on Maine’s historical expertise in forestry dependent industries, abundance of biomass, and drive by

industry leaders to commercialize Bioproducts. It is included here as an example as the Initiative has set a goal not only to conduct research and commercial activity but to “become a world leader in the transformation of forest resources to a valuable bio-economy.

Northstar Alliance: In many ways, the Northstar Alliance (www.maine.gov/wired), which promotes the development of linkages between the marine trades and the composites sector, operates according to this model. When a major funding opportunity arose thanks to the US Department of Labor’s WIRED (Workforce Innovation in Regional Economic Development) program, a host of public and private sector partners with support from the State coalesced into the Alliance. In addition to building stronger partnerships, the initiative has made major contributions to strengthening Maine’s boat industry.

Recommendation: Identify, build, and market a targeted set of cross-industry or cross-discipline platforms that are **differentiating or “signature” innovation assets** of national and international importance. Connect state investment to support “signature” innovation clusters that are based not only on existing R&D expertise, but on expertise with strong connections to growing national and international markets. As in other states, the innovation council (MIEAB) could serve as the facilitator of this process.

- Focus large academic R&D investments on areas identified as signature research, providing a state match for federal grants, funds for attracting eminent scholars, and other approaches as a means to connect and align expertise to build differentiating assets for Maine.
- Support enhanced cluster capacity with fewer, yet larger and cross-industry projects. Maine’s Cluster Initiative Program, Development Awards, and other efforts provide project level funding up to \$500,000. The Maine Technology Asset Fund provided funding for two years at larger funding amounts (up to \$5 million⁸). This was a well-designed initiative, but it only supported one-time investments spread across 28 awards. While it is important to have competitive project awards, there is also the need to build comprehensive capacity across a select number of cross-industry or cross-discipline platforms with larger, multi-year investments directly connected to signature innovation clusters.

Innovative Practice: Intermediaries that serve as the node connectors for high impact companies linking companies to various public and private resources through start-up, growth and expansion stages.

Many states and regions across the US are recognizing that local entrepreneurs face significant challenges in accessing all of the resources and capabilities they need to start and grow new ventures with world class coaching, mentoring, and access to larger pools of capital. Smart regions are building or supporting organizations that provide these critical connections. The organizations can assume multiple names and identities. Terms like Entrepreneurial Support Organizations (ESOs), entrepreneurial networks, or even enterprise builders are beginning to enter the economic development lexicon. All of these organizations share a similar focus. Instead of providing a huge menu of programs, they view their primary role as that of a resource broker that helps the entrepreneur to

⁸ Awards in excess of \$5million were allowed but considered the exception. As indicated in the MTAF application, “Although there is no maximum request amount, awards of over \$5 million will be the exception, and will be reserved for applications of the very highest caliber.”

implement their business plan across various needs, rather than provide a limited number of specialized services.

This role has emerged from a recognition that the founders and/or executive teams of entrepreneurial growth companies generally have a set of core technical (i.e., engineering, software development) and functional (accounting, sales) capabilities. As the firm evolves, every entrepreneurial growth company will require important inputs from many different kinds of outside resources. It is time consuming and often hard to navigate the system of providers when you are busy running a business. Entrepreneurial brokers serve two critical functions: they act as an overall strategic advisor (most of them are experienced entrepreneurs) and they connect the entrepreneur to specific resources at strategic times. The resources may be traditional public and nonprofit collaborators or they may come from a wide array of local, regional and external private sector resources. These resource broker efforts are focused on building these new kinds of linkages and expanding networks based on the business' need rather than service areas of programs.

Northeast Ohio's Jumpstart (www.jumpstartinc.org) is one of the best known, and most effective entrepreneurial support organizations. It defines its mission as "the business of accelerating the growth of companies." It pursues this mission by customizing support efforts for each entrepreneur, with a special focus on providing financing, coaching, and targeted programs for minority and women entrepreneurs. Since its startup in 2004, Jumpstart has helped to generate local economic impacts exceeding \$75 million and to create 502 new jobs.

In Oklahoma, i2E (Ideas to Enterprise) is a nonprofit organization run by seasoned entrepreneurs. It operates on a statewide basis providing commercialization services to entrepreneurs and start-up businesses in an array of technology sectors, assisting with technology assessment, business planning, risk and market assessments, and access to capital. They run a technology loan program (which leverages over \$12 in additional capital for every \$1 of state money) and the state seed fund, as well as manage an Angel network of private investors connect entrepreneurs to the number of other university and private sector partners throughout the state, In its ten years of operations they have served over 2,000 entrepreneurs creating an annual growth rate that is more than eight fold the state average in any given year.

Recommendation: Enhance the overall entrepreneurial environment and ability to move ideas to market through intermediaries or "node connectors" that link the various public and private resources and finance vehicles.

Some nascent efforts to encourage similar networks in Maine are already underway. These include the informal Maine Entrepreneurs Network, which operates a popular LinkedIn discussion group, along with monthly meetings held in the Portland metro area. A more in-depth effort is underway with the Maine Center for Enterprise Development's (www.mced.biz) "Top Gun" program which provides training, coaching, and mentoring for a small group of high potential entrepreneurs. These efforts are promising starts, yet a more systematic effort is needed to ensure more sustained and statewide entrepreneurial assistance. In addition, these programs must transition away from a sole focus on service delivery to investigate how best to link Maine's most promising entrepreneurs to key resources located across the state, across New England, throughout the US, and around the globe.

Innovative Practice: State policies and incentives are aligned with innovation outcomes and funding is leveraged with federal and private sources to accelerate the pace at which products are developed, brought to market, and taken to scale.

Leveraging Policies to Accelerate Economic Outcomes from R&D

Recommendation: Various case studies conducted for Maine’s R&D evaluation pointed to a technology transfer process and university rewards systems that continue to underperform when compared to similar systems across the US. Academic institutions have received the largest share by far of Maine’s recent new investments in R&D. A large portion of this investment supports research that is enhancing the pursuit of knowledge, and may lack a direct commercial counterpart of pathway. Nonetheless, statewide performance in terms of generating commercial outcomes needs to improve. Current academic systems place great emphasis on “inputs” into academic research and institutions, namely, the ability to attract research dollars from private, non-profit, or public sources. As noted in the *Science & Technology Plan*, a similar focus on outputs and outcomes is also required. These metrics typically take the form of academic publications and citations, but should also track economic development outcomes such as new technology commercialization or company spin-outs. More powerful incentives to generate economic development outcomes are needed. A change in this type of policy and reward system has been proven effective in other universities across the country, with one of the most notable improvements in Utah.

Modifying Tax Credits to Accelerate Business and Job Creation

Recommendation: Review and ensure Maine’s R&D tax credit is competitive and rewards sustained research capacity. State policymakers should investigate options to modify the existing R&D tax credit to be competitive with credits provided in other states. A revised tax credit should increase the tax credit rate on incremental R&D spending and basic research to be competitive with other states. The credit could also 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).

In 2009, Oklahoma updated its quality jobs tax credit to include smaller businesses and a new tax credit targeting engineers and technical professionals. The Small Employer Quality Jobs incentive allows qualifying small businesses (90 or fewer employees) that are creating new direct jobs within one year to receive up to a 5% cash-back incentive to locate or expand in Oklahoma. The 21st Century Quality Jobs incentive was created to attract growth industries and sectors to Oklahoma through a policy of rewarding businesses with a highly skilled, knowledge-based workforce. The intended purpose of the program is to promote impactful high wage jobs without competing with existing incentives. Qualifying companies may be eligible for up to twice the net benefit rate of the Quality Jobs program, or 10% of the taxable payroll of these new jobs.

Recommendation: The state should make modifications to High Technology Investment Tax Credit and Jobs & Investment Tax credit to reflect the current market environment facing innovation-based companies. Many tax credits were developed in an era when incentives targeted the recruitment of large businesses as opposed to supporting the organic growth of firms already located in a target state or region. Reducing job or investment requirements to be more in line with the size of today’s science and technology companies would work to grow businesses that already have a foothold in the state.

Leveraging Federal Programs

Moving research from an idea to a new product, and then to scale within the marketplace, requires significant and sustained levels of research that is hard to support through state funds alone. Where possible, state investments funds should be used to help leverage other private and federal funds. In some states, a five to fifteen fold leverage can be achieved with catalytic state investments. Using state funds to leverage larger amounts of federal and private investment also means that the matching source has already done the legwork and initial investment in determining the strategic importance of a particular research focus. This increases the likelihood of a research moving closer toward commercial potential.

Recommendation: Use state funds to strategically attract funding and resources from private, federal, and foundation sources. A growing number of states are moving beyond initial assistance with grant writing or small bridge funds and matching all or part of federal funds that a private company receives from competitive awards such as the Federal Small Business Innovation Research (SBIR) program. Since the evaluation of competitive research programs is time consuming and if focused at just the state level may miss significant national opportunities, states like Kentucky and North Carolina are letting the federal government determine the winners, and then rewarding those winners with matching funds of 50-100% to accelerate their progress. (Note: SBIR Phase I awards are up to \$150,000 and Phase II are up to \$1 million.) In North Carolina, since the program's inception approximately \$12.7 million has been provided as matching funds via 158 awards and over \$210,000 has been awarded as incentives to submit Phase 1 proposals. About 75% of all matching awards have gone to companies with 10 people or less. While MTI has modified its program to include a modest pre-phase II SBIR grant of \$10,000, the level of grants is well below that of other state programs. With other states indicating strong gains from their program, a more significant match in Maine should be explored—especially in cases with strong commercialization potential.

Leveraging Private Capital

Private investors, especially angel and venture capitalists (VCs), look for good deals. Good deals are those that are well connected to growing markets, have a “secret sauce” that few other have, and are surrounded by networks of peers and advisors that can help new companies address specific growth hurdles. Equity investment may be slightly influenced by additional tax incentives, but, if the deal flow is not present, then incentives will not matter. In small states, it is especially hard for the public sector to establish stand-alone seed or venture funds that are large enough to prime the pump for later stage investment. Funds that are established as a co-investment funds tend to do a better job at leveraging private sector dollars. By being a co-investor with private funds, deals also tend to be more robust and co-investors are able to bring additional expertise and mentoring to the table. This model of co-investment can be applied at the angel and VC level.

Recommendation: One place the state could increase private equity leverage is by increasing the scope of the Small Enterprise Growth Fund. SEGF reports that “For every \$1 that the SEGF invests in a Maine business, more than \$9 are invested alongside by individuals and other venture funds.” The

legislature just passed a bill that would increase the scope of SEGF by allowing the Small Enterprise Growth Board to establish and manage separate investment funds raised from entities other than the State. The bill is awaiting signature by the Governor. The state should support this expansion and also support future funding increases through bond funding so that further investments can be made.

A second way is to support the creation of the “Fund of Funds” –The purpose of this finance mechanism is to attract more venture capital to innovative Maine businesses. It has been considered for passage over the past several years and is once again up for consideration at the Legislature. The program provides encouragement for investment in high-quality venture capital funds that evidence both a commitment to seeking Maine investments and the ability to produce favorable returns to minimize the risk of tax credit redemption. If passed as originally proposed this program would improve access of innovative Maine businesses to venture capital funds.

Workforce Development

Key metrics in this year’s Innovation Index continue to show potential challenges related to the state’s pipeline of science and engineering students and workers. When compared to other states and regions, Maine lags in terms of attracting students and workers in these critical fields. The workforce recommendations in the recent Science and Technology Plan serve as a strong foundation for addressing those challenges identified in the Index.

As noted earlier, Maine’s past investments in R&D have had a desired effect. Maine is “in the game.” But, to continue the sports metaphor, Maine must now “take its game to next level.” It cannot achieve this goal by simply investing more money in traditional approaches; it will need to rethink how it plays the game. In some cases, this will require eliminating programs and investments that are no longer reaping dividends. In others, it may require minor tweaking or even large scale expansions of successful projects. It will also require a new commitment to aligning, connecting, and leveraging past efforts and new initiatives. This mix of approaches can help ensure that the state’s leaders are effective stewards of past investments, while also setting the stage for newer approaches.

Recommendations from 2009 Case Study – “The Innovation Landscape in Maine: Strengthening the Role of Maine’s Industry Associations in Supporting the Maine Innovation Economy.”

Based on the interviews, research, and resulting findings for this case study, we present the following recommendations for enhancing the role of industry associations in developing a strong Maine innovation economy:

Enhance Support for the Core Mission of Information Exchange and Network Development

Establish an ongoing and systematic vehicle by which shared issues and opportunities for joint programs, partnerships, and collaborations can be identified.

Through the course of our research and interviews we have identified the following ideas for shared services, partnerships and collaborations as a starting point for moving forward:

Marketing – At present, branding for Maine’s innovation driven assets, opportunities, and culture is nearly non-existent. Existing efforts are small and fragmented with limited impact. For example, funding limitations have prevented Maine from participating (at a state level) in major national trade shows, such as BIO2008, the National Specialty Food Trade Shows, and Aquaculture related trade shows. In response, economic developers in the Greater Portland Region have chosen to go it alone with their own resources and no state support for participation in BIO2009. They are considering similar efforts in other industries. A system to support greater participation in tradeshow and to expand national and international marketing efforts is badly needed.

Workforce – Technology associations and their member consistently cite workforce development as a top issue impacting the future growth and success of Maine’s technology sectors. Simply put, Maine’s higher education institutions are not developing a sufficiently large and skilled pipeline of science, technology, engineering, and mathematics students. Associations still report challenges in building strong partnerships with key workforce players, such as the Department of Labor, Regional Workforce Boards, Career Centers, and the industry boards of academic institutions. Business input into key workforce development strategies appears limited. A lack of funding for key industry training programs, such as the Governor’s Training Initiative, also constrains progress.

Regulatory and Business Environment– Maine’s technology industries all share a commitment to creating an environment conducive to business growth and development. Most of the interviewed association leaders cited challenges in areas such as taxes, permitting, and human resources policies. Land use issues, especially those related to the siting of new facilities, are particularly important in the energy and aquaculture sectors. For information technology firms, taxes and labor/contractor regulations have the most significant impact on business growth. Each technology industry association conducts some advocacy efforts to influence state policy, particularly as they relate to their specific industry. However, when it comes to ongoing advocacy for major issues, such as state research and development bond proposals that cut across technology sectors collaboration remains fairly limited. In most of these cases, the state Chamber of Commerce has been the primary, and sometimes the only, prominent business voice.

Maine's technology community needs to better coordinate its policy agenda to help influence future policy debates.

Provide seed or operational funds for associations representing the emerging sectors of the State's targeted industry clusters, and for emerging entrepreneurship networks that connect businesses across industry sectors.

If the state is committed to promoting innovation and entrepreneurship, it should consider providing capacity-building grants for associations representing the emerging sectors of Maine's seven target industry clusters (e.g. Biotechnology, Information Technology and Environment). This would assist these organizations in building the networks and programs like that of other mature cluster organizations including the Manufacturer's Association of Maine and the Maine Food Producers Alliance. For example, a three-year capacity grant of \$100,000 per year would be equivalent to one cluster initiative grant. These grants need to be of scale and a long enough period of time to create sustained capacity. It is our recommendation that capacity building grants be managed at arms length of project grants; perhaps by the Office of Innovation, rather than through MTI. This structure could limit potential conflicts of interest and allow MTI to maintain the competitive nature of its project grants.

A related effort should focus on providing seed support to regional entrepreneurship networks where new business owners can interact with their peers and potential mentors. Relatively small investments can play a catalytic role in stimulating the emergence of these entrepreneurial networks. For example, the Wisconsin Entrepreneur's Networks has seeded a statewide network of Inventor and Entrepreneur Clubs by providing small \$1,000 grants to defray the early operating costs of these networks. Thanks to these small grants, more than 40 local entrepreneur networks now operate across the state.

Expand the capacity of the Maine Office of Innovation (OOI) to serve as the state's comprehensive communication vehicle for innovation, entrepreneurial, and technology sector activity

The Maine Office of Innovation, along with key partners such as MTI and industry associations, should help establish a Maine innovation web portal that expands upon the current tools and resources. The site should include a shared calendar for events sponsored by all technology-industry associations and support groups, and it should also include regular newsletters and other information that can be pushed out to key partners and stakeholders. The portal does not need to be operated by the Office of Innovation; this work could be contracted out to other organizations. Numerous options are possible. For example, in Wisconsin, the Wisconsin Entrepreneur's Network (www.wenportal.org) has proved highly successful. In other states, private sector providers manage these functions. For example, Xconomy.com manages web portals covering the technology economy in numerous locations, such as Boston, San Diego, and Seattle. Other states, such as North Carolina, operate a portal and customer service center where business owners can request information or access to support services. The Maine Business Answers website provides some of these services, but does not presently provide access to wider range of information related to innovation and entrepreneurship.

Expand the communication of Maine's innovation resources to audiences outside of the state

Building on lessons from the Maine Office of Tourism, a similar approach for branding Maine's assets can be developed for the state's technology sectors. The state started such a comprehensive information approach under the Maine Science and Technology Foundation in 2000 through the creation of Mainescience.org, but the effort was scrapped with the demise of the Maine Science and Technology Foundation. The state might benefit from a portal where industry groups can obtain information and access resources, as well as submit their stories to be a part of the state's innovation community.

Increase the Capacity for Growth and Competitiveness of Companies

Much of what industry associations do for their members has little direct interface with state government, with the exception that governments are often involved in funding or providing incentives for certain programs or efforts. Members of Maine's innovation-based industry associations would be better served with continued and accelerated focus on the following issues.

Increase access to early stage capital

The state should expand funding for the Small Enterprise Growth Fund, which provides early stage funding (\$100,000-300,000 range) and which has a track record of attracting other private equity funds to their investments. Increasing funding for SEGF is included in upcoming bond proposals to be considered by Maine voters. A collective advocacy effort is needed to inform voters of this program's importance.

The state should enact legislation to expand angel investment. Maine does have a seed capital tax credit program that provides significant tax credits to investors (60% of the value of the investment in certain economically challenged areas of the state and 40% in the remainder of the state) in Maine start-ups and growth oriented companies. Proposals are currently being put forward to increase the level of tax benefit to 60% statewide and the transferability of credits to extend their use. Support for this should be part of a collective advocacy effort within the technology community. Industry groups should continue to advocate for the Maine Fund of Funds, which would create a new vehicle for equity investment in the state. While TechMaine has been advocating for this program for two years, a more coordinated advocacy approach is needed to gain attention and support for this issue.

Enhance the entrepreneurial capacity through better coordination advisory services, technical assistance, and mentoring programs.

The Office of Innovation should facilitate an effort to re-visit and reform the entrepreneurial service delivery system in Maine. This effort should build on earlier work sponsored by the Kauffman Foundation as well as ongoing research into entrepreneurship education that has been sponsored by the Governor's Quality of Place Council.⁹

⁹ Amanda Rector, "Entrepreneurship Education and Training in Maine," Paper Prepared for Maine Quality of Place Council, September 17, 2008.

Systematically address workforce skills and availability issues that cut across all Maine Technology Industry Sectors

All of Maine's technology industry associations have identified talent development as a major concern, and each has attempted to address these problems in some fashion. For a variety of reasons, each industry has sought to address its own unique challenges through its own unique industry lens or perspective. To date, most of these efforts have fallen far short of expectations and appear to have had limited impact on reforming Maine's workforce service delivery system.

Recommendation: Explore the feasibility of establishing a cross-industry collaborative or workforce development partnerships that would take a systematic look at building a healthier pipeline of technology-savvy talent, including strengthening workforce development activities in Maine's higher education system, Career Centers, Department of Labor, Workforce Investment Boards, and among other non-profit workforce-related service providers.

Enhance advocacy vehicles and the improve engagement between state government and the private sector

Establish a technology committee within MIEAB

Building on suggestions from interviews and best practices of other states, a technology committee within MIEAB could be established that would consist only of private sector members—expanding beyond council members to other business and executive directors or chairs of key technology groups. This committee would be instrumental in defining shared needs among industry clusters and acting as a communication channel to both the broader council and the array of science and technology associations throughout the state. It would provide a vehicle by which technology organizations could quickly align around policy issues or make recommendations to program development and funding allocations.

Convene an annual innovation roundtable

Maine lacks an event or vehicle by which technology groups and related organizations like angel networks can convene to identify shared business development and policy issues. Holding an annual summit where various industry groups discuss their cluster development and R&D needs with MIEAB, key state agencies and selected members of the assembly could accomplish two goals. First, it could identify key business development issues facing science and technology companies in Maine, and examine ways in which collaboration among organizations would be beneficial. Secondly, it could identify leading policy and program issues in advance so that organizations could better anticipate and respond to policy debates that might affect the technology sector.

3. Evaluation Results

This section details the answers 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, case study on Maine's technology related industry associations, the economic impact analysis, and the 2010 Innovation Index.¹⁰

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 of 2006, the latest year for which comprehensive data is available, Maine has reached only \$450 million in total R&D performed. The 2010 Science and Technology Action Plan for Maine includes the following goal: “**Maine's R&D activity will equal \$1.4 billion by 2015, (3%) of Gross State Product**”. Based on the 2006 data Maine has attained a level of 0.971% of gross state product. In order to attain this 2015 goal, Maine must significantly intensify its R&D support activity.

