

The Defense Industry in Massachusetts:

CURRENT PROFILE AND ECONOMIC SIGNIFICANCE





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Dear Colleague,

Associated Industries of Massachusetts (AIM) is proud to present *The Defense Industry in Massachusetts: Current Profile and Economic Significance*, a report prepared by the University of Massachusetts Donahue Institute and made possible by a grant from Raytheon Company.

The success of the defense industry in Massachusetts during the past two decades is one of the great untold stories of the Commonwealth's economic history. As the overall economy has struggled in the face of two recessions and fundamental industry shifts, Massachusetts defense contractors have quietly almost tripled the value of their contracts to \$15.6 billion, increased their employment rolls by over 70 percent to 115,563 people and increased their overall economic output by 146 percent. These contracts support businesses large and small, as well as many of our state's higher education institutions — including the University of Massachusetts system.

Massachusetts currently ranks fifth nationally in Department of Defense contract awards and seventh in contracts from the Department of Homeland Security. Payroll generated by Bay State defense companies, from giant first-tier suppliers to smaller manufacturers up and down the supply chain, now stands at a record \$8.93 billion. The industry generates more than \$3 billion in tax revenue for local, state and federal governments struggling with fiscal emergencies.

And the best is yet to come.

Massachusetts excels in the kind of highly specialized, research and technology related products and services that are expected to be the lynchpin of defense spending in the future. Nine of the top 10 products sold to defense agencies are related to technology and research; \$1.8 billion in Fiscal Year 2009 contracts were awarded to colleges and universities. The Department of Defense confirms in its *2010 Quadrennial Defense Review* that future priorities and initiatives will lean heavily on technology advancements and research and development.

Those priorities bode well for a Commonwealth with a history of technology innovation, outstanding public schools, well-trained workers and the best research universities in the world.

The report shows that a defense industry that has been vital to the Massachusetts economy will become even more so in the years ahead. For AIM, the voice of Massachusetts employers for 95 years, and the University of Massachusetts, the potential growth of the defense industry represents the kind of economic development that will rebuild our economy. The formula for success is simple: cutting-edge producers of world-class technologies and services providing stable, well-paid jobs for the people of our Commonwealth.

Sincerely,

Richard C. Lord
President & Chief Executive Officer
Associated Industries of Massachusetts

Jack M. Wilson
President
University of Massachusetts



Summary of Key Findings

The defense industry is an important and remarkably stable component of the Massachusetts economy. Over the course of the past ten years, thousands of Massachusetts firms and institutions have been engaged by the Department of Defense and the Department of Homeland Security to provide essential equipment, supplies and technical services in support of national defense operations. Massachusetts ranks among the top ten states as a provider of goods and services, and contracts awarded to Massachusetts contractors have steadily increased over the past decade, nearly tripling in value since 2000.

The report that follows provides an overview of the nature and scale of the defense industry within the Commonwealth. The analysis provides a look at the unique aspects of the defense industry in Massachusetts and looks at important trends over the period between 2000 and 2009. Findings from the analysis include the following key points.

The defense sector in Massachusetts is a leading industry sector within the state and is by far the major recipient of federal contracts.

- The defense industry attracted \$15.6 billion in 2009 or 85 percent of all federal contract dollars awarded to Massachusetts.
- These federal contracts translated into approximately \$26 billion in total economic activity for the Commonwealth.
- The defense industry supported approximately 115,563 jobs in Massachusetts in 2009.
- The top 5 federal contract recipients in the Commonwealth are defense contractors.
- The top 5 products or services sold to the federal government are related to defense technology.

The defense industry in Massachusetts has been a source of remarkable economic growth and expansion.

- During a period of serious economic decline in many areas of the economy, the defense industry has been a source of stability and growth.
- Total defense related economic activity in Massachusetts increased from \$10.6 billion in 2001 to \$26 billion in 2009.
- The number of employees supported by the defense sector has grown by nearly 50,000 jobs since 2001 (from 67,615 to 115,563 — an increase of more than 70 percent).

- The value of federal defense contracts awarded to Massachusetts firms has increased by nearly 200 percent from \$5.5 billion in 2001 to \$15.6 billion in 2009.

Defense contracts support very technical, high value-added sectors of the economy, which employ large numbers of highly educated and trained workers.