3.1 Maine's Competitive Position

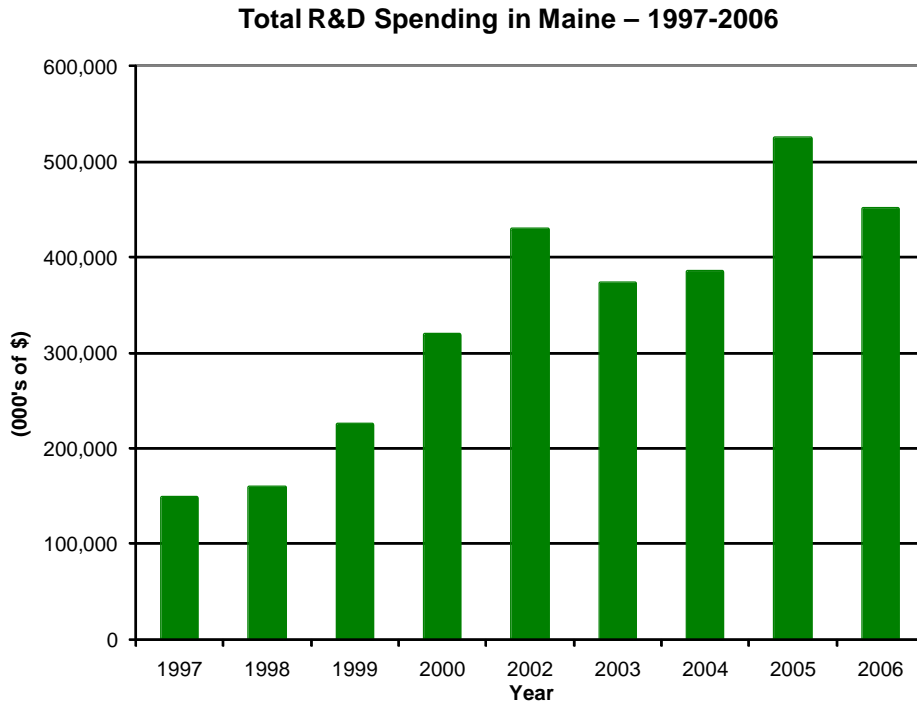
Overall, has Maine's public investment in research and development stimulated and sustained consistent, competitive growth in Maine's economy, especially when compared to other states?

Bottom Line: *While state investment increases in the late 1990's and early 2000's did improve Maine's competitive position with regard to total R&D performance, Maine has not made significant progress since 2002, and therefore has not had the impact hoped for in its “Science and Technology Action Plan.”*

Total R&D Capacity: According to the National Science Foundation, Maine's total R&D capacity has increased from approximately \$429 million in total R&D spending in 2002 to \$450 million in 2006 (see **Figure 3.1**). This represents an increase of \$21 million or 4.95% over the past five-year reporting period. During that same period, the State of Maine invested approximately \$105 million of general funds and another \$67 million in bond funding into R&D efforts for a total Maine investment of \$172 million.

¹⁰ 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 impact study is in section 7 of this report. The Case Study and Innovation Index for 2010 is under separate cover.

Figure 3.1.

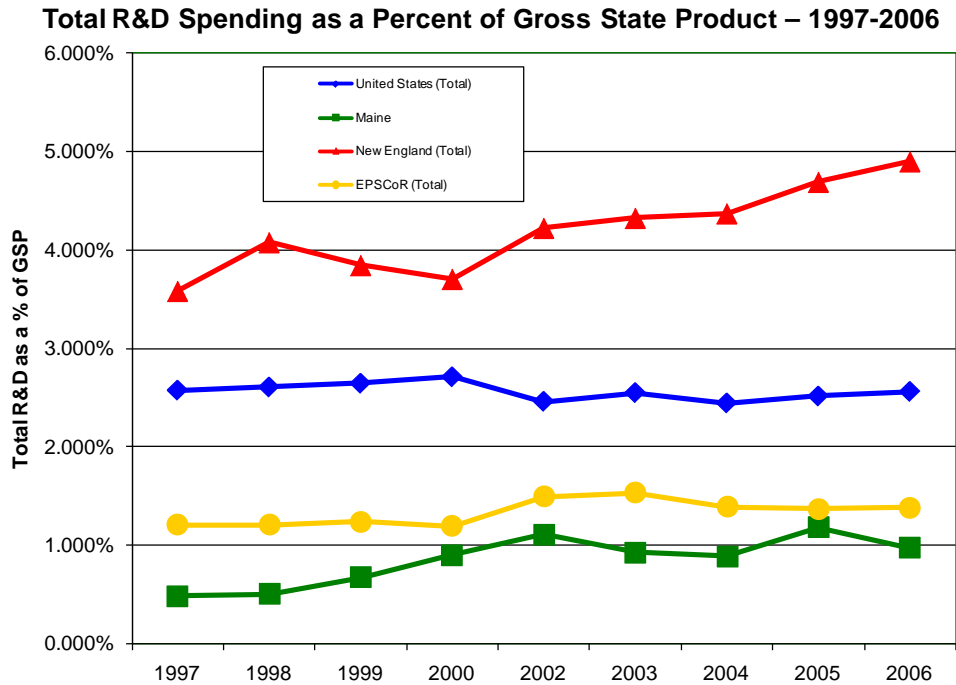


Note: From 1997-2000 & 2002-2006 chart portrays one-year increments; all other years are in two-year increments.

Sources: Total R&D spending is from National Science Foundation/Division of Science Resources Statistics. National Patterns of R&D Resources (annual series), 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>.

In 2006, total R&D performance in Maine represented 0.97 percent of GSP compared to 2.56 percent for the U.S., 4.90 percent for New England, and 1.38 percent for the EPSCoR states. Maine lags the reference groups on this indicator, but has remained near the average of other EPSCoR states for several historical years. However Maine saw a decrease in this indicator from 2005 to 2006, distancing it from EPSCoR. **In 1997 Maine ranked 49th among all states in total R&D as a percent of gross state product (GSP). In 2002, Maine improved its ranking to 38th and improved again in 2005 to 35th. However, in 2006, the latest year for which comparable data is available, Maine's ranking returned to 38th. Thus, while the state investment increases in the late 1990's and early 2000's did improve Maine's competitive position; overall Maine has made little progress since 2002 on this indicator.**

Figure 3.2.



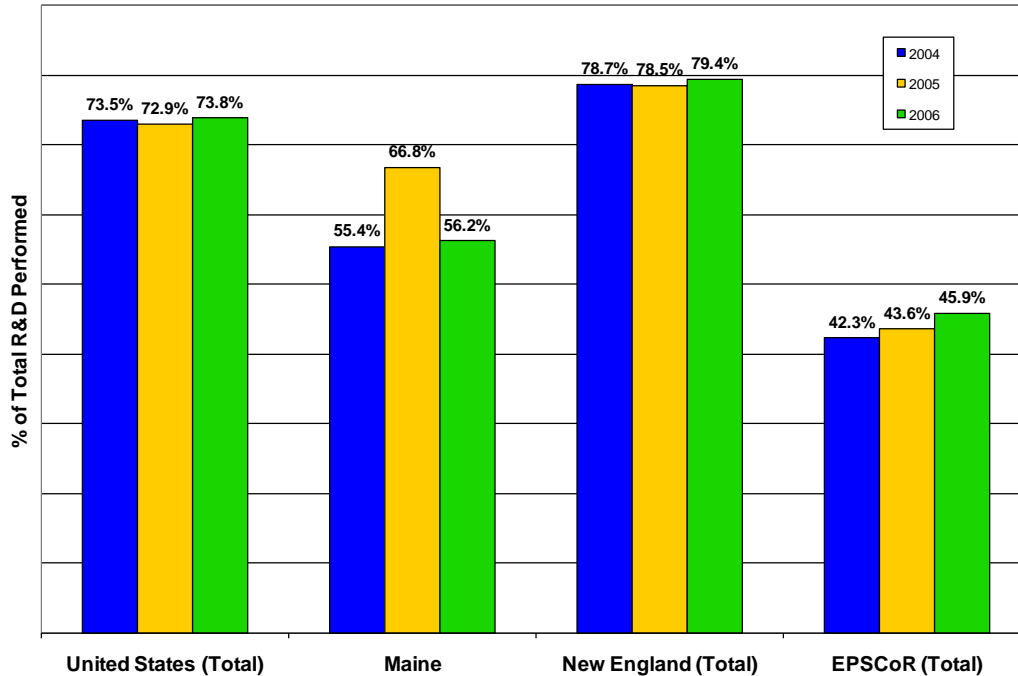
Note: From 1997-2000 & 2002-2006 chart portrays one-year increments; all other years are in two-year increments.

"Total R&D Performed - National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002, 2004, and 2007 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, 1980-1997 data; and Revised Estimates for 2005-2008; <http://www.bea.gov/regional/gsp/>; 1997-2007 is based on NAICS.

R&D Performance Mix: Maine’s R&D environment is unusual in that a larger portion of the R&D is performed by not-for-profit research institutions. Furthermore, the performance of Maine’s not-for-profits research institutions is driven primarily by one major institution, The Jackson Labs, which in 2009 accounted for 63 percent of R&D expenditures and 74 percent of all research related employment among all Maine not-for-profit institutions. It should also be noted that Maine’s R&D performed by universities and colleges is heavily influenced by the University of Maine, Orono. In 2009 UMaine Orono represented 50 percent of all research related employment and 56 percent of R&D expenditures among all universities and colleges in Maine. **Figures 3.3 through 3.5** show the relative importance of the three types of R&D performers in Maine. As indicated in **Figure 3.3** industry has a larger role in Maine’s R&D than in other EPSCoR states but the proportion is lower than for the United States or New England as a whole. Maine’s overall industry R&D ranking (based on industry R&D expended as a percent of gross state product) remains at 38th among all states. **This relatively weak performance is a potential concern as industry R&D is generally considered to have higher direct economic impact and commercialization potential.**

Figure 3.3.

Industry R&D as a Percent of Total R&D Performed – 2004 - 2006

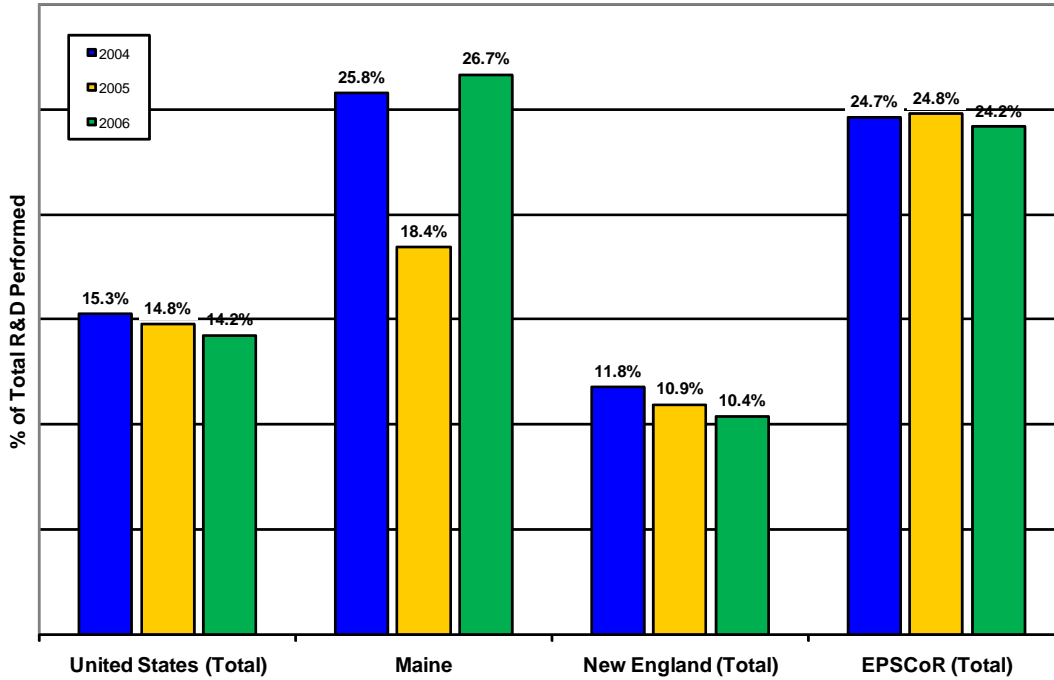


Source: Industry R&D Performed – Industry R&D performance is from National Patterns of R&D Resources: 2007 Data Update Detailed Statistical Tables | NSF 08-318 | November 2008 <http://www.nsf.gov/statistics/infbrief/nsf08313/> Gross State Product is from Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997- 2008; <http://www.bea.gov/regional/gsp/>. 1997-2008 is based on NAICS while 1980-1996 is based on SIC industry classification.

Figure 3.4 shows an increase in academic R&D as a percent of total R&D in the last year available, and that Maine’s academic R&D continues to remain higher than the rate in the United States or in the New England states as a whole. **Figure 3.5** indicates the importance of nonprofit R&D to Maine. Maine’s percent of nonprofit R&D is approximately seven times greater than the U.S. or EPSCoR average.

Figure 3.4.

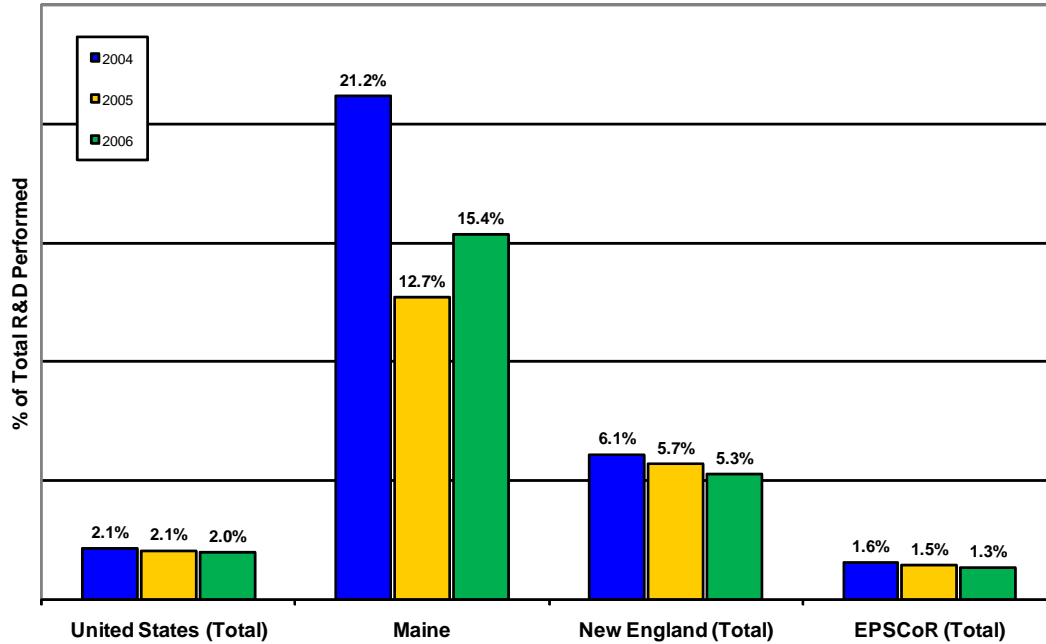
Academic R&D as a Percent of Total R&D Performed – 2004 - 2006



Source: Academic R&D performance data is from National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2008; <http://www.nsf.gov/statistics>.

Figure 3.5.

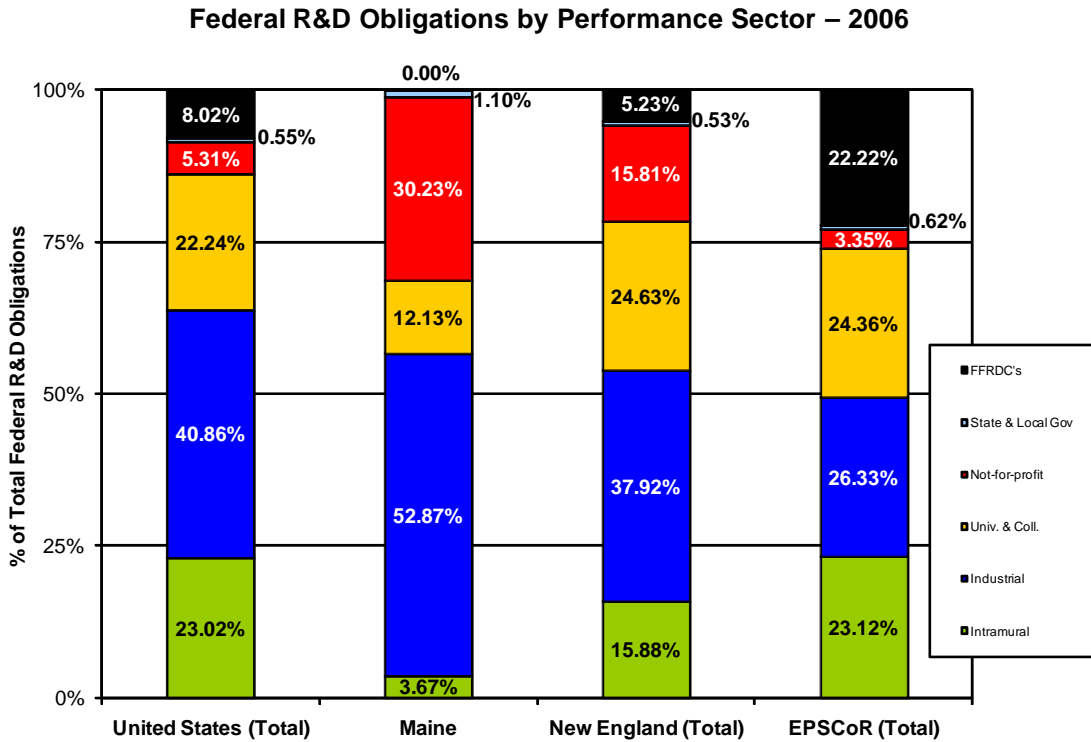
**Federally Supported Not-for-Profit R&D
as a Percent of Total R&D Performed – 2004 - 2006**



Source: 1987-2006 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; 2004-2006 is from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, 2005 and 2006; <http://www.nsf.gov/statistics..>

The federal government is a major funder and plays a critical role in spurring R&D. **Figure 3.6** 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 3.6.



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, 2005 and 2006; <http://www.nsf.gov/statistics>

Further assessing the performance of Maine R&D by sector using the latest data available, 2003-2007¹¹, **Table 3.1** compares Maine’s five-year investment levels¹² by 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. Maine has invested 59% of its state R&D funding in universities between 2003 and 2007. In 2007, the universities represented 29% of the total R&D spending. The state has invested 17% in industry R&D between 2003 and 2007 through private sector-focused programs, and industry performed 55% of the state’s R&D. The nonprofit sector received 24% of funding and accounted for 16% of the total research. In terms of growth in R&D performance between 2003 and 2007 Maine’s industry and nonprofit sectors lagged that of the US, whereas Maine’s academic sector outpaced the US, primarily due to an extremely low baseline in 2003 which ranked Maine’s academic R&D as 50th among states. This higher than average growth rate has moved Maine’s ranking to 46th.

¹¹ 2007 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.

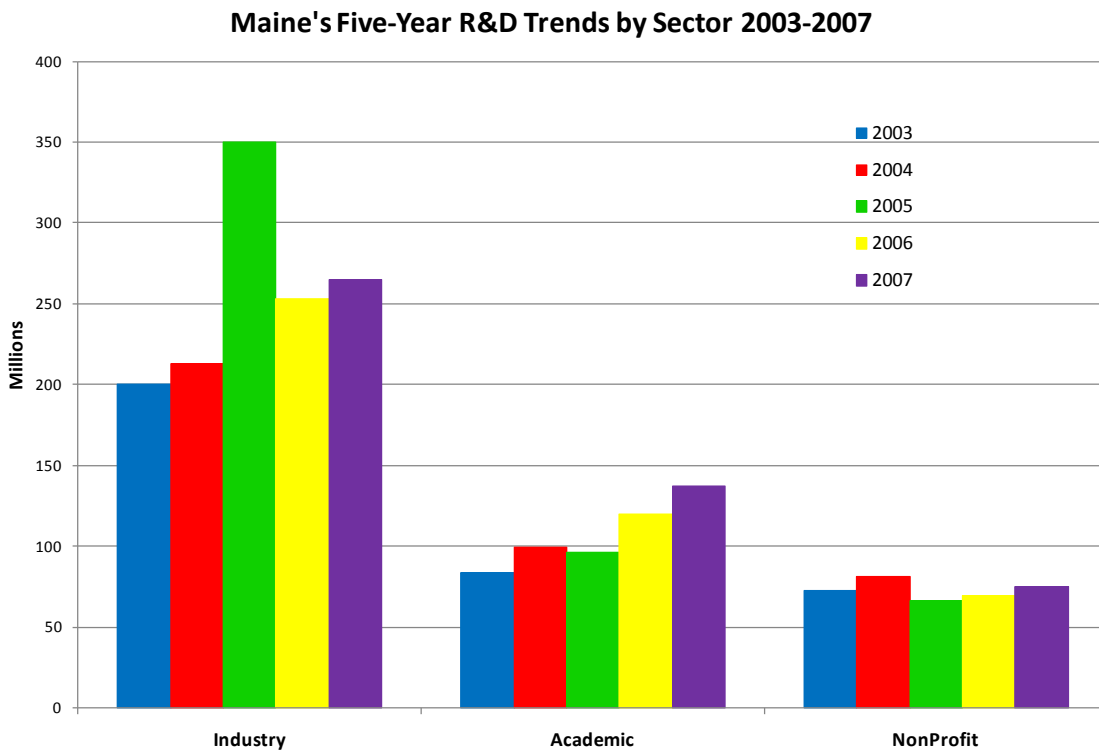
¹² Maine’s investment by sector was estimated based on actual general fund appropriations and binds for the State’s R&D related programs and an estimated percent of allocation of those funds from the Maine Office of Innovation.

Table 3.1. Five-Year Comparison of Public Investment (2003–2007) and Performance of R&D (2003–2007)

	% of Maine Public Investment in R&D 2003–2007	% of Performance of R&D, 2007	Maine % Change in Performance of R&D, 2003–2007	U.S. % Change in Performance of R&D, 2003–2007
Industry	17%	55%	33%	36%
Academia	59%	29%	64%	24%
Nonprofit	24%	16%	3%	30%

Figure 3.7. presents trends in R&D performance by sector between 2003 and 2007. Year to year data indicates fluctuations, however, between 2003 and 2007, Maine’s industry and academic sectors experienced increases while the not-for profit sector remained relatively constant.

Figure 3.7.



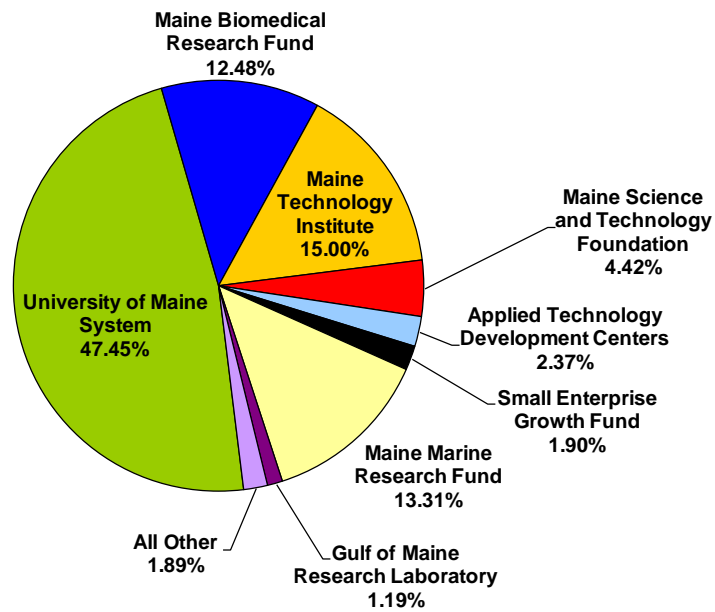
Sources: Total R&D Performed – National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges, Survey of Federal Funds for R&D, and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

Figure 3.8 shows the distribution of R&D investments by major program areas since starting in 1996, and also just for the most recent year. While some programs serve a combination of industry, university, and nonprofit clients, between 1996 and 2009 the University of Maine received the most funding,

followed by the Maine Technology Institute and the Marine Research and Biomedical Research Funds. In the 2009/10 fiscal year, 70% of the funding went to the University of Maine system (primarily through the Maine Economic Improvement Fund) and 28% went to the Maine Technology Institute. Together, UMaine System and MTI accounted for 98% of R&D funds in the latest fiscal year. Worth noting is that in recent years, funding has declined for the Maine Patent Program, Applied Technology Development Centers, and Small Enterprise Growth Fund.¹³

Figure 3.8.

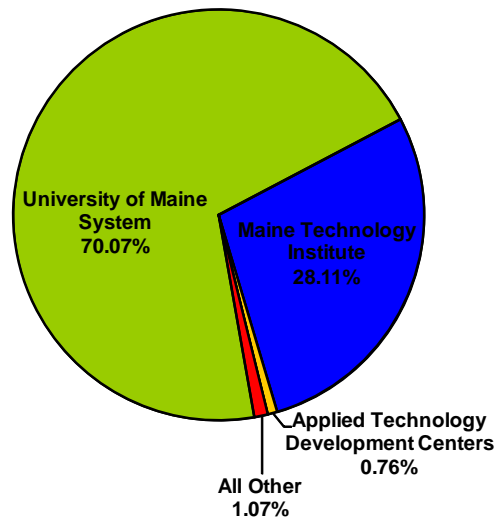
Maine State Funding for R&D by Program FY1996/97-FY2009/10



Total State Funding for R&D = \$420,884,282

¹³ The current Legislature has passed a bill that is waiting to be signed by the Governor that would increase the scope of SEGF. Additionally, bond funding for SEGF will be considered by voters in June 2010.

Maine State Funding for R&D by Program FY2009/2010

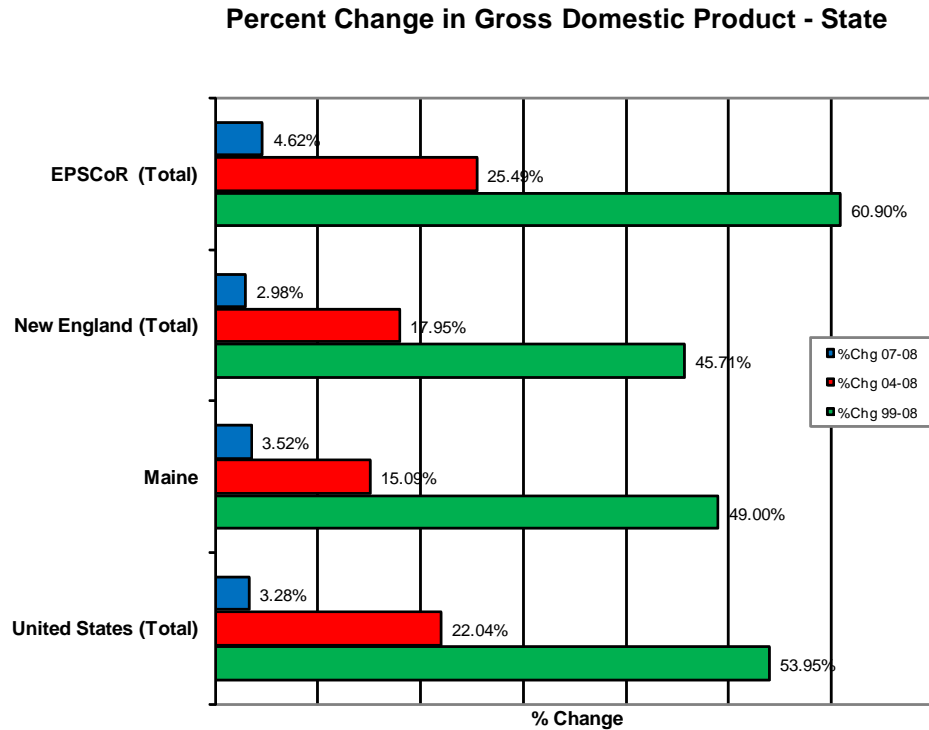


Total State Funding for R&D = \$24,796,646

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

Economic Growth: Gross state product provides a macro measure of a state's economic performance. **Figure 3.9** shows that during the last ten year period for which data is available (1999-2008), Maine's gross state product (GSP) grew by 49.00 percent. This growth rate is higher than the overall GSP growth for New England (45.70%) during the same period, yet is below the 60.90% growth rate for EPSCoR states and the 53.95% growth rate for the United States. From 2007-2008, Maine experienced a growth rate of 3.52% while New England GSP grew at 2.98%, EPSCoR states at 4.62%, and the United States at 3.28%.

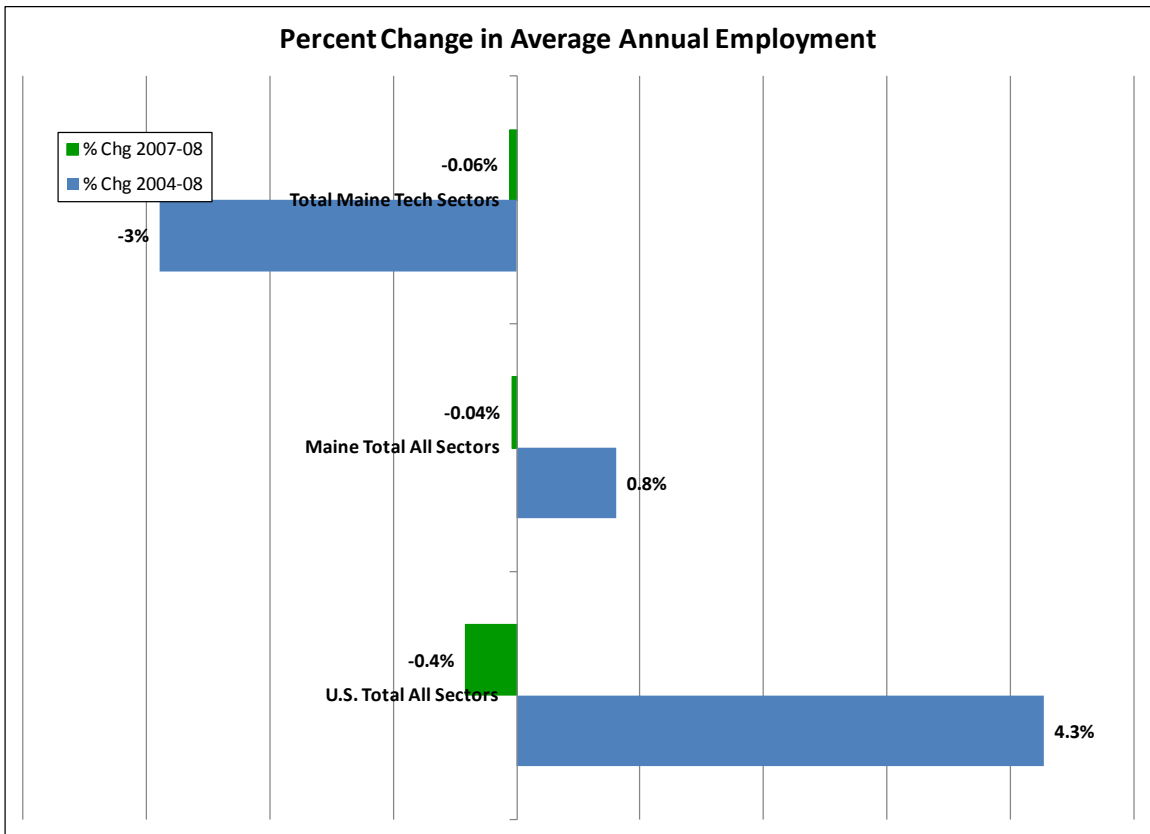
Figure 3.9.



Source: Gross state product is from Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997-2008; <http://www.bea.gov/regional/gsp/>; 1997-2008 is based on NAICS while 1980-1996 is based on SIC industry classification.

As indicated in **Figure 3.10** between 2007 and 2008, total average employment in Maine’s targeted technology sectors declined by 0.06 percent. This compared to a change in total employment in the US of -0.40 percent and for all sectors in Maine of -0.04 percent. Over the five year period from 2004 to 2008, the total average employment number in Maine in the targeted technology sectors declined by 3.0 percent. This compared to an increase in total employment in the US of 4.3 percent and in Maine of 0.8 percent.

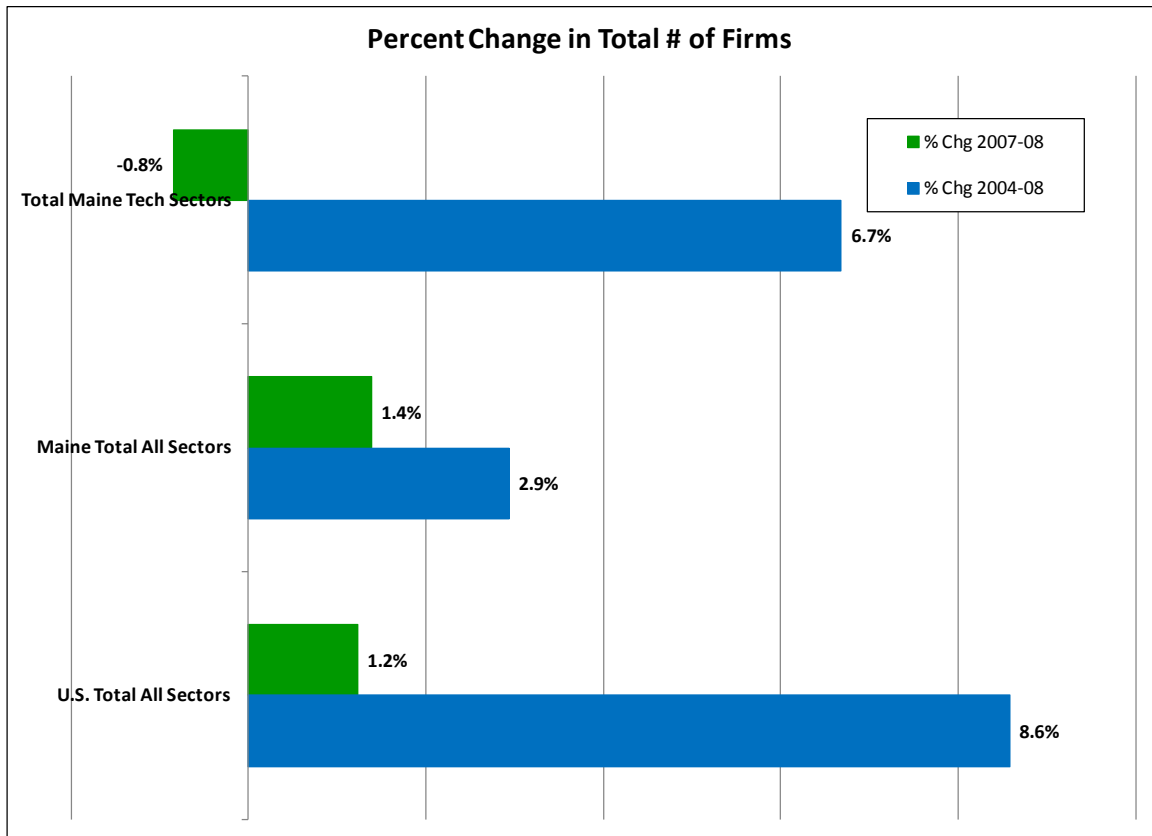
Figure 3.10.



Sources: Data for Maine's Targeted Technology Sectors is provided by Maine Center for Workforce Research and Information, Maine Department of Labor. Data on totals statewide and in the US is from Quarterly Census of Employment and Wages, Bureau of Labor Statistics; US Department of Labor, <http://data.bls.gov>.

As indicated in **Figure 3.11** between 2007 and 2008, the number of firms in the Targeted Technology Sectors in Maine decreased by 0.8 percent. This compared to an increase in total establishments in the US of 1.2 percent and in Maine of 1.4 percent. Over the five-year period from 2004 to 2008, the sectors had seen an overall increase of 6.7 percent. This compared to an increase in total establishments in the US of 8.6 percent and in Maine of 2.9 percent.

Figure 3.11.



Sources: Data for Maine's Targeted Technology Sectors is provided by Maine Center for Workforce Research and Information, Maine Department of Labor. Data on totals statewide and in the US is from Quarterly Census of Employment and Wages, Bureau of Labor Statistics; US Department of Labor, <http://data.bls.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: *In the past five years, Maine has gained ground in terms of academic R&D expenditure performance but commercialization metrics are not increasing at a similar rate. The consistently low level of Science and Engineering graduate students also remains a concern.*

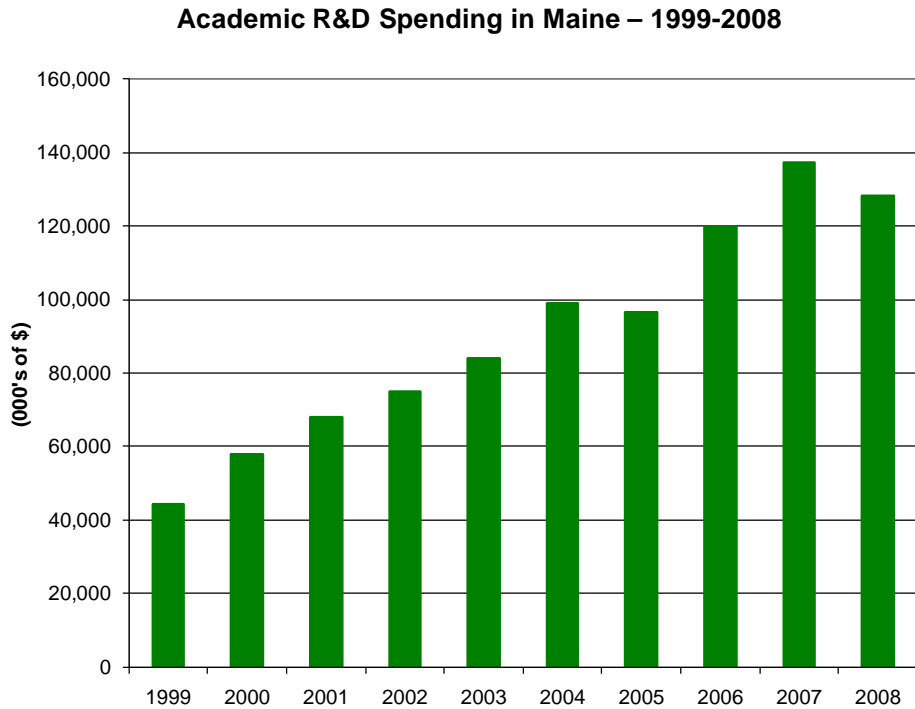
Over the past five years, FY 2005-06 through FY 2009-10, Maine has allocated over \$81 million in revenues from bonds and appropriation (or 46% of state R&D investments) in direct support of the University of Maine System (UMS). Additional state funds were received by UMS and the state's other higher education institutions through other R&D support programs, such as those managed by the Maine Technology Institute. The annual evaluation survey tracks Maine R&D programs utilized by the following academic institutions:

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

It should also be noted that based on the annual survey conducted for this evaluation, Maine's R&D performed by universities and colleges is heavily influenced by the University of Maine, Orono. In 2009 UMaine Orono represented 50 percent of all research related employment and 56 percent of R&D expenditures among all universities and colleges in Maine.

As indicated in **Figure 3.12** and based on the most recent five years of R&D data reported to the National Science Foundation, Maine's academic institutions have raised their R&D spending from \$99 million in 2004 to slightly more than \$128 million in 2008-- an increase of 29%. The 2008 level is down from a five-year high of \$137 million in 2007.

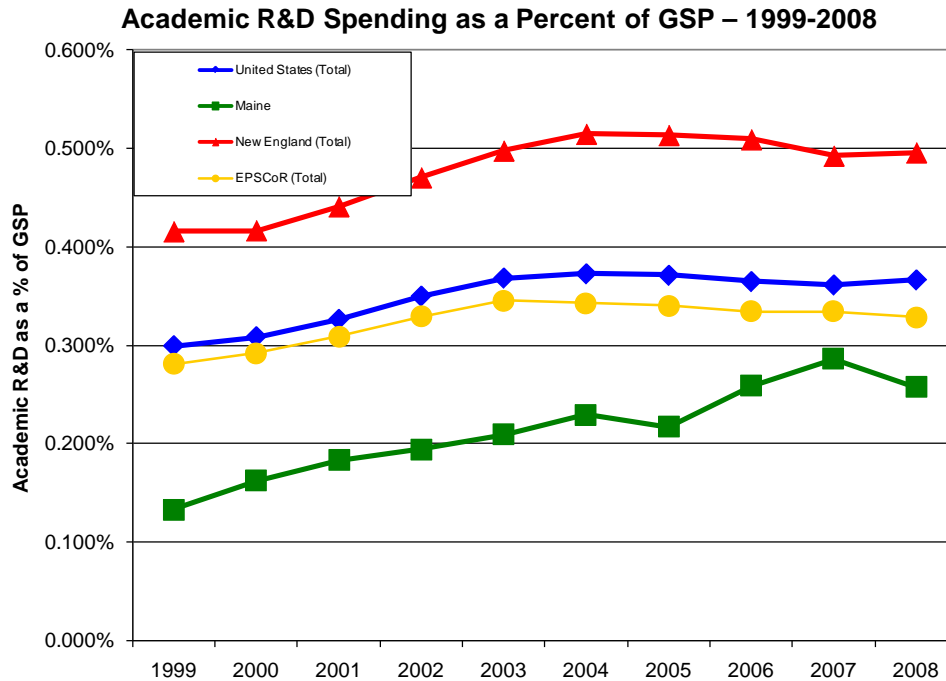
Figure 3.12.



Sources: Academic R&D performance data is from National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 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 (see Figure 3.13.). While Maine's performance still lags the benchmark groups on a relative basis, the state has been closing the gap in recent years. Between 2004 and 2008 growth in academic R&D in Maine equaled 29.2 percent outpacing the growth experienced on average in the U.S (20.0 percent) and New England (13.6 percent), and the EPSCoR states (20.5 percent). Like Maine, all of these benchmark groups witnessed a decline in R&D performance in 2008.

Figure 3.13.



Sources: Academic R&D performance data is from National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 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 1997-2008; <http://www.bea.gov/regional/gsp/>. 1997-2008 is based on NAICS while 1980-1996 is based on SIC industry classification

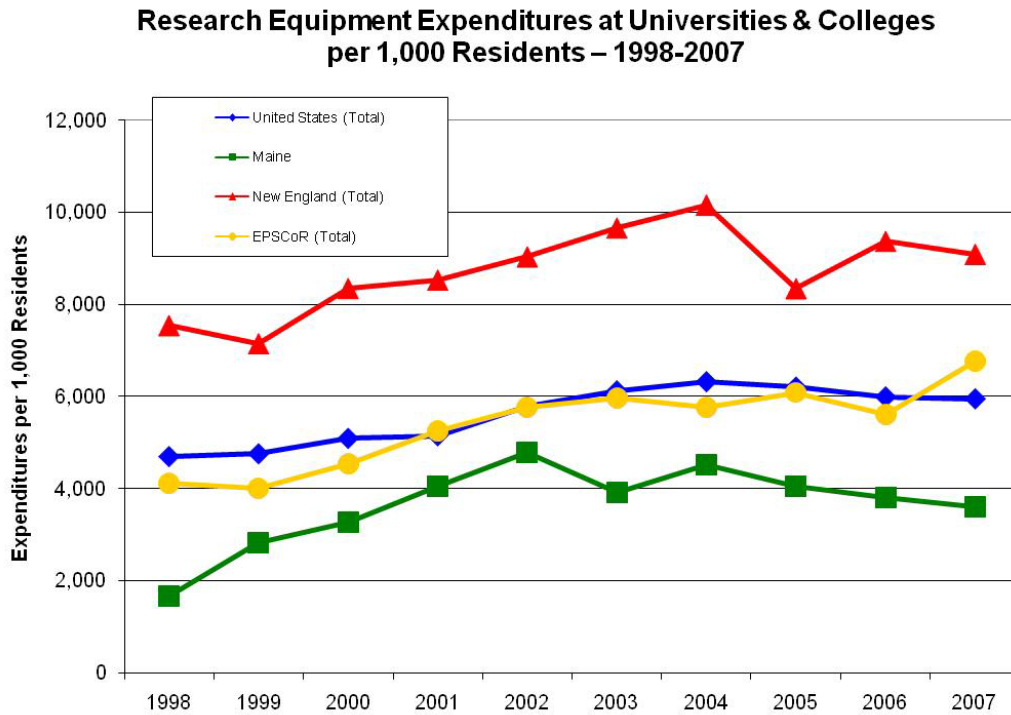
The survey of university and nonprofit research institutions conducted for this annual evaluation revealed mixed results compared to the previous year. Based on the 2009 survey:

- Universities noted just under \$102 million in R&D expenditures, down 27% from the previous year's \$139 million R&D expenditures.
- Universities received 421 new federal grants and contracts--- a decrease of 19% from the 2007 level of 521. However the dollar value of those awards increased by 44%, from the 2007 level of \$85 million to \$122 million in 2008.
- The number of industry grants and contracts in 2009 was 303, a decrease of 4% from the 2008 level of 316. The 2009 value of those contracts was \$3.4 million, a decrease of 30% from the 2008 value of contracts of \$4.8.
- The number of EPSCoR awards decreased 56%, from nine awards in 2008 to 4 awards in 2009; however, the value of EPSCoR awards increased 592% from \$3 million in 2008 to \$21 million in 2009. This was due to the award of a \$20 million NSF grant for the Sustainability Solutions Initiative.