- Federal defense contracts supported work in research and development, sophisticated manufacturing, and highly specialized technical and professional services:
 - The Professional, Scientific and Technical services sector — including architecture, engineering, R&D, and computer services — received \$6.7 billion in federal contracts, an increase of 168 percent since 2005.
 - The Transportation Equipment Manufacturing sector — including aircraft engines and parts, guided missile manufacturing and space vehicle manufacturers — received \$3.1 billion in federal contracts in 2009.
 - The Computer and Electronic Product Manufacturing sector — including guidance, navigation, aeronautical, nautical and search/detection systems — received \$2.1 billion in federal contracts in 2009.
- The Massachusetts defense industry generated \$8.9 billion in payroll in 2009, an increase of 102 percent since 2001.

Defense-related contracts support some of the state's largest manufacturers and employers but also contribute to the growth of small businesses and minority-owned companies.

- In 2009 four organizations were awarded \$10.1 billion, or 65 percent, of all federal defense contracts to Massachusetts:
 - Raytheon: \$4.58 billion
 - General Dynamics: \$2.14 billion
 - Massachusetts Institute of Technology: \$1.75 billion
 - General Electric: \$1.68 billion
- Massachusetts has also seen a 63 percent increase in contract dollars awarded for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR).
- Contract awards to minority-owned businesses have tripled since 2005.



Introduction

Simply stated, the defense industry is significant in Massachusetts. In 2009 the majority of all federal contract dollars (85 percent) awarded to Massachusetts companies were for defense related activities.¹ In fact, contracts awarded to Massachusetts contractors by the Department of Defense (DoD) and the Department of Homeland Security (DHS) have steadily increased over the past decade, nearly tripling in value since 2000. In 2009, between DoD and DHS, 19,790 contracts were awarded to 2,624 Massachusetts contractors, totaling \$15.6 billion. These numbers are impressive, and it's no surprise that Massachusetts ranked 5th among all states in the value of DoD contracts and 7th for DHS contract values in 2009.

This examination of the defense industry and economic impact analysis is structured in two parts: in the first part we examine the nature of defense contract awards to Massachusetts firms, as well as the role of small businesses, minority owned businesses, and institutions of higher education within the defense industry. In the second part we conduct a time-series analysis of the impacts generated by the defense industry, including economic, employment, payroll, and tax impacts on the Massachusetts economy.



Part 1

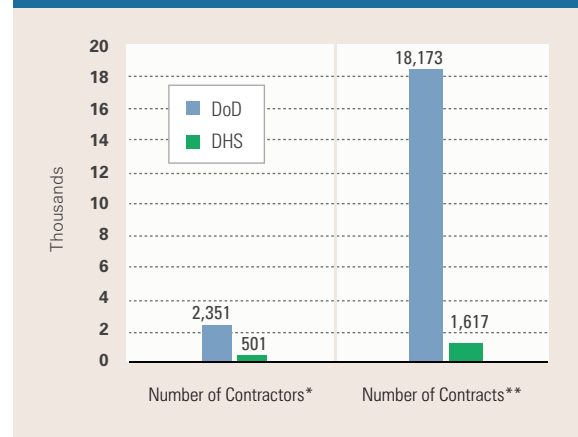
DEFENSE CONTRACTING IN MASSACHUSETTS

The Department of Defense is by far the top federal contracting agency to the Commonwealth, with awards totaling \$15.1 billion in Fiscal Year 2009. The U.S. Agency for International Development (\$514.5 million), the Department of Homeland Security (\$465.4 million), and the Department of Health and Human Services (\$391 million) ranked second, third, and fourth in terms of total contract values. This profile of the Massachusetts defense industry is based on an aggregate analysis of contract awards by DoD and DHS due to their primary roles in national security and defense. Figure 1 illustrates the total numbers of defense contracts and contractors by agency in 2009.

Between 2000 and 2009, the total value of contracts awarded to Massachusetts nearly tripled,² while the number of contracts increased by over three and a half times. As shown in Figure 1 for 2009, the vast majority of contracts to Massachusetts over this time period were awarded by DoD. While the data shown are for the latest year available, these data adequately represent the proportions of procurement from DoD and DHS over the past ten years.

▼ DoD is the dominant originator of contracts

Figure 1. Procurement from Massachusetts Contractors, FY2009



Source: usaspending.gov Data Feed

* This count is based on unique vendor ID codes. A vendor (contractor) is a business unit that has entered into a contract to supply supplies or services. Some contractors have awards from both DoD and DHS. The number of unique contractors for both groups is 2,624.