- In 2009, universities reported 28 disclosures, an increase from 20 in 2008; 17 patents applied for, down from 25 in 2008; and 3 patents granted, down from 6 in 2008.
- Licenses decreased from five in 2008 to two in 2009, and the license revenues decreased 33% from \$128,000 in 2008 to \$85,000 in 2009.
- In 2009, 786 science graduate students and 5,947 undergraduate students enrolled, compared to 750 graduate and 5,107 undergraduate students reported in 2008.
- In 2009, universities invested \$2,424,876 in new major research equipment, compared to \$2,591,089 in 2008.
- Peer-reviewed publications were up for journal articles, book chapters and books compared to 2008.

Building R&D capacity at universities requires investment in facilities and infrastructure. **Figure 3.14** tracks the research equipment expenditure at universities and colleges. 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.

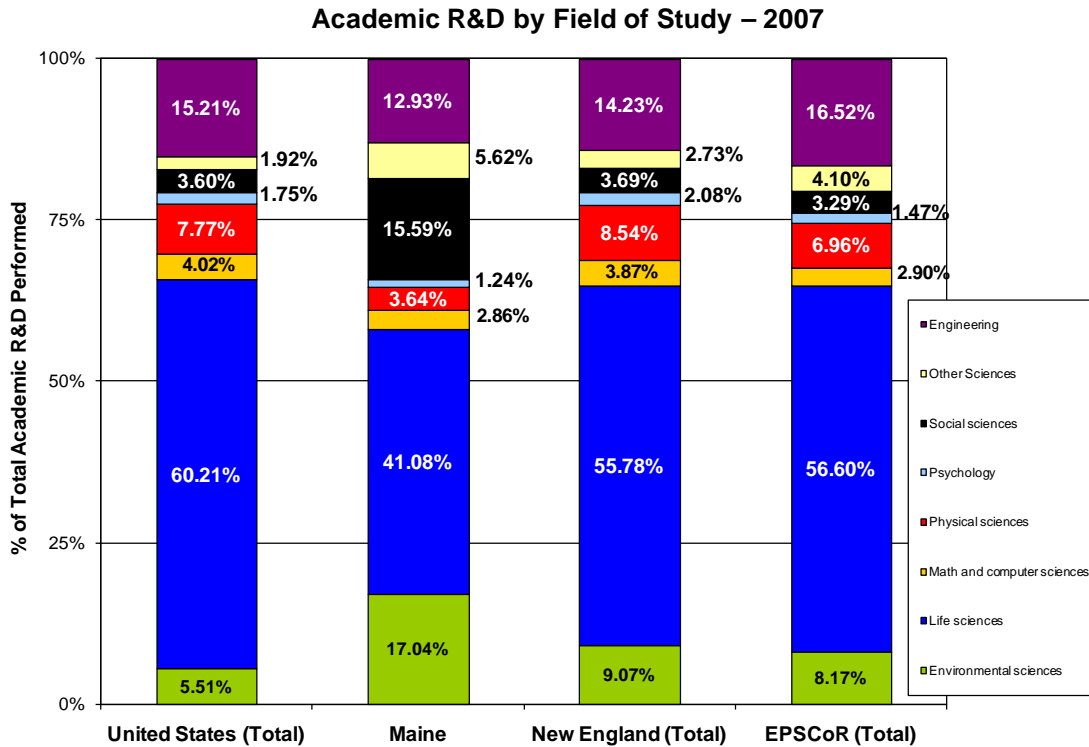
Figure 3.14.



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>.

Few states or universities excel in all research or academic disciplines. Universities tend to develop expertise in specific disciplines 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 3.15** shows that Maine's academic research is 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 remains critical.

Figure 3.15.



Source: University & College R&D Performed – National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2007. <http://www.nsf.gov/statistics>

Commercialization of research: While overall R&D expenditures have increased at fairly rapid pace for universities in the past five years, commercialization of research has been slower. In this year’s (2009) survey to universities, 28 invention disclosures (up from 20 in 2008), three patents awarded (down from 6 in 2008), and one start-up firm were recorded. The 2009 survey figures for these indicators tend to place Maine in the lower tier of university technology transfer performance when compared to other US states.

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. Invention disclosures and issued patents were about half of what might be expected from this volume of research. License agreements were weak at universities but stronger for nonprofits.

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.¹⁴

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

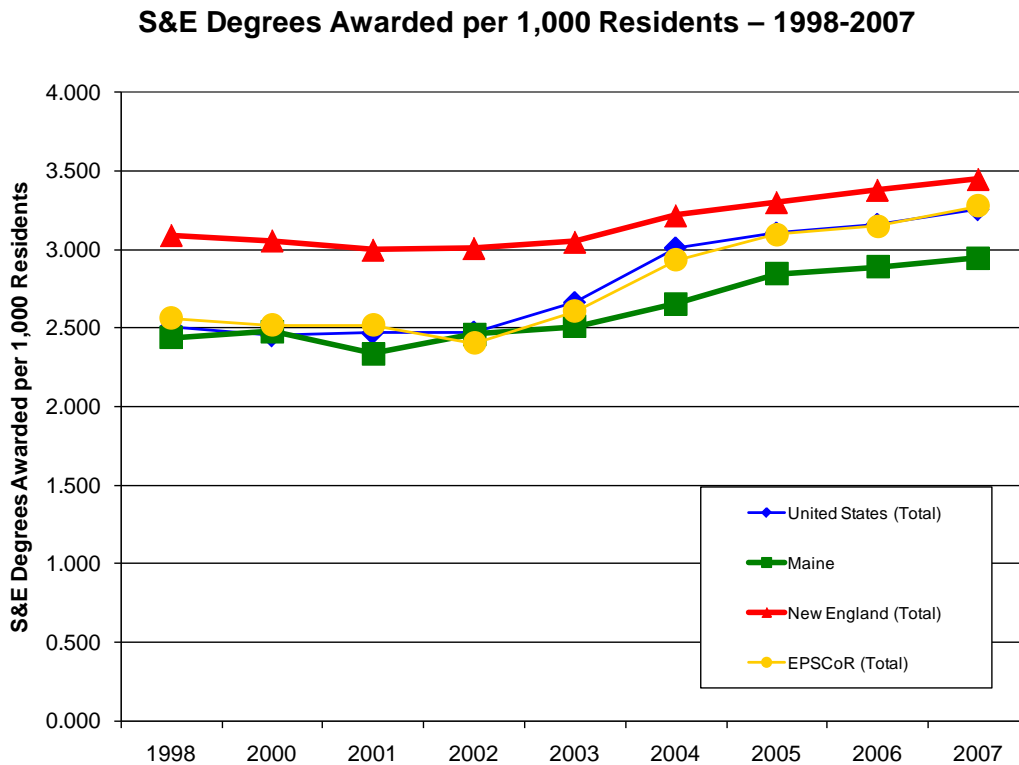
	Average U.S. for universities, hospitals, and nonprofit inst.	Predicted for all Maine universities based on NSF data reported for public & private universities	Actual for universities (survey totals)	Predictions based on the total R&D reported in evaluation survey to universities & nonprofits	Actual for both universities and nonprofits
Invention disclosures	\$2.46m in R&D expenditure per disclosure	55 disclosures	28	80 disclosures	45
Patents Issued	\$13.47m in R&D expenditure per filed patent	10 patents	3	14.6 patents	6
Licenses	\$9.55m in R&D expenditure per license	14 licenses based on survey reporting	5	21 licenses	21
Start-ups	\$88m in R&D expenditure per start-up	1.55 start-ups per year	1	2.2 start-up	1

Source: AUTM 2007 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 (\$197.9 m) and the total reported to NSF (\$137 m). Actual for Maine was determined by the same survey results.

¹⁴ 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.

Maine’s science and engineering workforce: 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 in many industries. In 2007, Maine-based institutions awarded 3,878 degrees in science and engineering fields, with master’s degree or doctorate representing 15% 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 3.16**).

Figure 3.16.

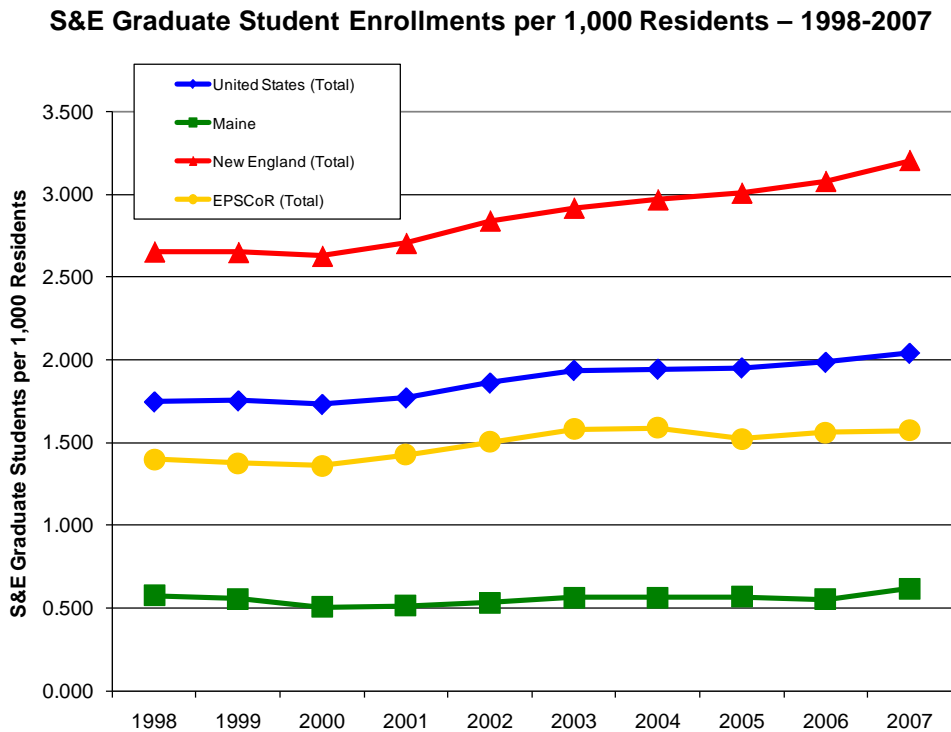


Note: 1999 data is unavailable

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 3.17**, 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 3.17.

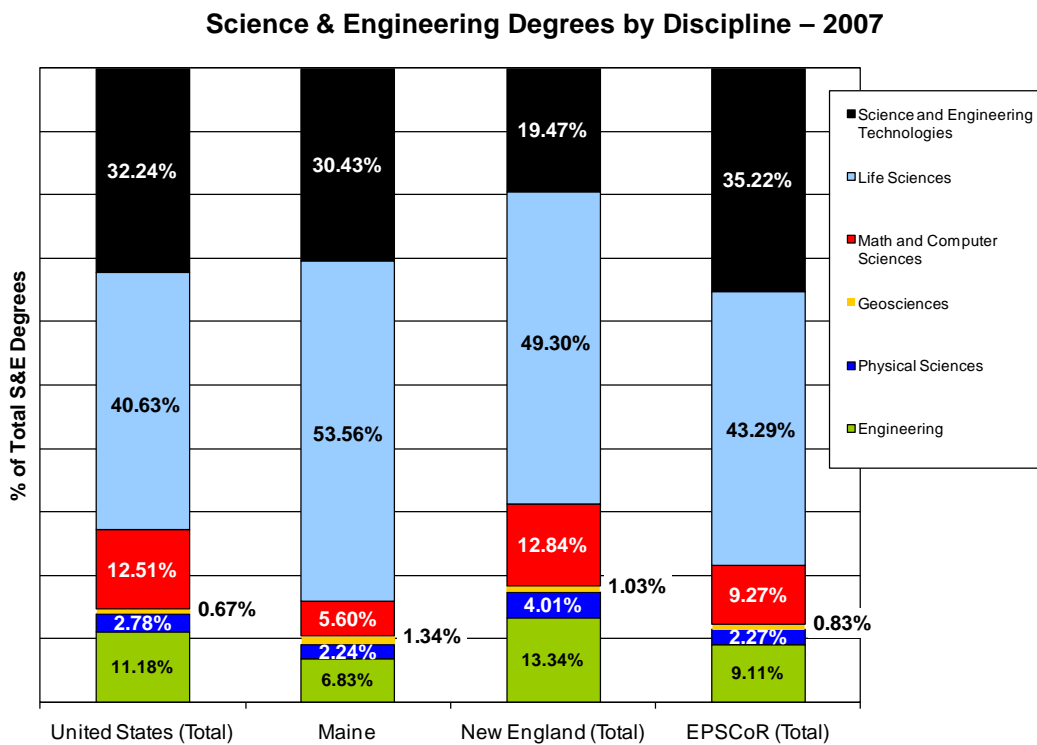


Source: S&E Graduate Students – NSF WebCASPAR Database System based on "Survey of Graduate Students and Postdoctorates in Science and Engineering," National Science Foundation and National Institutes of Health. <http://webcaspar.nsf.gov>

Based on the 2007 data reported to NSF, Maine’s colleges and universities had 812 graduate enrollments in S&E programs, up from the 728 level in 2008.

Preparation for Maine’s workforce can be enhanced when science and engineering training is aligned with the needs of industries employing these graduates. **Figure 3.18** indicates that Maine is producing a large number of life sciences graduates, but a small number of engineers, mathematicians, and computer scientists.

Figure 3.18.



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

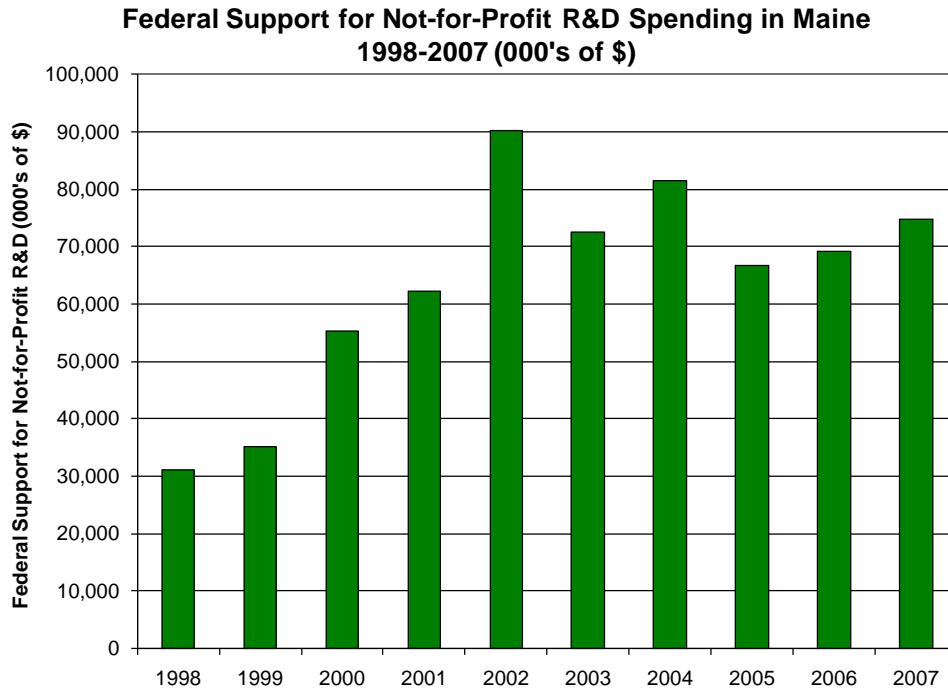
Are Maine's investments in nonprofit research institutions broadening their impact on Maine's economy?

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.*

After years of continual increases between 1998 and 2002, in terms of absolute dollars reported by the National Science Foundation (see **Figure 3.19**), federal funding for not-for-profit R&D performance in Maine has achieved a relatively steady state of anywhere from \$65-\$85 million per year. Maine has enjoyed rapid growth over the past decade as only \$31 million was invested in 1998. The highest recent total occurred in 2002 when the state's non-profit laboratories spent more than \$90 million. In 2007, the latest year for which data is available, not-for-profit R&D performance was \$75 million, an increase 8.0 percent from 2006¹⁵. As indicated previously, the performance of Maine's not-for-profits research institutions is driven primarily by one major institution, The Jackson Labs, which in 2009 accounted for 63 percent of R&D expenditures and 74 percent of all research related employment among all Maine not-for-profit institutions.

¹⁵ 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.

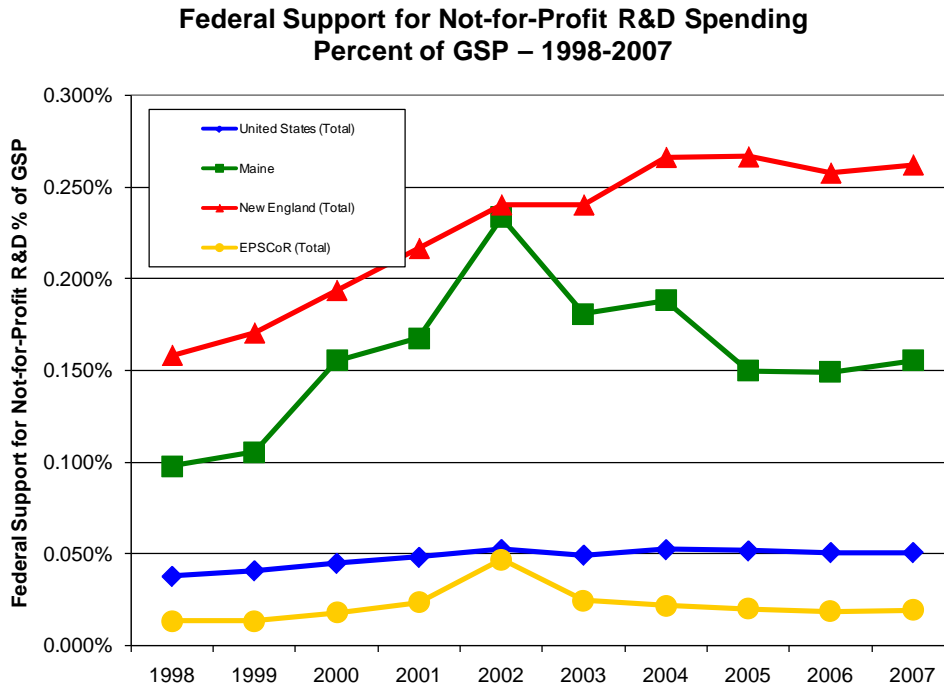
Figure 3.19.



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; 2002-2007 is from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, 2005, 2006 and 2007; <http://www.nsf.gov/statistics>.

When ranked in terms of non-for-profit R&D spending as a percent of gross state product (see Figure 3.20), Maine continues to be a national leader. However, this competitive advantage appears to be eroding over the past several years. From 1995 to 2002, Federal support R&D performed at Maine's not-for-profit research labs grew dramatically, from 0.084 percent in 1995 reaching 0.234 percent of GSP in 2002. Since 2002, Federal support has decreased to levels between 0.150 percent and 0.188 percent of GSP and the 2007 level was 0.155 percent. Even with this decrease, Maine in 2007 remained significantly above the level of the nation as a whole at 0.051 percent and the EPSCoR states combined at 0.019 percent of GSP.

Figure 3.20.



Sources: 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; 2002-2007 is from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, 2005, 2006 and 2007; <http://www.nsf.gov/statistics>.

Gross State Product - Gross State Product is from Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997-2008; <http://www.bea.gov/regional/gsp/>. 1997- 2008 is based on NAICS while 1980-1996 is based on SIC industry classification

In the past five years, FY 2005-06 through 2009-10, 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

In 2009 based on the research institution survey conducted for this evaluation, Maine's not-for-profit research institutions reported the following R&D expenditures and outcomes¹⁶:

- \$96 million in R&D expenditures, up slightly from \$93 million in the previous year
- \$3.5 million in new research equipment investments, a decrease of 4 percent from the previous year level of \$3.7 million.
- 340 new extramural proposals submitted for a total of \$214 million, up from 330 proposals and \$176 million in the dollar value for the previous year.
- 1,710 full-time equivalent research jobs, representing a 1 percent decrease from 2008 level of 1,730 jobs
- The 498 scientific and peer-reviewed journal articles, books, and book chapters, compared to 496 in 2008
- 88 new federal grants and contracts received for a total of \$68 million, representing a decrease of 20 percent in the number of awards but an increase of 7 percent in the total dollar value awarded from 2008
- 37 industry contracts valued at \$4.0 million, up from 2008 level of 20 contracts valued at \$590 thousand
- Mixed performance in the development of intellectual property: 17 disclosures (22 in 2008); 18 patents applications, (21 in 2008), and 3 patents granted, (0 in 2008)
- 19 licenses granted in 2009 (14 in 2008) with no licenses were granted to Maine companies
- \$1.4 million in licensing revenue, up from the 2008 level of \$896 thousand
- No new spin-off companies or jobs

Maine's nonprofit research cluster is sizable and its improved performance in terms of publications, federal grants, and contracts indicate a strong national reputation. Yet if the 1,710 jobs were better connected to industry, this research sector could prove to be a major catalyst for economic development. These connections, however, still appear to be weak when one compares the US average performance of nonprofits research in regard to metrics such as patents, spinoffs, industry sponsored research, and invention disclosures.