** Based on unique contract ID codes.



Since 2000, Massachusetts has ranked among the top 10 states for contract awards for both DoD and DHS. Figure 3 shows the top ten states for DoD and DHS contract awards in FY 2009. The consistently high number of contracts and contract awards to Massachusetts displays the important role that the Commonwealth plays in the national defense industry. In turn, defense contracting has become vital to the Massachusetts economy. Eighty-five percent (\$15.6 billion) of all federal contracts to the state are defense related. In addition, more than fifty percent (2,624) of the 4,843 contractors awarded federal contracts in 2009 were awarded defense contracts. Some of these contractors have business from both DoD and DHS.

Massachusetts Defense Industry Sectors

Over the full ten-year period, the Massachusetts defense industry has been dominated by highly technical, high value-added sectors. However, contracting patterns in recent years illustrate a dramatically expanded interest in highly specialized technical services and research and development services from Massachusetts contractors. In 2009, Professional, Scientific and Technical Services firms (NAICS 541) were awarded over \$6.7 billion (43.3

percent of Massachusetts contracts), up from 28 percent of all contracts in 2005. This sector comprises establishments that sell expertise in multiple fields such as engineering, architecture and research and development. Another prominent sector in Massachusetts is Transportation Equipment Manufacturing (NAICS 336), which includes manufacturers of motor vehicles, aircraft, and guided missiles in their entirety and as separate parts. This sector was awarded roughly \$3.1 billion in 2009 (20.1 percent of total contracts to Massachusetts), up from 15.5 percent of contracts in 2005. In addition, Computer and Electronic Product Manufacturing (NAICS 334) firms were awarded roughly \$2.1 billion in total contracts (13.7 percent of total contracts to Massachusetts). In 2009 these three sectors in Massachusetts were awarded approximately \$12 billion, or 77.1 percent of contract dollars awarded to Massachusetts by DoD and DHS.

Professional, Scientific, and Technical Services

Since 2005, the value of contracts awarded within the Professional, Scientific, and Technical Services sector has increased by 168 percent, or \$4.2 billion, representing the most significant change of all the defense industry sectors in Massachusetts. While the Professional, Scientific, and

▼ Massachusetts contract values have nearly tripled in 10 years

Figure 2. Massachusetts Defense Contractors, DoD and DHS FY2000 – FY2009

Fiscal Year	Number of Contractors*	Number of Contracts**	Total Value of Contracts
2000	1,037	5,666	\$5,506,264,396
2001	1,075	4,852	\$5,783,303,749
2002	690	7,020	\$5,802,004,365
2003	768	8,858	\$6,830,634,769
2004	2,007	12,018	\$8,056,923,473
2005	2,731	18,806	\$9,614,387,475
2006	2,666	18,524	\$10,256,946,575
2007	2,611	19,503	\$12,536,065,430
2008	2,668	21,068	\$13,968,296,880
2009	2,624	19,790	\$15,579,072,383

* This count is based on unique vendor ID codes (DUNS numbers). A vendor (contractor) is a business unit that has entered into a contract to supply supplies or services.

** Based on unique contract ID codes.

Source: usaspending.gov Data Feed

▼ Massachusetts ranks 5th and 7th for DoD and DHS contracts

Figure 3. Top Ten States for DoD and DHS Contract Awards, FY2009

State Name	DoD Rank	Value of DoD Contracts	Percentage of U.S. Total DoD Awards	DHS Rank	Value of DHS Contracts	Percentage of U.S. Total DHS Awards
Virginia	1	\$53.06b	14.32%	1	\$5.18b	36.65%
California	2	\$46.07b	12.44%	3	\$1.22b	8.69%
Texas	3	\$28.55b	7.71%	4	\$678m	4.79%
Maryland	4	\$17.61b	4.75%	2	\$1.67b	11.85%
Massachusetts	5	\$15.11b	4.08%	7	\$465m	3.29%
Florida	6	\$14.34b	3.87%	6	\$506m	3.58%
Arizona	7	\$12.19b	3.29%	--	--	--
Connecticut	8	\$12.14b	3.28%	--	--	--
Missouri	9	\$11.82b	3.19%	--	--	--
Pennsylvania	10	\$10.20b	2.75%	--	--	--
District of Columbia	--	--	--	5	\$615m	4.35%
New Jersey	--	--	--	8	\$310m	2.20%
Alaska	--	--	--	9	\$294m	2.08%
Tennessee	--	--	--	10	\$269m	1.91%

Source: usaspending.gov Data Feed

▼ Massachusetts contractors provide highly specialized technical services and manufacturing

Figure 4. Top Ten Defense Industry Sectors in Massachusetts, by Dollar Value

Industry Sector	FY2005			FY2009		
	Rank	Value of Contracts	Percent of Total	Rank	Value of Contracts	Percent of Total
Professional, Scientific, and Technical Services (541)	1	\$2,522,003,801	27.61%	1	\$6,751,357,952	43.30%
Transportation Equipment Manufacturing (336)	3	\$1,416,931,589	15.51%	2	\$3,126,960,490	20.10%
Computer and Electronic Product Manufacturing (334)	2	\$2,207,708,121	24.17%	3	\$2,130,109,915	13.70%
Repair and Maintenance (811)	--	\$37,916,676	0.42%	4	\$465,750,792	3.00%
Construction of Buildings (236)	7	\$243,092,753	2.66%	5	\$459,020,738	2.90%
Machinery Manufacturing (333)	9	\$118,424,970	1.30%	6	\$448,454,904	2.90%
Telecommunications (517)	4	\$954,514,967	10.45%	7	\$406,975,251	2.60%
Administrative and Support Services (561)	--	\$31,157,436	0.34%	8	\$221,594,642	1.40%
Miscellaneous Manufacturing (339)	--	\$36,925,955	0.40%	9	\$190,502,226	1.20%
Water Transportation (483)	8	\$277,794,934	3.04%	10	\$184,243,425	1.20%
<i>All Others (Includes N/A)</i>	--	<i>\$1,286,646,501</i>	<i>14.09%</i>	--	<i>\$1,194,102,048</i>	<i>7.70%</i>
Total	--	\$9,133,117,703	100.00%	--	\$15,579,072,383	100%

Note: Water Transportation (483) is comprised of industries that provide water transportation of passengers and cargo using watercraft such as ships, barges and boats.

Source: usaspending.gov Data Feed & DoD Personnel & Procurement Statistics, Personnel & Procurement Reports and Data Files, <http://siadapp.dior.mhs.mil/index.html>; Federal Procurement Data Systems (FPDS), <https://www.fpds.gov/>

Technical Services sector only represented a quarter of the value of defense contracts in Massachusetts in 2005, it still ranked first in that year as well. In 2009 this sector increased in size to envelop 43 percent of the total value of defense contracts in Massachusetts. Professional careers within this sector usually require advanced degrees and include: architectural, engineering, and specialized design services; computer services; consulting services; research services; and other professional, scientific, and technical services. Massachusetts has leveraged its world-class high-tech firms, research facilities and well-educated workforce to become a major competitor for contracts in this critical area.

Transportation Equipment Manufacturing

Transportation Equipment Manufacturing experienced a 121 percent increase since 2005, with \$3.1 billion in contract awards to Massachusetts in fiscal year 2009, maintaining its status as the second largest defense-related industry sector in Massachusetts. Aircraft engines and parts manufacturers are the largest sub-sector within Transportation Equipment Manufacturing followed by guided missile manufacturers and space vehicle manufacturers. Contracts to this sector more than doubled between 2005 and 2009, thus indicating the growing strength of this area of technologically advanced manufacturing industry in the Commonwealth.

Computer and Electronic Product Manufacturing

Of the top three industry sectors in Massachusetts, Computer and Electronic Product Manufacturing experienced the only decline, dropping slightly in value from \$2.2 billion in 2005 to \$2.1 billion in 2009. Computer and Electronic Products was second to the top defense industry sector in 2005, when it received close to one quarter of the total value of contracts. However, this sector only accounted for 13.7 percent of awards in 2009 due to the dramatic expansion of contracts to Technical Services and Research firms. The most popular types of products in this

sector in 2009 were Guidance, Navigation, Aeronautical, Nautical and Search/Detection Systems, totaling \$653 million (30 percent of Massachusetts' Computer and Electronic Product Manufacturing). Even with a slight decline, this sector is clearly an indispensable, multi-billion dollar player in the Massachusetts defense industry.

Top Products, Research & Development, and Services³

Massachusetts' Top Defense Products

One of Massachusetts' strengths is its variety of complex defense-related products and basic commodities. Contracts for Engines, Turbines, and Components accounted for over \$1.6 billion for 2009. Contracts for Communication, Detection, and Coherent Radiation Equipment ranked second with slightly less than \$1 billion followed by contracts for Guided Missiles, with approximately \$750 million. The production of many top defense products requires the skills of highly trained and educated individuals — qualities that can be found in the Massachusetts workforce.