¹⁶ The institution survey findings are included in **Attachment B**.

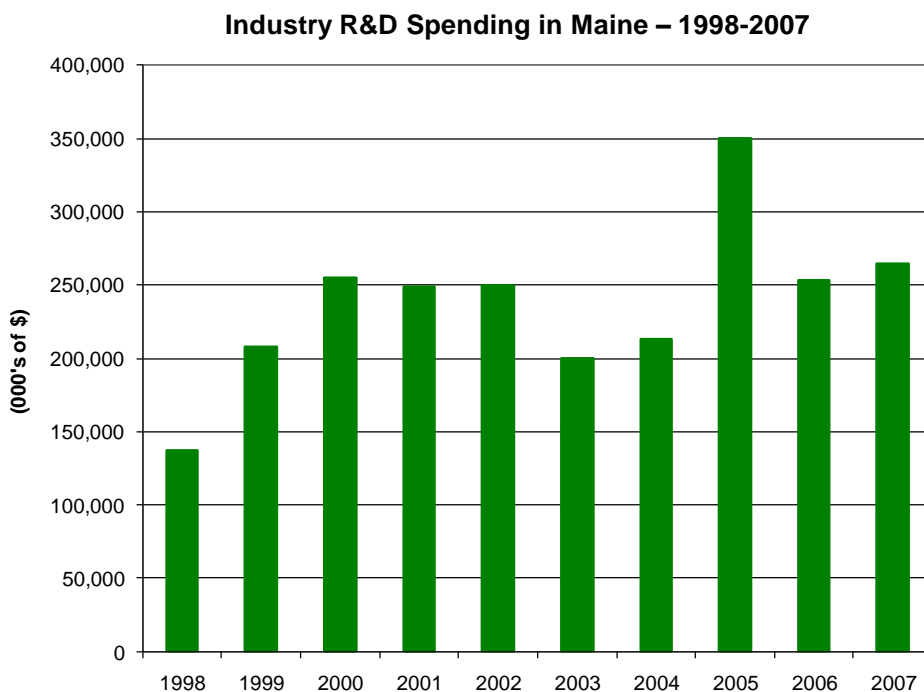
3.4 Maine’s Research-intensive Companies

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

Bottom Line: *On many industry indicators, Maine’s trend, reflect that of the national economy—declining financing, job loss, and relatively flat outputs of innovation (patents, trademarks, etc.) Yet, the amount of industry R&D is still below the average of most states, and the growth of innovation-based companies remain small, indicating that companies may start, but tend to stagnant after a relatively short period of time.*

As indicated in **Figure 3.21** in 2007, Maine’s industry spent \$ 265 million on R&D. Overall, Maine’s industry R&D expenditures has been relatively flat since 2000, with a single year spike in 2005.

Figure 3.21.

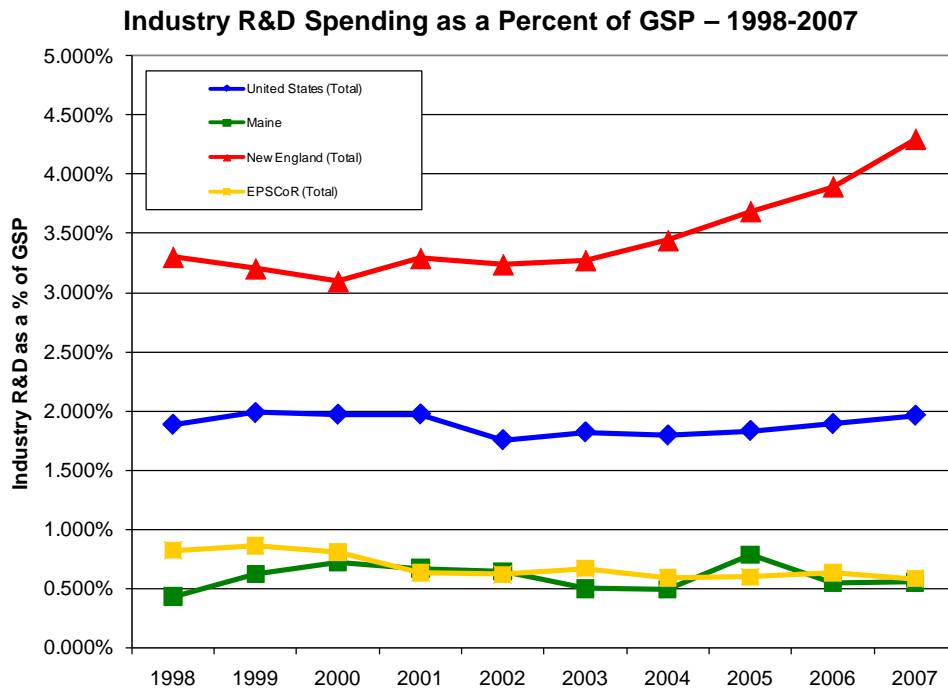


Source: Industry R&D Performed – Industry R&D performance is from National Patterns of R&D Resources: 2007 Data Update Detailed Statistical Tables | NSF 08-318 | November 2008 <http://www.nsf.gov/statistics/infbrief/nsf08313/>

Maine ranks 38th in industry R&D spending as a percent of gross state product. While industry R&D in the US averages over 73% of all R&D, it only accounts for 56% of Maine’s R&D expenditures. As indicated in **Figure 3.22** in 2007, industry R&D in Maine represented 0.55 percent of gross state product (GSP). This was slightly lower than the EPSCoR level of 0.58 and more significantly lower than the

U.S. at 1.96 and New England at 4.29. Maine's increased slightly on this indicator but its ranking remained the same at 38.

Figure 3.22.



Industry R&D performance is from National Patterns of R&D Resources: 2007 Data Update Detailed Statistical Tables | NSF 08-318 | November 2008 <http://www.nsf.gov/statistics/infbrief/nsf08313/> Gross State Product is from Bureau of Economic Analysis, U.S. Department of Commerce, 1980-1996 data; and Revised Estimates for 1997-2008; <http://www.bea.gov/regional/gsp/>.

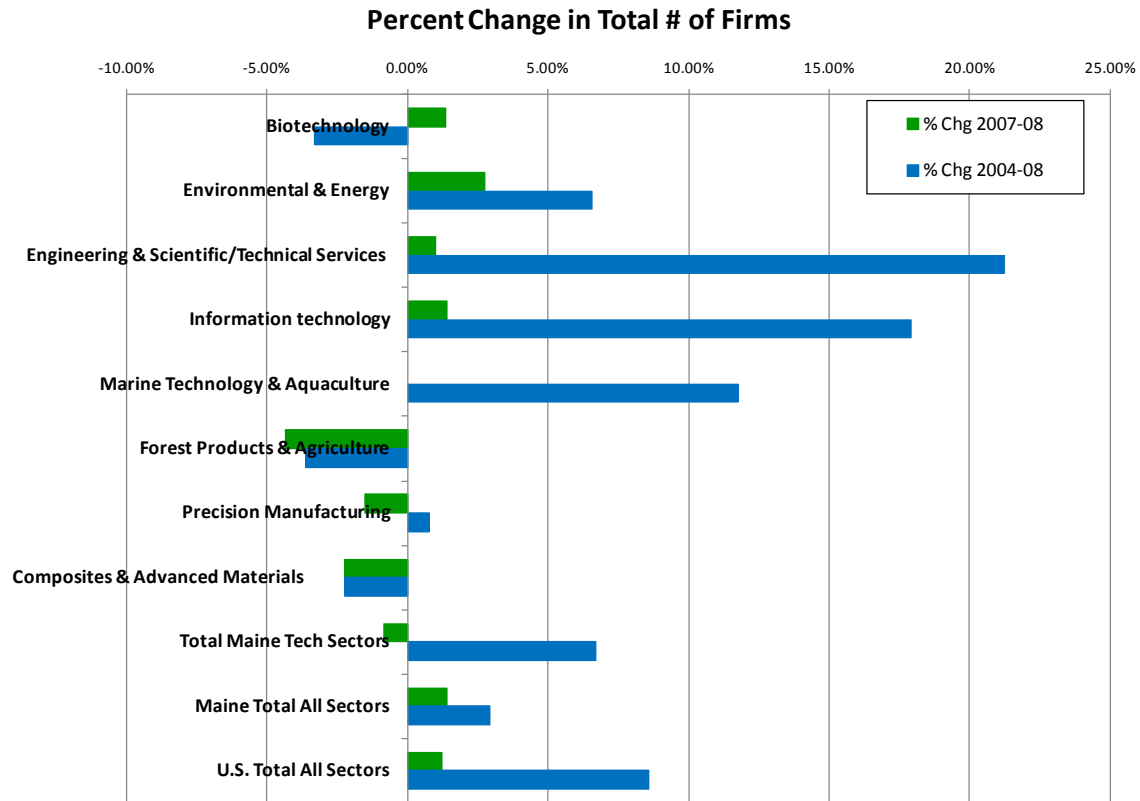
Looking broadly at Maine's innovation economy, we also track the growth in specific industry sectors, not just those companies receiving state assistance. Overall, Maine's innovation or technology based sectors comprise approximately 8.4% of all firms in the state¹⁷. In terms of growth in number of firms based on Maine Department of Labor data, as shown in **Figure 3.23**, Engineering & Engineering & Scientific/Technical Services saw the largest increase in the percent change of total firms from the 2004-2008 period followed by Information Technology, Marine Technology & Aquaculture, and precision manufacturing. Forest Products & Agriculture, Biotechnology and Composites & Advanced Materials have seen a decline in the percent change of total firms for the 2004-2008 period. Environmental & Energy saw the greatest increase between 2007 and 2008 followed by Information Technology, Biotechnology, and Engineering & Scientific/Technical Services.

Overall entrepreneurial growth can also play a factor in supporting Maine's innovation economy. The last two sectors shown on Figure 3.20 compare overall firm growth in Maine to the US. While the five

¹⁷ A definition of Maine's technology sectors is included in Attachment C

year trend suggests Maine’s growth rate of firms was less than half the US average, the recent period of 2007-2008 indicates a growth slightly above the US average.

Figure 3.23.



Sources: Data for Maine’s Targeted Technology Sectors is provided by Maine Center for Workforce Research and Information, Maine Department of Labor. Data on totals statewide and in the US is from Quarterly Census of Employment and Wages, Bureau of Labor Statistics; US Department of Labor, <http://data.bls.gov>.

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 2007 to 2008, the number of venture capital deals remained the same at four in Maine; however the total investment increased from \$6.6 million in 2007 to \$16.0 million in 2008.

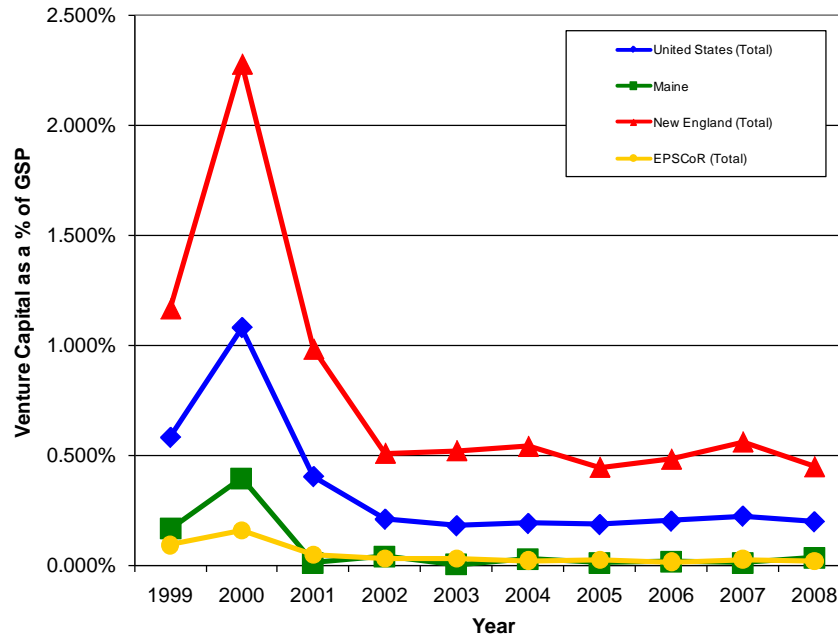
Figure 3.24 indicates the level of reported venture capital investment (as a percent of gross state product) in Maine companies as reported to the MoneyTree Venture Capital Survey.¹⁸ The performance of venture financing by states like Maine, tend to be a fraction of the U.S. average since the national average is skewed by a small fraction of states receiving the vast majority of larger scale venture funding. On this indicator, Maine and the EPSCoR states lagged that of the U.S, and New England. In

¹⁸ Note that VC deals reported include primarily institutional VC deals and do not include many other common forms of equity financing including angel investment and some private equity deals.. In states with smaller scale companies, equity financing is often under-reported to national databases due the nature of the investment. This can be illustrated with the information following Figure 3.21

2008, four deals occurred within the industry classes of consumer products and services and industrial/energy and software.

Figure 3.24

Venture Capital Invested as a Percent of Gross State Product – 1999-2008



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/Vx-Component/static/stats/2009q3/0MAINMENU.html>; Data Current as of October 2009. 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 1997-2008; <http://www.bea.gov/regional/gsp/>; 1997-2008 is based on NAICS while 1980-1996 is based on SIC industry classification.

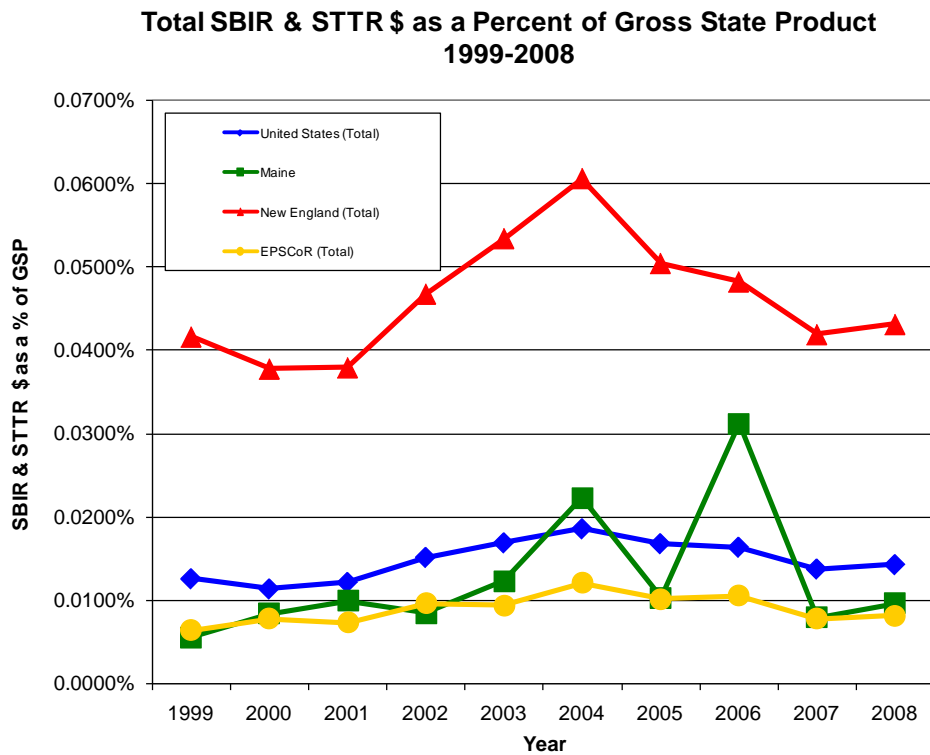
The federal government provides grants to small businesses performing R&D through its Small Business Innovation Research (SBIR) program. From 2000 through 2004 Maine experienced annual increases in the amount of SBIR awards. Since 2004 the amount of annual awards received in Maine has decreased. In 2004, Maine received 29 SBIR awards with a total value of \$9.6 million. In 2007, 16 awards totaled \$3.8 million, and in 2008 (the last year reported), 14 SBIR awards totaled \$4.7 million. **Table 3.3** shows the breakdown of awards by Phase for 2007 and 2008.

Table 3.3.

SBIR – Awards by Phase – 2007 & 2008	2008	2007
Phase I Awards	8	11
Phase I \$ value	\$724,223	\$1,144,457
Phase II Awards	6	5
Phase II \$ value	\$4,029,084	\$2,665,282

Figure 3.25 shows that Maine’s share of SBIR/STTR funds as a percent of gross state product has increased slightly since 1999 with large spikes in 2004 and again in 2006 before dropping off in 2007 and staying relatively unchanged in 2008.

Figure 3.25.

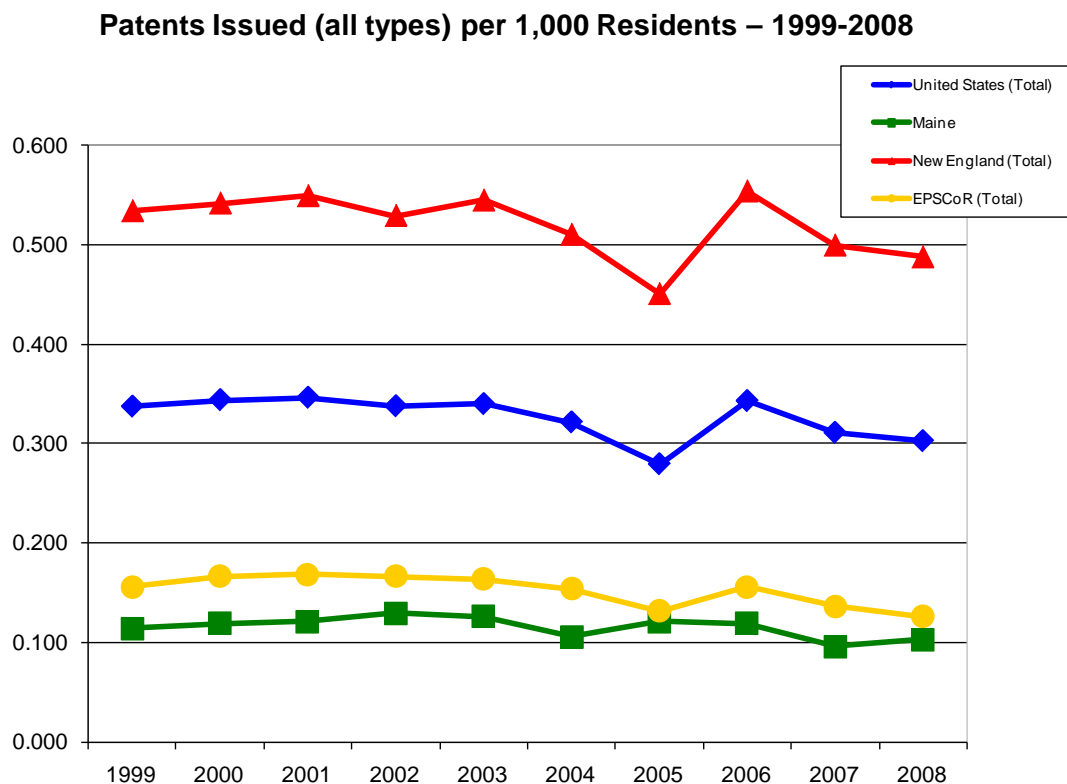


Source: SBIR/STTR data is from the U.S. Small Business Administration, www.sba.gov/sbir

Patents are often used as one measure of knowledge creation and the commercial potential of research. In 2008, 136 patents were issued to Maine individuals and organizations, including industry, universities and nonprofit research centers. The total number of patents has increased slightly from a year earlier (126 patents in 2007), and remained similar to the amount five years earlier (138 patents in 2004).

Figure 3.26 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 1999 to 2003 followed by decreases in 2004 and 2007. On this indicator, it is not so much the trend line within Maine that is concerning, but the significant lag in patents compared to the US.

Figure 3.26.



Source: Patents – Total patents issued was from “Patent Counts by Country/State and Year, All Patents, All Types”, January 1, 1977-December 31, 2008; by Calendar Year; US Patent and Trade Mark Office, December 2008; <http://www.uspto.gov/>

Data from companies using Maine R&D programs

In the past five years, FY 2005-06 through FY 2009-10, Maine has invested \$31 million (17% of all state R&D funding) in programs targeted to support the private sector research and development. Over the past five years over 860 businesses (about 2 percent of Maine’s establishments and 20 percent of Maine’s targeted technology sectors) were served by the various programs that support R&D including:

- Maine Technology Institute (MTI)

- Maine Patent Program
- 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 numerous firms benefit from these programs. Over 860 companies have received assistance from one of these entities in the last five years, and 17.4% have worked with more than one of these stakeholders.¹⁹ About one-third of companies were founded less than five years ago. Yet the majority of companies have been in business for over five years, indicating programs are serving firms at all stages in the business life cycle.

The profile of the 363 companies responding to this year’s survey indicate that businesses using state services are quite broad:

- The number of employees per firm range from one to over 500, with an average of 13.4 employees. This year’s survey included 283 companies that reported employment data. The respondents reported this year’s employment—a total of 3,786 employees—was down by an average of 3%. These companies reported 3,907 jobs for the previous year’s employment level, an average of 13.8 employees per firm.
- While the average revenue of survey respondents was \$3,066,331 per firm, there was a wide distribution: 22% reported no revenues, while over 8% reported more than \$5,000,000. In comparison, these same companies reported \$2,722,765 per firm average. This shows a growth in revenue of \$343,566 per firm average, or 12.6%.
- Productivity of companies indicated a moderate increase over last year. Revenues per employee were \$243,784 this year, and last year’s average was \$209,765 per employee.
- Payroll and wage data also showed improvements. The average wage of this year’s employee was \$43,292, compared to last year’s average wage of \$42,061.
- By their nature, innovation-based companies tend to have a significant portion of their sales out of state. However, 50% of survey respondents reported less than 25% of their sales outside the State of Maine, and only 12% reported more than 10% of their sales were international in nature.

Not surprisingly, the national economic downturn has also created many challenges for Maine’s tech sector. These challenge areas include:

¹⁹ Forty-two percent of the companies responded to the annual survey. The company survey findings are included in **Attachment A**.

- Debt financing: 37 companies or 10.2% accessed new debt financing during their most recently completed fiscal year, down from 16.5% the prior year.
- Equity financing: 19 companies or 5.2% accessed new equity financing during their most recently completed fiscal year, down from 7.7% the prior year.
- R&D Expenditures: Companies in this year's survey report spending over \$31.47 million on R&D - approximately \$106,321 per company. This figure is down slightly from last year's average of \$141,190 per company, however, is consistent with national reporting of R&D expenditures.

Many of the firms that responded to the survey are producing and protecting their intellectual property (IP). Fifty percent indicate that they intend to use some form of intellectual property protection (Patents, Trade Secrets, Licensing, Copyrights, Trademarks, or other). Thirty-five percent (up from 31% reported by the 2008-2009 survey respondents) of the respondents report that they plan to file or have filed patent protection for the innovations developed through state funding. Forty-seven companies reported that they were granted a total of 89 U.S. patents in 2009. Another 25 foreign patents were granted to the respondent companies this year. For total U.S. and foreign patents granted this represents 0.31 per all respondent companies in 2009-2010 and 0.28 per respondent company in 2008-2009. Thirty-eight of the companies surveyed had registered for trademark protection in 2009; 12 have registered copyrights. Seventy-eight of the responding companies reported that they have licensed or intend to license their IP.

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 4.0 in the current survey year, compared to 3.8 in the previous survey. Additionally, 31.9% of respondents in the current survey (2009-2010) indicated that the assistance they received was either very important or critically important. In the previous survey (2008-2009), the comparable percentage was 42.0%.

Table 3.4.

Importance of State Assistance to Companies in Private Survey	All Respondents 2009-2010	
	Number of Companies	Percent
Critically Important (5)	61	20.7%
Very Important (4)	33	11.2%
Frequently Important (3)	14	4.8%
Occasionally Important (2)	17	5.8%
Not Important (1)	4	1.4%
N/A	165	56.1%
Total	294	100%

As indicated in **Table 3.5** the mean score for satisfaction with assistance received was 4.3 in the current survey year, compared to 4.3 in the previous survey. Additionally, 39.1% of respondents in the current survey indicated that they were either very satisfied or satisfied in the assistance they received. In the previous survey (2008-2009), the comparable percentage was 49.7%.

Table 3.5.

Satisfaction With State Assistance by Companies in Private Survey	All Respondents 2009-2010	
	Number of Companies	Percent
Very Satisfied (5)	64	21.8%
Satisfied (4)	51	17.3%
Somewhat Satisfied (3)	13	4.4%
Unsatisfied (2)	2	0.7%
Very Unsatisfied (1)	1	0.3%
N/A	163	55.4%
Total	294	100%

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 a systematic link between academic, nonprofit and industry investments. With the exception of higher wages, the benefits of increased R&D spending are not yet generating large-scale economic benefits for the targeted technology sectors or the wider economy.

Data from the Maine Department of Labor provides a five-year snapshot of employment trends by Maine's targeted technology sectors. As indicated in **Table 3.6** between 2004 and 2008, Maine's targeted technology sectors had a net change of 1,610 jobs lost. This net loss was the result of a loss of 3,148 jobs in the sectors of biotechnology, marine technology and aquaculture, and forest products and agriculture. Among these sectors, forest products and agriculture accounted for 84 percent of the job loss. During this period 1,538 combined jobs were gained in the sectors of environment and energy; engineering and scientific/technical services; information technology; precision manufacturing, and composites and advanced materials. Of the jobs gained the three sectors of environment and energy; engineering and scientific/technical services; and information technology accounted for 82 percent of jobs gained.

Table 3.6.

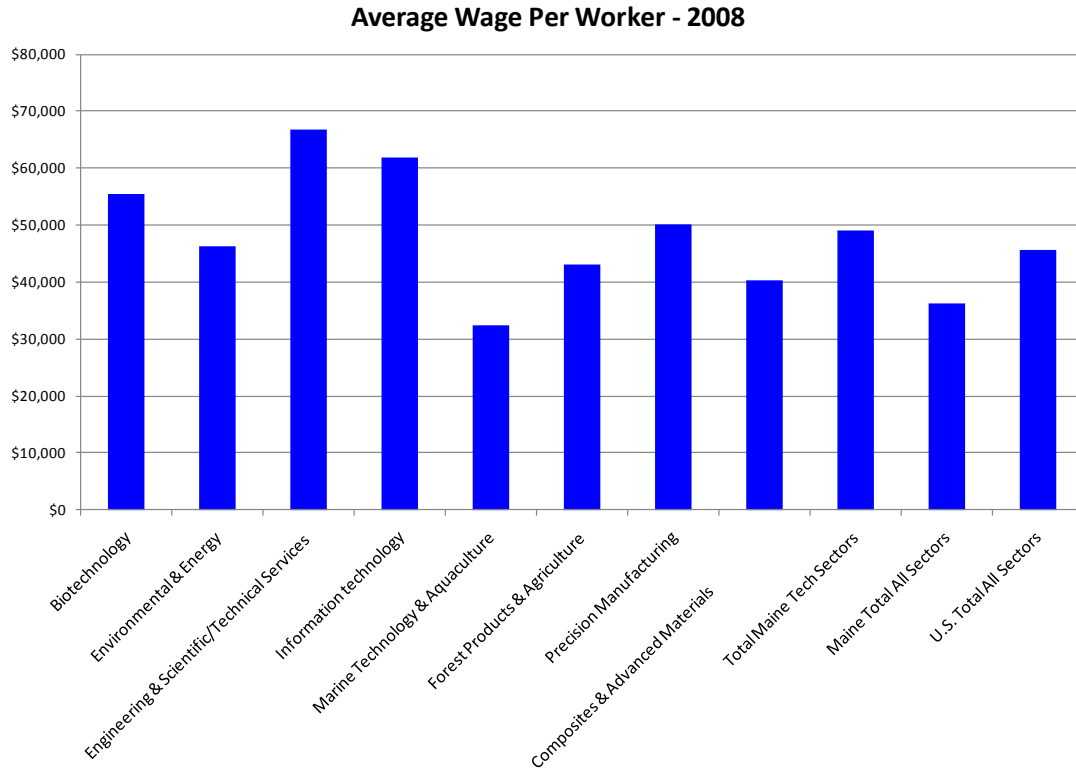
Cluster Summary - Employment Change - 2004-08	2004	2005	2006	2007	2008	# Change 2004-2008	% of 2004-2008 Losses	% of 2004-2008 Gains
Biotechnology	3,648	4,063	4,185	3,029	3,170	-478	15.18%	
Environmental & Energy	2,538	2,575	2,612	2,722	2,669	131		8.52%
Engineering & Scientific/Technical Services	2,962	3,006	3,146	3,240	3,433	471		30.62%
Information technology	6,287	6,452	6,595	6,799	6,619	332		21.59%
Marine Technology & Aquaculture	201	134	145	156	161	-40	1.27%	
Forest Products & Agriculture	28,264	28,281	27,476	26,364	25,634	-2,630	83.55%	
Precision Manufacturing	10,236	10,157	10,393	10,224	10,836	600		39.01%
Composites & Advanced Materials	1,580	1,591	1,603	1,605	1,584	4		0.26%
Total Maine Tech Sectors	55,716	56,259	56,155	54,139	54,106	-1,610		
Total Tech Sectors Jobs Lost						-3,148		
Total Tech Sectors Jobs Gained						1,538		
Total Tech Sectors Jobs Net						(1,610)		

Sources: Data for Maine's Targeted Technology Sectors is provided by Maine Center for Workforce Research and Information, Maine Department of Labor.

In terms of wage levels, as indicated in **Figure 3.27**, the average wage per worker in 2008 varied considerably from sector to sector. Engineering & scientific/technical services ranked the highest with an average wage of \$66,778 while Marine Technology came in the lowest at an average wage of

\$32,387. The average wage of all of Maine’s targeted technology sectors was \$49,053 which was higher than Maine as a whole at \$36,317 and the U.S. total average of \$45,563.

Figure 3.27.



Sources: Data for Maine’s Targeted Technology Sectors is provided by Maine Center for Workforce Research and Information, Maine Department of Labor.

Data from companies using Maine R&D programs

As shown in **Table 3.7** the sectors served by state programs remain well distributed among an array of industries.

Table 3.7.

Sector Distribution	2009	2008
Advanced Materials & Composites	10.19%	10.41%
Advanced Technologies for Forestry & Agriculture	10.47%	10.17%
Biotechnology	8.54%	9.44%
Environmental Technology	9.64%	9.93%
Information Technology	15.43%	15.98%
Marine Technology & Aquaculture	9.09%	9.93%

Precision Manufacturing	18.73%	19.13%
Other	1.65%	1.45%

As shown in **Table 3.8** based on the companies that responded to the 2009 survey the sectors of advanced materials and composites, biotechnology, and marine technology and aquaculture experienced employment increases between 2008-2009 while advanced technologies for forestry and agriculture, environmental technology, information technology, and precision manufacturing experienced declines.

Table 3.8.

Employment by Industry Sector - from Private Sector Survey	# of			Employment	Employment
	Companies in Survey	2009 Employment	2008 Employment	Change #	Change %
Advanced Materials & Composites	37	970	913	57	6.2%
Advanced Technologies for Forestry & Agriculture	38	1053	1161	-108	-9.3%
Biotechnology	31	377	376	1	0.3%
Environmental Technology	35	413	477	-64	-13.4%
Information Technology	56	201	222	-21	-9.5%
Marine Technology & Aquaculture	33	150	148	2	1.4%
Precision Manufacturing	68	660	757	-97	-12.8%

Source: 2009 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 for some companies were unknown.

As shown in **Table 3.9** all sectors experienced increased revenues from 2007-09 except for environmental technology and marine technology and aquaculture. The largest revenue percent increases were experienced in biotechnology and advanced materials and composites.

Table 3.9.

Revenue by Industry Sector - from Private Sector Survey	# of			Revenue	Revenue
	Companies	2009 Revenue	2008 Revenue	Change #	Change %
Advanced Materials & Composites	37	\$140,054,265	\$115,857,278	\$24,196,987	20.9%
Advanced Technologies for Forestry & Agriculture	38	\$476,123,916	\$452,113,433	\$24,010,483	5.3%
Biotechnology	31	\$116,759,851	\$86,427,005	\$30,332,846	35.1%
Environmental Technology	35	\$57,475,354	\$61,628,100	-\$4,152,746	-6.7%
Information Technology	56	\$15,719,694	\$13,892,143	\$1,827,551	13.2%
Marine Technology & Aquaculture	33	\$18,666,211	\$19,798,533	-\$1,132,322	-5.7%
Precision Manufacturing	68	\$96,832,166	\$89,349,369	\$7,482,797	8.4%

Source: 2009 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 for some companies were unknown.

Table 3.10 highlights U.S. and foreign patents reported by Maine's targeted industry sectors. Biotechnology has the most with 40, followed by Environmental with 39.

Table 3.10.

Patents Granted by Industry Sector - from Private Sector Survey	# of	U.S.	Foreign	Total
	Companies in Survey	Patents Granted	Patents Granted	Patents Granted
Advanced Materials & Composites	37	8	1	9
Advanced Technologies for Forestry & Agriculture	38	5	0	5
Biotechnology	31	29	11	40
Environmental Technology	35	9	30	39
Information Technology	56	5	1	6
Marine Technology & Aquaculture	33	22	6	28
Precision Manufacturing	68	18	4	22

Source: 2009 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 for some companies were unknown.

3.6 Institutional Results of the Maine Technology Asset Fund

In 2007, the Maine Legislature authorized and the voters approved \$50 million in bonds to create the Maine Technology Asset Fund (MTAF). The purpose of MTAF was to fund competitive research, development and commercialization projects to boost economic development and create jobs across the State over a two year-period. MTAF funds must be used to fund capital and related expenditures for research, development and commercialization and cannot be used for funding on-going operations. Twenty-eight awards were made under the MTAF program. As part of this evaluation, Maine's research institutions reported how the funds have been used. Detailed results related to MTAF reporting by the research institutions are contained in Attachment B. These are results for awards made in the summer of 2008, the first round of MTAF. The following institutions reported MTAF fund use in 2009 as part of this evaluation:

- Bigelow Labs
- University of New England
- University of Maine
- The Jackson Labs
- Gulf of Maine Research Institute
- Maine Institute for Human Genetics and Health

For their 2009 fiscal year, the research institutions expended \$2.5 million in the State funds they received under the MTAF program. These funds directly resulted in the following for 2009²⁰:

- Leveraging of \$2.2 million in other R&D expenditures including \$1.2 million in expenditures from federal R&D funds and \$1 million in expenditures from individual and foundations sources
- 1,500 of R&D space
- 8 research staff (FTE's)
- 23 scientific peer-reviewed journal articles published; 3 scientific peer-reviewed book chapters published; 18 other papers not published (e.g. research reports for industry)
- 68 peer-reviewed and/or competitive research proposals submitted valued at \$32 million; 15 of which were proposals submitted jointly with other main institutions valued at \$23 million; 13 of which were proposals submitted jointly with non-Maine institutions only and valued at \$9 million; 16 of which were proposals submitted jointly with both Maine and non-Maine institutions and valued at \$3 million
- 29 new Federal research grants, contracts, subcontracts valued at \$4.6 million
- 1 industrial research contract awarded by a Maine company valued at \$12,500
- 5 new foundation grants and gifts valued at \$283,700

²⁰ MTAF results are anticipated over the long term as these are investments in capital items.

3.7 Results from the 2009 Case Study - The Innovation landscape in Maine: Strengthening the Role of Maine's Industry Associations in Supporting the Maine Innovation Economy

Each year, as part of the annual evaluation, a case study is conducted to take a closer look at an issue that impacts the performance of Maine's Research and Development and innovation economy. This year's case explores the role of business and industry associations in the development of clusters and the acceleration of an innovation economy. The full case study has been published as a separate report. Included here are the summary findings. Additionally, the recommendations from the case study are incorporated into the recommendations section of this report.

The success of an industry association, and its role in a state's innovation economy, is ultimately defined by its ability to add value to companies and to sustain membership. By this criterion, Maine's technology-based industry associations appear to be providing sufficient value to their member firms who "vote with their pocketbooks" by actively participating in the organization's work.

Maine's industry associations face some significant challenges in developing sustained capacity that can help companies within the state build strong, competitive ventures. A small population means relatively few industries have sufficient scale and critical mass to support many elements of their value chain, requiring them to look beyond state borders for resources. Fewer companies and private sponsors also mean that state and local governments may need to fill specific gaps to put Maine on a more competitive playing field.

Helping industry associations to better serve their members and develop stronger companies within their respective sectors could be supported through various means of collaboration among technology groups, with other business and industry associations in Maine, with other state and national organizations, and with state government. As state agencies and technology associations consider new collaborative approaches, they must also be cautious to do no harm. New collaborations should not come at the expense of jeopardizing associations' ability to serve and grow memberships in their niche sectors – groups need to maintain the programs and services that are at the core of their membership activities.

General Conclusions

Insights from other states and regions indicate that alliances and mergers have the potential to enhance the value of associations in promoting clusters and innovation through expanded programs and services. Results can be seen in all types of models (informal and formal alliances), indicating there is no single model with a significant advantage over others. Effective approaches tend to develop organically in response to unique historical patterns or in response to unique personalities of the region or state. Most formal collaborative models were based on strategic alliance built around similar sectors, markets or geographies. While advocacy is a common role of industry associations, mergers or alliances did not automatically result in better relationships with the public sector. The working relationship between industry associations and the state appears to be driven more by the formal processes by which the state reaches out to the private sector rather than the number of groups with which the public sector engages.

Attachment A

Data from Private Sector Survey

Findings from Private Sector Survey, 2009²¹

1. Survey Response

The total number of companies/entities surveyed in 2009–2010 is 862 (in comparison with 855 in the 2008-2009 survey). 363 companies/entities have responded for a response rate of 42.1%. This compares to 413 companies and a response rate of 48.3% for 2008-2009. The response rate for individual questions varies and is noted throughout the narrative.

2. Maine R&D Program Affiliation

862 total entities surveyed in 2009-2010, represented 1,088 awards or instances of assistance from State R&D programs, and the 363 total respondents to the survey represented 547 awards or instances of assistance. Entities can receive assistance from multiple programs. On a program basis response, 2009-2010 survey rates range from a low of 27.0% 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 80.4%.

²¹ 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 2009-2010		All Surveyed 2009-2010		2009-2010 Program Response Rate
	Number	Percent	Number	Percent	
ATDC	50	9.1%	106	9.7%	47.2%
MAIC	4	0.7%	9	0.8%	44.4%
EPSCOR	2	0.4%	2	0.2%	100.0%
MPP	136	24.9%	503	46.2%	27.0%
MSCTCP	31	5.7%	62	5.7%	50.0%
SEGF	8	1.5%	13	1.2%	61.5%
MTI	316	57.8%	393	36.1%	80.4%
Total	547	100.0%	1088	100.0%	50.3%

State R&D Programs	All Respondents 2008-2009		All Surveyed 2008-2009		2008-2009 Program Response Rate
	Number	Percent	Number	Percent	
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 comparison between the 2008-2009 and 2009-2010 surveys, program response rates ranged from 5.1% (for the ATDC and SEGF) to 16.4% (for the MAIC) higher in the 2008– 2009 survey, with the exception of the EPSCOR program, which had 100% response rate in both. The response rate for MTI clients decreased from 86.7 % to 80.4%, or 6.3%.

3. Company Headquarters

Of the 317 companies who responded to this question in the current survey, 302, or 95.3%, are headquartered in Maine.

Twelve companies are headquartered in the U.S., but outside of Maine. The other states represented are Alabama, Connecticut, Massachusetts, Nebraska, Ohio, Virginia and Wisconsin. Three companies reported being headquartered outside of the U.S. and are located in Canada and the U.K.

In the previous survey, 346 companies responded to this question, and 334, or 96.5%, were headquartered in Maine.

4. Geographic Breakdown

County Breakdown	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
No County Listed	69	19.0%	67	16.2%
Androscoggin	8	2.2%	13	3.1%
Aroostook	10	2.8%	11	2.7%
Cumberland	104	28.7%	120	29.1%
Franklin	7	1.9%	7	1.7%
Hancock	13	3.6%	16	3.9%
Kennebec	18	5.0%	20	4.8%
Knox	9	2.5%	11	2.7%
Lincoln	11	3.0%	14	3.4%
Oxford	6	1.7%	8	1.9%
Penobscot	37	10.2%	47	11.4%
Piscataquis	1	0.3%	1	0.2%
Sagadahoc	8	2.2%	9	2.2%
Somerset	2	0.6%	4	1.0%
Waldo	4	1.1%	6	1.5%
Washington	6	1.7%	11	2.7%
York	38	10.5%	37	9.0%
Other State	12	3.3%	11	2.7%
Total	363	100%	413	100%

Regional Breakdown	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
No County Listed	69	19.0%	67	16.2%
Central	58	16.0%	73	17.7%
Eastern	19	5.2%	27	6.5%
North	10	2.8%	11	2.7%
South	142	39.1%	157	38.0%
Western	53	14.6%	67	16.2%
Other State	12	3.3%	11	2.7%
Total	363	100%	413	100%

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, Oxford, Penobscot, Piscataquis, and Somerset

There were no significant changes between the 2008-2009 and 2009-2010 surveys as far as where company headquarters are located. Cumberland, Penobscot and York counties remain the counties with the highest representation.

5. Industry Breakdown

Industry Sector	All Respondents 2009-2010		All Surveyed 2009-2010	
	Number	Percent	Number	Percent
Advanced Materials & Composites	37	12.2%	51	11.8%
Advanced Technologies for Forestry & Agriculture	38	12.5%	54	12.4%
Biotechnology	31	10.2%	42	9.7%
Environmental Technology	35	11.5%	49	11.3%
Information Technology	56	18.4%	86	19.8%
Marine Technology & Aquaculture	33	10.9%	49	11.3%
Precision Manufacturing	68	22.4%	88	20.3%
Other	6	2.0%	15	3.5%
Total	304	100%	434	100%

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%	462	100%

In 2009-2010, the 363 total respondents to the survey represented 304 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 2008-2009 and 2009-2010, there are no noteworthy changes.

6. Year Organized

Year Organized	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
Pre-1980	22	7.0%	28	8.2%
1980-1984	15	4.8%	18	5.2%
1985-1989	14	4.4%	18	5.2%
1990-1994	21	6.7%	26	7.6%
1995-1999	39	12.4%	43	12.5%
2000-2004	104	33.0%	120	35.0%
2005-2009*	100	31.7%	90	26.2%
Total	315	100%	343	100%

*2008-2009 survey category label is 2005-2008. 2009-2010 survey category label is 2005-2009

In 2009-2010, of the 315 respondents, 31.7% were organized within the last five years. A total of 64.7% were organized within the last ten years.

7. Number of Employees (including employer)

Number of Employees	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
1 - 10	230	81.3%	278	80.8%
11 - 20	23	8.1%	23	6.7%
21 - 30	7	2.5%	11	3.2%
31 - 40	2	0.7%	5	1.5%
41 - 50	5	1.8%	7	2.0%
51 - 100	8	2.8%	8	2.3%
101 - 499	7	2.5%	9	2.6%
500+	1	0.4%	3	0.9%
Total	283	100%	344	100%

Total Number of Employees this year: 3,786 (13.4 employees per firm average)

Total Number of employees last year: 3,907 (13.8 employees per firm average)

Change in employment: 3.1% decrease / 121 fewer employees

8. Wages

Total wages and salaries paid this year: \$169,142,102

Average wage and salary per employee this year: \$43,292

Average wage and salary per employee last year: \$42,061 (data based on 2008-2009 survey)

Change in average wage and salary per employee: 2.9% / \$1,231

9. Revenues

Company Revenues	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
\$0	66	21.9%	75	22.5%
\$1 - 49,999	71	23.6%	77	23.1%
\$50,000 - 99,999	28	9.3%	34	10.2%
\$100,000 - 499,999	62	20.6%	53	15.9%
\$500,000 - 999,999	19	6.3%	25	7.5%
\$1,000,000 - 4,999,999	31	10.3%	40	12.0%
\$5,000,000+	24	8.0%	30	9.0%
Total	301	100%	334	100%

Company revenues earned this year: \$922,965,550 (\$3,066,331 per firm average)

Company revenues earned last year: \$819,552,189 (\$2,722,765 per firm average)

Change in company revenue: 12.6% / \$103,413,361 (12.6% / \$343,566 per firm average)

Revenue per employee this year: \$243,784

Revenue per employee last year: \$209,765

Change in revenue per employee: 16.2% / \$34,019

10. Sources of Revenue

Revenues	All Respondents 2009-2010		All Respondents 2008-2009	
	Dollars	Percent of Total	Dollars	Percent of Total
Sales of Products and Services	\$ 905,988,526	93.0%	\$ 1,035,478,478	95.2%
Grants and Contracts	\$ 15,833,817	1.6%	\$ 26,261,379	2.4%
All Other Sources	\$ 52,791,270	5.4%	\$ 25,461,171	2.3%
Total	\$ 974,613,613	100%	\$ 1,087,201,028	100%

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.

11. R&D Expenditures

The respondents spent \$31,470,969 in R & D in the reporting period (\$106,321 per firm average).

The respondents spent \$46,028,254 in R & D in the previous year (\$141,190 per firm average) (data taken from 2008-2009 survey).

Change in R&D Expenditures: -31.6% / -\$14,557,285 (-24.7% / -\$34,869 per firm average)

12. Corporate Income Tax Paid

The respondents spent \$828,414 in Maine corporate income tax in the reporting period (\$2799 per firm average)

The respondents spent \$684,695 in Maine corporate income tax in the previous year (\$2081 per firm average) (data taken from 2008-2009 survey).

Change in Corporate Income Tax Paid: 21.0% / \$143,719 (34.5% / \$718 per firm average)

13. Tax Credits Claimed

Maine R&D Tax Credits Claimed	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent of Total	Number	Percent of Total
No	\$ 284	95.9%	\$ 317	95.8%
Yes	\$ 12	4.1%	\$ 14	4.2%
Total	296	100%	\$ 331	100%

There are no noteworthy changes in tax credits claimed between the 2008-2009 and 2009-2010 surveys.

14. Where are Your Customers?

Percent of Sales in Maine	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
0 - 10	178	60.1%	195	59.3%
11 - 25	15	5.1%	26	7.9%
26 - 50	20	6.8%	20	6.1%
51 - 75	16	5.4%	16	4.9%
76 - 100	67	22.6%	72	21.9%
Total	296	100%	329	100%

Percent of Sales Outside Maine, in U.S.	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
0 - 10	137	46.3%	166	50.5%
11 - 25	13	4.4%	13	4.0%
26 - 50	27	9.1%	25	7.6%
51 - 75	27	9.1%	33	10.0%
76 - 100	92	31.1%	92	28.0%
Total	296	100%	329	100%

Percent of Sales Outside of U.S.	All Respondents 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
0 - 10	261	88.2%	285	86.6%
11 - 25	18	6.1%	19	5.8%
26 - 50	8	2.7%	13	4.0%
51 - 75	5	1.7%	5	1.5%
76 - 100	4	1.4%	6	1.8%
Total	296	100%	328	100%

A comparison of the above three tables between the previous and current surveys shows no noteworthy increase in the percentage of sales occurring in Maine between 2008-2009 and 2009-2010, and a slight increase in the percentages of sales outside of Maine, but in the U.S. There is a slight increase of 0.2% in the percentage of companies which have 51-75% of their sales outside the U.S, and a decrease of 1.3% in the companies that have 26-50% of their sales outside the U.S.

15. Debt Financing

37 companies or 10.2% (37 out of the 363 respondents who answered that question) accessed new debt financing during their most recently completed fiscal year.

In the previous survey year, 68 companies or 16.5% (68 out of 413 respondents who answered that question) accessed new debt financing.

Debt Financing Sources	All Respondents 2009-2010		
	Number of Transactions	Dollars of New Debt	Percent of Total Debt
Bank	32	\$ 8,011,354	11.6%
SBA Loans	4	\$ 244,000	0.4%
Friends and Family	22	\$ 1,884,328	2.7%
Other	37	\$ 58,925,918	85.3%
Total	95	\$ 69,065,600	100%

Debt Financing Sources	All Respondents 2008-2009		
	Number of Transactions	Dollars of New Debt	Percent of Total 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%

Note: The total number of transactions is more than the 37 because there were multiple transactions at some companies.

In a comparison between the 2008-2009 and 2009-2010 surveys, bank financing has decreased from 88.2% to 11.6%, a difference (decrease) of 76.6% between the previous and current surveys. Financing from other sources has increased from 7.0% to 85.3%, an increase of 78.3%, driven primarily by a large loan received by one company.

16. Equity Financing

19 companies or 5.2% (19 out of the 363 respondents who answered that questions) accessed new equity financing during their most recently completed fiscal year.

In the previous survey year, 32 companies or 7.7% (32 out of 413 respondents who answered that question) accessed new equity financing.

Equity Financing Sources	All Respondents 2009-2010		
	Number of Transactions	Dollars of New Debt	Percent of Total Debt
Venture Capital	4	\$ 6,902,688	31.6%
State Seed Capital Funds	0	\$ -	0.0%
Angel Investors	19	\$ 7,207,573	33.0%
Friends and Family	17	\$ 578,733	2.6%
Other	15	\$ 7,179,517	32.8%
Total	55	\$21,868,511	100%

Equity Financing Sources	All Respondents 2008-2009		
	Number of Transactions	Dollars of New Debt	Percent of Total Debt
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%

Note: The total number of transactions is more than the 19 because there were multiple transactions at some companies.

In a comparison between the 2008-2009 and 2009-2010 surveys, venture capital has decreased from 68.3% to 31.6%, a difference (decrease) of 36.7% between the previous and current surveys. Financing from other sources has increased from 6.6% to 32.8%, an increase of 26.2%.

17. Federal Awards

In the 2009-2010 survey year, 15 or 4.1% (15 out of 363 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 \$5,127,925 (\$14,127 per company average). 18 or 4.4% (18 out of 413 respondents who answered that question) of respondents in 2008-2009 received some type of Federal grant. The total of awards for 2008-2009 was \$22,626,391 (\$54,785 per company average).

12 or 3.3% (12 out of 363 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. This compares to 17 or 4.1% (17 out of 413 respondents who answered that question) of respondents who received an SBIR or STTR award in 2008-2009.

Federal Award	All Respondents 2009-2010	
	Number of Awards	Total \$ of Awards
SBIR Phase I or Phase II	11	\$ 4,176,215
STTR	1	\$ 400,000
Total	12	\$ 4,576,215

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

Respondents in 2009-2010 reported \$4,576,215 in SBIR and STTR awards (\$12,607 per firm average) which was a decrease of \$14,268,153 or -75.7% from the 2008-2009 amount of \$18,844,368 (\$45,628 per firm average).

18. Intellectual Property

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 2009-2010		All Respondents 2008-2009	
	Number	Percent	Number	Percent
Yes	195	50.4%	200	52.9%
No	192	49.6%	178	47.1%
Total	387	100%	378	100%

Copyrights:

Did you or do you plan to use copyright protection?

Copyright Registration	All Respondents 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent (of 201)	Number of Companies	Percent (of 406)
Have Registered	12	6.0%	11	2.7%
Intend to Register	38	18.9%	53	13.1%
Filed	19	9.5%	6	1.5%
Not Sure	62	30.8%	79	19.5%
Total	131	65%	149	37%

The above table shows that 34.4% are in some aspect of actively pursuing copyright protection, compared to 17.2% of respondents in the 2008-2009 survey.

Comparing the previous and current survey years, the data show an increase in all areas on a percentage basis, but a decrease in the number of companies who intend to register or who are not sure.

Licenses:

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

Licensing Agreements	All Respondents 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent	Number of Companies	Percent
Yes	78	39.4%	72	37.1%
No	36	18.2%	43	22.2%
Not Sure	84	42.4%	79	40.7%
Total	198	100%	194	100%

License Locations	All Respondents 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent	Number of Companies	Percent
Maine	46	23.2%	44	22.7%
Not in Maine	53	26.8%	59	30.4%
Not Sure	99	50.0%	91	46.9%
Total	198	100%	194	100%

In the two tables above, a comparison of the survey years shows an increase from 37.1% to 39.4%, or 2.3%, from 2009-2009 to 2009-2010 in the percentage of companies who either did or plan to enter into a licensing agreement. The data also show an increase of 0.5% (from 22.7% to 23.2%) in the percentage of companies for whom Maine is or will be the licensing agreement location. There is also a decrease of 3.6% and an increase of 3.1% 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:

U.S. Patent Protection	All Respondents 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent (of 363)	Number of Companies	Percent (of 413)
Have Filed	61	16.8%	68	16.5%
Intend to File	66	18.2%	59	14.3%
Granted	47	12.9%	57	13.8%
Rejected	7	1.9%	5	1.2%
Total	181	50%	189	46%

A comparison of survey years in the table above shows a slight increase of 3.9% from 2008-2009 to 2009-2010 in the percentage of companies intending to file and a slight decrease of 0.9% in those that have been granted U.S. patent protection.

U.S. Patent Protection	Number of Patents 2009-2010	Number of Patents 2008-2009
Have Filed	90	101
Intend to File	182	97
Granted	89	101
Rejected	7	6
Total	368	305

Foreign patent protection:

Foreign Patent Protection	All Respondents 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent (of 363)	Number of Companies	Percent (of 413)
Have Filed	27	7.4%	34	8.2%
Intend to File	32	8.8%	35	8.5%
Granted	16	4.4%	15	3.6%
Rejected	2	0.6%	0	0.0%
Total	77	21%	84	20%

The percentage of companies who have been granted foreign patent protection has increased from 3.6% to 4.4% from the previous to the current survey.

Foreign Patent Protection	Number of Patents 2009-2010	Number of Patents 2008-2009
Have Filed	62	104
Intend to File	205	133
Granted	25	36
Rejected	2	0
Total	294	273

For total U.S. and foreign patents granted this represents .31 per all respondent companies in 2009-2010 and .28 per respondent company in 2008-2009.

Trademarks:

Did you or do you plan to use trademark protection?

Trademark Registration	All Respondents 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent (of 201)	Number of Companies	Percent (of 406)
Have Registered	38	18.9%	37	9.1%
Intend to Register	52	25.9%	58	14.3%
Filed	42	20.9%	28	6.9%
Not Sure	55	27.4%	65	16.0%
Total	187	93%	188	46%

The above table shows that 65.7% of respondents are in some aspect of actively pursuing trademark protection (compared to 30.3% in the 2008-2009 survey). Additionally, comparing the previous and current survey years, the data in the table above show a 11.4% increase (from 16.0% to 27.4%) in the percentage of companies who are unsure about whether or not they will actively pursue trademark registration, though the actual number of companies dropped by 10.

Trade Secrets:

Did you or do you plan to use trade secrets?

Trade Secret Usage	All Respondents 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent	Number of Companies	Percent
Yes	74	37.4%	77	39.9%
No	67	33.8%	43	22.3%
Not Sure	57	28.8%	73	37.8%
Total	198	100%	193	100%

There is an increase of 11.5% (from 22.3% to 33.8%) in the percentage of companies who did not or do not plan to use trade secrets between the 2008-2009 and 2009-2010 survey years. There is a corresponding decrease, from 37.8% to 28.8%, or 9.0%, in the percentage of companies who were not sure if they did or planned 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 2009-2010		All Respondents 2008-2009	
	Number of Companies	Percent (of 201)	Number of Companies	Percent (of 406)
Have Registered	4	2.0%	0	0.0%
Intend to File	28	13.9%	15	3.7%
Filed	8	4.0%	4	1.0%
Not Sure	63	31.3%	115	28.3%
Total	103	51%	134	33%

The table shows that 19.9% of respondents in the current survey are in some aspect of actively pursuing other intellectual property protection. This compares to 4.7% in the 2008-2009 survey.

19. Support Organizations

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 82% of the 294 respondents who answered this question in the 2009-2010 survey received some level of support from MTI during the survey period. This percentage showed an increase from the 2008-2009 survey (in which there were 368 respondents who answered this question) of approximately 9% from 73%. More than 56% of those recipients in the current survey year found the assistance to be ‘critically important’, compared to more than 53% in the 2008-2009 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 4.13.

Support Organizations	All Respondents 2009-2010						
	Didn't Use	Degree of Importance					Mean Score
		1	2	3	4	5	
MTI	51	9	16	32	49	137	4.19
Umaine System	115	14	19	42	41	63	3.67
Other Firms Outside Maine	110	12	26	58	45	43	3.44
Other Maine Firms	113	11	34	46	52	38	3.40
Maine Patent Program	162	16	27	23	22	44	3.39
Education/Research Outside Maine	156	15	22	36	32	33	3.33
Trade Associations Outside Maine	166	15	29	37	25	22	3.08
MSBDC	170	21	23	31	25	24	3.06
Maine Trade Associations	165	20	25	39	23	22	3.02
Other Educational Institutions in Maine	203	12	21	33	12	13	2.92
MEP	200	19	18	28	16	13	2.85
Non-Profit Research Institutes in Maine	207	17	16	30	11	13	2.85
ATDC	228	14	16	19	3	14	2.80
Maine Procurement Technical Assistance Center	219	17	19	13	18	8	2.75

Support Organizations	All Respondents 2008-2009						
	Didn't Use	Degree of Importance					Mean Score
		1	2	3	4	5	
MTI	99	11	19	39	55	145	4.13
Umaine System	189	26	27	19	33	74	3.57
Other Firms Outside Maine	147	21	33	53	38	76	3.52
Other Maine Firms	174	12	42	45	58	37	3.34
Maine Patent Program	177	21	32	54	43	41	3.27
Education/Research Outside Maine	226	20	24	42	40	16	3.06
Trade Associations Outside Maine	226	25	27	36	24	30	3.05
MSBDC	211	37	28	32	23	37	2.97
Maine Trade Associations	243	26	28	30	18	23	2.87
Other Educational Institutions in Maine	272	21	19	26	12	18	2.86
MEP	258	14	35	32	13	16	2.84
Non-Profit Research Institutes in Maine	260	17	33	27	15	16	2.81
ATDC	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 82.7% for MTI to a low of 22.4% for ATDC. These results are similar for the 2008-2009 survey. In the current survey, use of support from Maine Trade Associations was 43.9%, compared with 43.5%, the penetration rate of Trade Associations outside Maine. The results are similar in the previous survey with the penetration rates of Trade Associations outside Maine being lower. 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 Organizations	2009-2010	2008-2009
	Penetration Rates	Penetration Rates
MTI	82.7%	73.1%
Umaine System	60.9%	60.1%
Other Firms Outside Maine	62.6%	52.7%
Other Maine Firms	61.6%	51.9%
Maine Patent Program	44.9%	48.6%
Education/Research Outside Maine	46.9%	38.6%
Trade Associations Outside Maine	43.5%	38.6%
MSBDC	42.2%	42.7%
Maine Trade Associations	43.9%	43.8%
Other Educational Institutions in Maine	31.0%	29.9%
MEP	32.0%	34.0%
Non-Profit Research Institutes in Maine	29.6%	29.3%
ATDC	22.4%	26.1%
Maine Procurement Technical Assistance Center	25.5%	25.3%

Support Organizations	Mean Scores 2007-2008 to 2009-2010		
	2009-2010	2008-2009	2007-2008
MTI	4.19	4.13	3.91
Umaine System	3.67	3.52	3.63
Other Firms Outside Maine	3.44	3.34	3.36
Other Maine Firms	3.40	3.27	3.11
Maine Patent Program	3.39	3.57	3.5
Education/Research Outside Maine	3.33	3.05	3.2
Trade Associations Outside Maine	3.08	3.06	2.99
MSBDC	3.06	2.97	3.09
Maine Trade Associations	3.02	2.76	2.79
Other Educational Institutions in Maine	2.92	2.84	2.78
MEP	2.85	2.87	2.85
Non-Profit Research Institutes in Maine	2.85	2.81	2.9
ATDC	2.80	2.86	3
Maine Procurement Technical Assistance Center	2.75	2.58	2.71

Note for above tables:

MTI: Maine Technology Institute

ATDC: Advanced Technology Development Centers

MSBDC: Maine Small Business Development Centers

MEP: Manufacturing Extension Partnership

Attachment B

R&D Institutions Survey Data 2002–2009

2009 Combined University and Nonprofit Results

<i>Research Institutions Capacity Survey</i>	2009	
2009	Total for all Institutions	Attributable to State R&D Funding
Institutional Capacity		
a. Number (FTE) of enrolled science and engineering graduate students	798	68
b. Number of science and engineering graduate degrees awarded	146	25
c. Number of degree programs (deleted 2006)	0	0
d. Number (FTE) undergraduate students enrolled in science and engineering majors	5,947	980
e. Number (FTE) of undergraduate students participating in science and engineering programs	1,097	122
f. Number (FTE) of graduate students participating in science and engineering programs(Deleted in 2006)	0	0
g. R&D space	1,379,723	100,393
h. Current, depreciated, value of facilities and fixed equipment	732,103,964	34,451,592
i. Major (purchase price >\$50,000) research equipment purchased this year.	5,962,978	4,250,487
j. Number of positions FTE	6,118	290
Faculty	1,208	45
Research staff (non-faculty)	818	34
Professional staff	1,829	39
Students	105	159
Classified personnel	2,158	13
Research and Development Outcomes		
A. Publications		
1. Number of scientific peer-reviewed journal articles published	1,140	256
2/ Number of scientific peer-reviewed book chapters published	185	12
3. Number of scientific peer-reviewed books published	59	0
4. Number of other papers published	349	45
5. Number of other papers not published (e.g. research reports for industry)	385	18
B. Research Proposals		
1. Number of peer-reviewed and/or competitive research proposal submitted	1,396	989
2. Dollar Value	641,145,708	430,923,688
3. Number of these proposals submitted jointly with other main institutions	234	42
Dollar Value	105,297,275	32,585,726
4. Number of these proposals submitted jointly with non-Maine institutions only	268	55
Dollar Value	73,997,551	32,768,699

5. Number of these proposal submitted jointly with both Maine and non-Maine institutions	30	19
Dollar Value	32,918,597	12,099,038
C. Research Awards		
1. Number of new Federal research grants, contracts, subcontracts	509	94
Dollar Value	190,317,702	60,168,721
2. Number of these awarded under EPSCOR	4	3
Dollar Value	20,723,236	723,236
3. Number of these that were earmarked	13	11
Dollar Value	3,834,114	2,809,211
Total Expenditures for R&D in the Fiscal Year	197,878,253	74,910,724
Federal sources of funds for R&D expenditures	146,279,562	61,457,586
State sources of funds for R&D expenditures	24,799,755	4,257,967
Industry sources of funds for R&D expenditures	3,230,653	889,446
Individual and Foundations sources of funds for R&D expenditures	20,019,505	8,621,589
5. Number of industrial research grants, contracts and subcontracts awarded	340	17
Dollar Value	7,346,280	710,517
6. Number of these industrial research contracts awarded by Maine companies	155	18
Dollar Value	1,936,341	36,017
7. Number of new foundation grants and gifts	139	29
Dollar Value	13,970,049	5,818,361
D. Intellectual Property		
1. Number of disclosures made	45	10
2. Number of patents applied for	35	16
3. Number of patents awarded	6	1
4. Number of copyrights obtained	1	0
5. Number of plant breeder's rights obtained	0	0
6. Number of licensing agreements signed	21	17
7. Number of licensing agreements signed with Maine companies	2	0
8. License income received this year	1,488,860	1,400,000
E. Spin-off Companies		
1. Number of new companies formed	1	0
2. Number of jobs in these companies at spin-off	4	0

University Survey Results, 2002–2009

University Research-based Institutions					
	2009 Total for University Institutions	2008 Total for University Institutions	2002 Total for University Institutions	2008-2009 %Change for Universities	2002-2009 %Change for Universities
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	786	750	1,099	5%	-28%
b. Number of science and engineering graduate degrees conferred	145	203	207	-29%	-30%
c. DELETED (Number of degree programs)	0	0			
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	5,947	5,107	7,565	16%	-21%
e. Number of undergraduate students science and engineering degrees conferred	1,097	966		14%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)	0	0			
g. Total R&D space	973,279	969,251	633,778	0%	54%
h. Current, depreciated, value of facilities and fixed equipment	\$ 409,729,759	\$ 399,001,069	\$126,755,600	3%	223%
i. Major (purchase price >\$50,000) research equipment purchased this year.	\$ 2,424,876	\$ 2,591,089	\$17,833,583	-6%	-86%
j. Number of positions FTE	4,408	4,226	0		0%
Faculty	1,144	1,223	846	-6%	35%
Research staff (non-faculty)	232	680		-66%	
Professional staff	1,502	1,328	937	13%	60%
Students	24	117	671	-79%	-96%
Classified personnel	1,506	1,548	650	-3%	132%
Research and Development Outcomes					
A. Publications					

1. Number of scientific peer-reviewed journal articles published	775	299	639	159%	21%
2/ Number of scientific peer-reviewed book chapters published	166	63	21	163%	690%
3. Number of scientific peer-reviewed books published	59	26	70	127%	-16%
4. Number of other scientific papers published	257	1,313	277	-80%	-7%
5. Number of other scientific papers not published (e.g. research reports for industry)	363	1,443	619	-75%	-41%
B. Research Proposals					
1.a. Number of extramural research proposal submitted	1,056	979	715	8%	48%
	\$	\$			
1b. Dollars requested	426,825,342	319,092,892	\$175,226,589	34%	144%
2.a. Number of these proposals submitted jointly with other Maine institutions	200	127	37	57%	441%
	\$	\$			
2.b. Dollar Value	74,710,234	27,343,700	\$4,832,025	173%	1446%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	196	106	61	85%	221%
	\$	\$			
3.b. Dollar Value	19,520,415	25,739,774	\$5,697,830	-24%	243%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	10	76	0	-87%	
	\$	\$			
4.b. Dollar Value	19,909,064	68,957,068	\$0	-71%	
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	421	521	428	-19%	-2%
	\$	\$			
Dollar Value	122,070,967	84,637,718	\$48,988,610	44%	149%
2. Number of these awarded under EPSCOR	4	9	4	-56%	0%
	\$	\$			
Dollar Value	20,723,236	2,995,620	\$15,256,911	592%	36%
3. Number of these that were earmarked	12	7	0	71%	

Dollar Value	\$ 3,701,826	\$ 6,901,254	\$0	-46%	
4.a. Total expenditures for research and development for FY08	\$ 102,041,923	\$ 138,929,747		-27%	
4.b. Sources of funds for R&D expenditures: federal	\$ 69,407,504	\$ 75,914,472		-9%	
4.b. State	\$ 22,909,853	\$ 8,195,221		180%	
4.b. Industry	\$ 1,209,895	\$ 3,169,354		-62%	
4.b. Individuals and foundations	\$ 8,744,586	\$ 7,563,701		16%	
5. Number of industrial research grants, contracts and subcontracts awarded	303	316	1	-4%	30200%
Dollar Value	\$ 3,359,280	\$ 4,830,220	\$3,561,681	-30%	-6%
6. Number of these industrial research contracts awarded by Maine companies	154	153	0	1%	
Dollar Value	\$ 1,923,841	\$ 1,262,121	\$0	52%	
7. Number of new foundation grants and gifts	83	47	13	77%	538%
Dollar Value	\$ 6,790,659	\$ 7,583,782	\$2,049,096	-10%	231%
D. Intellectual Property					
1. Number of disclosures made	28	20	10	40%	180%
2. Number of patents applied for	17	25	8	-32%	113%
3. Number of patents awarded	3	6	0	-50%	
4. Number of copyrights obtained	1	0	1	0%	0%
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	2	5	0	-60%	
7. Number of licensing agreements signed with Maine companies	2	4	0	-50%	
8. License income received this year	\$ 85,048	\$ 127,599	\$0	-33%	
E. Spin-off Companies					
1. Number of new companies formed	1	2	0	-50%	
2. Number of jobs in these companies at spin-off	4	0	0	#DIV/0!	

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, 2002–2009

Non-Profit Research Institutions					
	2009 Total Non-Profit Institutions	2008 Total Non-Profit Institutions	2002 Total Non- Profit Institutions	2008-2009 Percent Change for Non-Profits	2002-2009 Percent Change for Non-Profits
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	12	11	3	9%	300%
b. Number of science and engineering graduate degrees conferred	1	1	0	0%	0%
c. DELETED (Number of degree programs)					
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	0	0	0		
e. Number of undergraduate students science and engineering degrees conferred	0	0			
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)					
g. Total R&D space	406444	363312	203,882	12%	99%
h. Current, depreciated, value of facilities and fixed equipment	\$ 322,374,205	\$ 197,914,144	\$150,360,110	63%	114%
i. Major (purchase price >\$50,000) research equipment purchased this year.	\$ 3,538,102	\$ 3,689,283	\$4,798,467	-4%	-26%
j. Number of positions FTE	1710.2	1729.9	0	-1%	
Faculty	64	98	58	-35%	11%
Research staff (non-faculty)	586.4	553.7		6%	
Professional staff	327.1	363.4	897	-10%	-64%
Students	80.9	45.1	3	79%	2597%
Classified personnel	651.8	669.7	257	-3%	154%

Research and Development Outcomes

A. Publications

1. Number of scientific peer-reviewed journal articles published	365	393	222	-7%	64%
2/ Number of scientific peer-reviewed book chapters published	19	13	20	46%	-5%
3. Number of scientific peer-reviewed books published	0	1	0	-100%	
4. Number of other scientific papers published	92	64	1	44%	9100%
5. Number of other scientific papers not published (e.g. research reports for industry)	22	25	2	-12%	1000%

B. Research Proposals

1.a. Number of extramural research proposal submitted	340	330	134	3%	154%
1b. Dollars requested	\$ 214,320,366	\$ 176,006,159	\$106,590,869	22%	101%
2.a. Number of these proposals submitted jointly with other Maine institutions	34	25	6	36%	467%
2.b. Dollar Value	\$ 30,587,041	\$ 2,692,122	\$2,170,689	1036%	1309%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	72	62	22	16%	227%
3.b. Dollar Value	\$ 54,477,136	\$ 35,671,543	\$11,559,016	53%	371%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	20	34	24	-41%	-17%
4.b. Dollar Value	\$ 13,009,533	\$ 11,341,765	\$13,093,005	15%	-1%

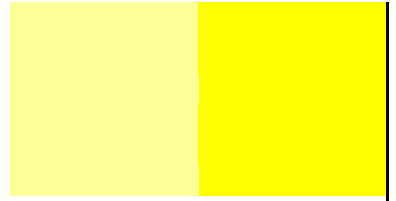
C. Research Awards

1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	88	110	64	-20%	38%
Dollar Value	\$ 68,246,735	\$ 63,760,800	\$66,049,383	7%	3%

2. Number of these awarded under EPSCOR	0	1	1	0%	-100%
Dollar Value	\$ -	\$ 136,513	\$600,000		-100%
3. Number of these that were earmarked	1	1	5	0%	-80%
Dollar Value	\$ 132,288	\$ 361,845	\$3,851,260	-63%	-97%
4.a. Total expenditures for research and development for FY08	\$ 95,836,330	\$ 93,377,694		3%	
4.b. Sources of funds for R&D expenditures:					
federal	\$ 76,872,058	\$ 72,973,834		5%	
4.b. State	\$ 1,889,902	\$ 2,102,128		-10%	
4.b. Industry	\$ 2,020,758	\$ 3,190,474		-37%	
4.b. Individuals and foundations	\$ 11,274,919	\$ 15,021,949		-25%	
5. Number of industrial research grants, contracts and subcontracts awarded	37	20	33	85%	12%
Dollar Value	\$ 3,987,000	\$ 590,013	\$2,176,807	576%	83%
6. Number of these industrial research contracts awarded by Maine companies	1	1	0	0%	
Dollar Value	\$ 12,500	\$ 12,500	\$0	0%	
7. Number of new foundation grants and gifts	56	48	11	17%	409%
Dollar Value	\$ 7,179,390	\$ 8,262,032	\$1,140,484	-13%	530%
D. Intellectual Property					
1. Number of disclosures made	17	22	6	-23%	183%
2. Number of patents applied for	18	21	4	-14%	350%
3. Number of patents awarded	3	0		#DIV/0!	
4. Number of copyrights obtained	0	0	1	#DIV/0!	-100%
5. Number of plant breeder's rights obtained	0	0	0	0%	
6. Number of licensing agreements signed	19	14	2	36%	850%
7. Number of licensing agreements signed with Maine companies	0	0	0	#DIV/0!	
8. License income received this year	\$ 1,403,812	\$ 896,207	\$150,000	57%	836%
E. Spin-off					

Companies

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

University Results Attributable to State Investment, 2002–2009

University Research-based Institutions					
	2009 Total Attributable to State Funding	2008 Total Attributable to State Funding	2002 Total Attributable to State Funding	2008-2009 Percent Change for Universities	2002-2009 Percent change for Universities
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	68	70	1,056	-3%	-94%
b. Number of science and engineering graduate degrees conferred	25	9	209	178%	-88%
c. DELETED (Number of degree programs)					
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	980	512	7,258	91%	-86%
e. Number of undergraduate students science and engineering degrees conferred	122	121		1%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)					
g. Total R&D space	40,095	37,930	606,258	6%	-93%
h. Current, depreciated, value of facilities and fixed equipment	8,225,800	0	\$121,251,600		-93%
i. Major (purchase price >\$50,000) research equipment purchased this year.	2,368,094	2,404,089	\$16,074,033	-1%	-85%
j. Number of positions FTE	980	0	0		0%
Faculty	34	153	432	-78%	-92%
Research staff (non-faculty)	2	201	23	0%	-91%
Professional staff	18	225	352	-92%	-95%
Students	133	600	198	-78%	-33%
Classified personnel	2	2	207	0%	-99%
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	6	0	527		-99%
2/ Number of scientific peer-reviewed book chapters published	1	0	30		-97%
3. Number of scientific peer-reviewed books published	0	0	64		-100%

4. Number of other scientific papers published	0	0	332		-100%
5. Number of other scientific papers not published (e.g. research reports for industry)	0	2	768	-100%	-100%
B. Research Proposals					
1.a. Number of extramural research proposal submitted	789	79	574	899%	37%
1b. Dollars requested	309,385,719	38,329,791	\$130,232,919	707%	138%
2.a. Number of these proposals submitted jointly with other Maine institutions	20	11	43	82%	-53%
2.b. Dollar Value	9,306,591	6,176,327	\$9,943,894	51%	-6%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	10	15	66	-33%	-85%
3.b. Dollar Value	6,182,370	8,100,256	\$10,482,110	-24%	-41%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	2	4	0	-50%	
4.b. Dollar Value	1,499,950	7,839,478	\$0	-81%	
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	35	48	429	-27%	-92%
Dollar Value	7,254,908	46,608,580	\$44,879,959	-84%	-84%
2. Number of these awarded under EPSCOR	3	9	6	-67%	-50%
Dollar Value	723,236	2,995,620	\$2,278,125	-76%	-68%
3. Number of these that were earmarked	11	7	0	57%	
Dollar Value	2,809,211	6,901,254	\$0	-59%	
4.a. Total expenditures for research and development for FY06	7,525,524	5,371,505			
4.b. Sources of funds for R&D expenditures: federal	3,831,417	3,954,000			
4.b. State	2,946,840	224,405			
4.b. Industry	23,518	0			
4.b. Individuals and foundations	723,749	1,193,100			
5. Number of industrial research grants, contracts and subcontracts awarded	17	301	0	-94%	
Dollar Value	23,517	4,099,309	\$1,916,817	-99%	-99%
6. Number of these industrial research contracts awarded by Maine companies	17	150	0	-89%	
Dollar Value	23,517	1,062,197	\$0	-98%	
7. Number of new foundation grants and gifts	4	4	2	0%	100%
Dollar Value	37,150	1,238,365		-97%	

D. Intellectual Property	0	0			
1. Number of disclosures made	0	18	\$6	-100%	-100%
2. Number of patents applied for	0	25	4	-100%	-100%
3. Number of patents awarded	0	6		-100%	
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	0	5	0	-100%	
7. Number of licensing agreements signed with Maine companies	0	4	0	-100%	
8. License income received this year	0	127,500	\$0	-100%	
E. Spin-off Companies	0	0			
1. Number of new companies formed	0	0	0		
2. Number of jobs in these companies at spin-off	0	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

Universities

Univ of Southern Maine
 Univ of New England
 Umaine Orono
 Umaine Machias
 Maine Maritime

Nonprofit Results Attributable to State Investment, 2002–2009

Non-Profit Research Institutions					
	2009 Attributable to State Funding	2008 Attributable to State Funding	2002 Attributable to State Funding	2008-2009 Percent Change for Non- Profits	2002- 2009 Percent Change for Non- Profits
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	0	0	0		
b. Number of science and engineering graduate degrees conferred	0	0	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%
e. Number of undergraduate students science and engineering degrees conferred	0	0			0%
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)					
g. Total R&D space	60298	83321	9,755	-28%	518%
h. Current, depreciated, value of facilities and fixed equipment	\$ 26,225,792	\$ 20,273,097	\$33,631,300	29%	-22%
i. Major (purchase price >\$50,000) research equipment purchased this year.	\$ 1,882,393	\$ 1,535,561	\$320,000	23%	488%
j. Number of positions FTE	100.9	223.2	0	-55%	
Faculty	11	41	0	-73%	
Research staff (non-faculty)	31.8	52	0	-39%	
Professional staff	21.2	38.3	52	-45%	-59%
Students	25.9	13.1	0	98%	
Classified personnel	11	78.8	9	-86%	22%
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	250	218	153	15%	63%

2/ Number of scientific peer-reviewed book chapters published	11	3	11	267%	0%
3. Number of scientific peer-reviewed books published	0	0	1	#DIV/0!	-100%
4. Number of other scientific papers published	45	42	0	7%	
5. Number of other scientific papers not published (e.g. research reports for industry)	18	16	0	13%	
B. Research Proposals					
1.a. Number of extramural research proposal submitted	200	218	106	-8%	89%
1b. Dollars requested	\$ 121,537,969	\$ 111,947,778	\$92,252,970	9%	32%
2.a. Number of these proposals submitted jointly with other Maine institutions	22	23	1	-4%	2100%
2.b. Dollar Value	\$ 23,279,135	\$ 4,996,434	\$8,218,269	366%	183%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	45	45	20	0%	125%
3.b. Dollar Value	\$ 26,586,329	\$ 28,965,397	\$35,698,533	-8%	-26%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	17	34	21	-50%	-19%
4.b. Dollar Value	\$ 10,599,088	\$ 11,341,765	\$43,916,802	-7%	-76%
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	59	76	41	-22%	44%
Dollar Value	\$ 52,913,813	34,060,593	\$47,176,309	55%	12%
2. Number of these awarded under EPSCOR	0		0	0%	0%
Dollar Value	0	\$ 25,000	\$0		
3. Number of these that were earmarked	0	1	0	-100%	
Dollar Value	0	\$ 361,845	\$0	-100%	
4.a. Total expenditures for research and development for FY06	\$ 67,385,200	74,907,765			
4.b. Sources of funds for R&D expenditures: federal	\$ 57,626,169	60,745,619			
4.b. State	\$ 1,311,127	1,262,736			
4.b. Industry	\$ 865,928	1,011,357			
4.b. Individuals and foundations	\$ 7,897,840	12,259,878			
5. Number of industrial research grants, contracts and subcontracts awarded	0	2	2	-100%	-100%
Dollar Value	\$ 687,000	32,500	\$175,604	2014%	291%

6. Number of these industrial research contracts awarded by Maine companies	1	1	0	0%	
Dollar Value	\$ 12,500	12,500	\$0	0%	
7. Number of new foundation grants and gifts	25	13,665	20	-100%	25%
Dollar Value	\$ 5,781,211	7,467,799		-23%	
D. Intellectual Property					
1. Number of disclosures made	10	19	\$2	-47%	400%
2. Number of patents applied for	16	18	0	-11%	
3. Number of patents awarded	1	-			
4. Number of copyrights obtained	0	-	0		
5. Number of plant breeder's rights obtained	0	-	0	0%	0%
6. Number of licensing agreements signed	17	14	0	21%	
7. Number of licensing agreements signed with Maine companies	0	-	0	#DIV/0!	
8. License income received this year	\$ 1,400,000	893,207	\$0	57%	
E. Spin-off Companies					
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

Universities

Univ of Southern Maine
 Univ of New England

Umaine Orono
Umaine Machias
Maine Maritime

2009 Combined University and Nonprofit Results – Attributable to Maine Technology Asset Fund

<i>Research Institutions Capacity Survey</i>	2009	
	Total for all Institutions	Attributable to MTAf
2009		
Institutional Capacity		
a. Number (FTE) of enrolled science and engineering graduate students	798	0
b. Number of science and engineering graduate degrees awarded	146	0
d. Number (FTE) undergraduate students enrolled in science and engineering majors	5,947	0
e. Number (FTE) of undergraduate students participating in science and engineering programs	1,097	0
g. R&D space	1,379,723	1,500
h. Current, depreciated, value of facilities and fixed equipment	732,103,964	2,433,733
i. Major (purchase price >\$50,000) research equipment purchased this year.	5,962,978	884,814
j. Number of positions FTE	6,118	0
Faculty	1,208	0
Research staff (non-faculty)	818	8
Professional staff	1,829	0
Students	105	0
Classified personnel	2,158	0
Research and Development Outcomes		
A. Publications		
1. Number of scientific peer-reviewed journal articles published	1,140	23
2/ Number of scientific peer-reviewed book chapters published	185	3
3. Number of scientific peer-reviewed books published	59	0
4. Number of other papers published	349	0
5. Number of other papers not published (e.g. research reports for industry)	385	18
B. Research Proposals		
1. Number of peer-reviewed and/or competitive research proposal submitted	1,396	68
2. Dollar Value	641,145,708	32,289,475
3. Number of these proposals submitted jointly with other main institutions	234	15
Dollar Value	105,297,275	23,052,259
4. Number of these proposals submitted jointly with non-Maine institutions only	268	13
Dollar Value	73,997,551	9,752,249
5. Number of these proposal submitted jointly with both Maine and non-Maine institutions	30	16
Dollar Value	32,918,597	3,146,512

C. Research Awards		
1. Number of new Federal research grants, contracts, subcontracts	509	29
Dollar Value	190,317,702	4,620,282
2. Number of these awarded under EPSCOR	4	0
Dollar Value	20,723,236	0
3. Number of these that were earmarked	13	0
Dollar Value	3,834,114	0
Total Expenditures for R&D in the Fiscal Year	197,878,253	4,952,465
Federal sources of funds for R&D expenditures	146,279,562	1,246,017
State sources of funds for R&D expenditures	24,799,755	2,461,184
Industry sources of funds for R&D expenditures	3,230,653	0
Individual and Foundations sources of funds for R&D expenditures	20,019,505	975,994
5. Number of industrial research grants, contracts and subcontracts awarded	340	0
Dollar Value	7,346,280	0
6. Number of these industrial research contracts awarded by Maine companies	155	1
Dollar Value	1,936,341	12,500
7. Number of new foundation grants and gifts	139	5
Dollar Value	13,970,049	283,700
D. Intellectual Property		
1. Number of disclosures made	45	0
2. Number of patents applied for	35	0
3. Number of patents awarded	6	0
4. Number of copyrights obtained	1	0
5. Number of plant breeder's rights obtained	0	0
6. Number of licensing agreements signed	21	0
7. Number of licensing agreements signed with Maine companies	2	0
8. License income received this year	1,488,860	0
E. Spin-off Companies		
1. Number of new companies formed	1	0
2. Number of jobs in these companies at spin-off	4	0
<p>2009 MTAF Respondents includes Bigelow University of New England University of Maine at Orono Jackson Labs Gulf of Maine Research Institute Maine Institute for Human Genetics and Health</p>		

Attachment C

Definition of High Technology

Definition of Targeted Technology Sectors is from Maine Office of Innovation and is based on targeted sectors identified by State Legislature in late 1990's and further defined by Statewide Cluster Analyses in 2002 and 2008, most recently reported in: *Maine's Technology Sectors and Clusters: Status and Strategy*; Maine Center for Business and Economic Research, University of Southern Maine; Battelle Technology Partnership Practice, Battelle Institute; Planning Decisions Inc; and PolicyOne Research, March 2008. To this definition engineering and other scientific/technical was added as it relates to most of the technology sectors. They include the following (table on next page):

NAICS Description	NAICS Code	Cluster Description
Crop production	111	Forest Products & Agriculture
Animal production	112	Forest Products & Agriculture
Animal aquaculture	1125	Marine Technology & Aquaculture
Forestry and logging	113	Forest Products & Agriculture
Support activities for crop production	1151	Forest Products & Agriculture
Support activities for animal production	115210	Forest Products & Agriculture
Support activities for forestry	115310	Forest Products & Agriculture
Other electric power generation	221119	Environmental & Energy
Water, sewage and other systems	2213	Environmental & Energy
Sugar and confectionery product manufacturing	3113	Forest Products & Agriculture
Fruit and vegetable preserving and specialty	3114	Forest Products & Agriculture
Dairy product manufacturing	3115	Forest Products & Agriculture
Bakeries and tortilla manufacturing	3118	Forest Products & Agriculture
Other food manufacturing	3119	Forest Products & Agriculture
Beverage manufacturing	3121	Forest Products & Agriculture
Wood product manufacturing	321	Forest Products & Agriculture
Paper manufacturing	322	Forest Products & Agriculture
Resin, rubber, and artificial fibers mfg.	3252	Composites & Advanced Materials
Pharmaceutical and medicine manufacturing	3254	Biotechnology
Fabricated metal product manufacturing	332	Precision Manufacturing
Machinery manufacturing	333	Precision Manufacturing
Computer and electronic product manufacturing	334	Precision Manufacturing
Electromedical apparatus manufacturing	334510	Biotechnology
Search, detection, and navigation instruments	334511	Marine Technology & Aquaculture
Analytical laboratory instrument mfg.	334516	Biotechnology
Irradiation apparatus manufacturing	334517	Biotechnology
Boat building	336612	Composites & Advanced Materials
Furniture and related product manufacturing	337	Forest Products & Agriculture
Medical equipment and supplies manufacturing	3391	Biotechnology
Software publishers	511210	Information Technology
Internet publishing and broadcasting	516110	Information Technology
Wired telecommunications carriers	517110	Information Technology
Internet service providers	518111	Information Technology
Web search portals	518112	Information Technology
Data processing and related services	518210	Information Technology
Internet Publishing and Broadcasting and Web	519130	Information Technology
Engineering services	541330	Engineering & Scientific/Technical Services
Testing laboratories	541380	Environmental & Energy
Computer systems design and related services	5415	Information Technology
Environmental consulting services	541620	Environmental & Energy
Other technical consulting services	541690	Engineering & Scientific/Technical Services
Physical, engineering and biological research	541710	Biotechnology
Research and Development in the Physical, Eng	541712	Biotechnology
Waste treatment and disposal	5622	Environmental & Energy