Massachusetts' Top Research & Development Sectors

The DoD assigns Research and Development spending to its own category. As a result, we are provided with a clear picture of how R&D greatly overshadows all other product and service categories in Massachusetts. In this area, Defense Systems is the leading R&D area with over \$2.4 billion in contract values — up from \$1.4 billion in 2005. Contracts for Other Research and Development and General Science and Technology round out the top three types of R&D, which make up just under 90 percent of the total R&D contract awards. Clearly, the state is positioned as a strong competitor in the nation for defense-related R&D.

Massachusetts' Top Defense Services

The defense service sector plays an important role in the Massachusetts economy by providing jobs for individuals

▼ Massachusetts is a key provider of advanced technology products

Figure 5. Top Ten Products, FY2009

Product	Contract Amount
Engines, Turbines, and Components	\$1.62b
Communication, Detection, and Coherent Radiation Equipment	\$952m
Guided Missiles	\$758m
Ammunition and Explosives	\$694m
Automatic Data Processing Equipment	\$581m
Fire Control Equipment and Systems	\$208m
Electrical and Electronic Equipment Components	\$143m
Subsistence (food products)	\$135m
Alarm Signal and Security Detection Systems	\$113m
Medical, Dental, and Veterinary Equipment and Supplies	\$92.7m
All Other Products (n=72)	\$661m
Total	\$5.96b

Source: usaspending.gov Data Feed

▼ Defense agencies rely on the Commonwealth for highly specialized R&D

Figure 6. Top Ten Research & Development Work, FY2009

Research Type	Contract Amount
Defense Systems	\$2.43b
Other Research and Development*	\$1.39b
General Science and Technology**	\$1.33b
Defense-Other	\$542m
Medical	\$15.91m
Community Services and Development	\$9.03m
Economic Growth and Productivity	\$5.52m
Environmental Protection	\$4.01m
Space	\$2.50m
Energy	\$2.31m
All Other Research	\$1.84m
Total	\$5.74b

* "Other Research and Development includes Basic & Applied Research, Advanced & Engineering Development, Operational Systems Development, and Management and Support

** General Science and Technology includes research in Physical Sciences, Mathematical and Computer Sciences, Environmental Sciences, Engineering, Life Sciences, Psychological Sciences, Social Sciences and Other Sciences, Not Elsewhere Classified.

Sources: usaspending.gov Data Feed; Federal Procurement Data System Product and Service Codes Manual

▼ Many top services are also based on specialized expertise

Figure 7. Top Ten Services, FY2009

Services	Contract Amount
Maintenance, Repair, and Management Support Services	\$974m
Professional Admin and Management Support Services	\$956m
Construction of Structures and Facilities	\$435m
Automatic Data Processing and Telecom Services	\$308m
Transportation, Travel, and Relocation Services	\$250m
Maintenance, Repair, or Alteration of Real Property	\$249m
Quality Control Testing and Inspection Services	\$150m
Medical Services	\$130m
Utilities and Housekeeping Services	\$95m
Special Studies and Analyses (Not R&D)	\$93m
All Other Services (n=13)	\$240m
Total	\$3.88b

Source: usaspending.gov Data Feed



with specialized trade skills. In fact, two of the top three types of defense services involve the trades. Maintenance, Repair, and Management Support Services accounted for \$974 million in total contracts, Personal Administration and Management Services accounted for \$956 million, and Construction of Structures and Facilities rounded out the top three with \$435 million in contracts.

Massachusetts Technology Producing Companies

In 2009, four organizations were awarded a combined total of over \$10.1 billion in contract dollars, which amounted to 65.2 percent of all contract awards to Massachusetts by DoD and DHS. They were Raytheon Company, General Dynamics, the Massachusetts Institute of Technology, and General Electric Company. Notably, these organizations are primarily involved in the production and research of the top products and services mentioned above. Figure 8 shows the top 10 Defense Contractors in the Commonwealth.

Role of Educational Institutions

Among Institutions of Higher Education, the Massachusetts Institute of Technology (MIT) ranked first in awarded contracts, amounting to nearly \$2 billion in 2009. MIT

accounted for approximately 11.2 percent of the total number of defense contract dollars awarded to Massachusetts, ranking third among all defense contractors in the Commonwealth. MIT was the only educational institution within the top 10. Boston College and Tufts University ranked a distant second and third among the research institutions awarded federal defense contracts. Aside from the University of Massachusetts-Amherst and Worcester Polytechnic Institute, the top higher education contractors were located in the eastern half of the state. Research and development is by far the highest awarded product or service type from Institutions of Higher Education, amounting to \$1.7 billion in total awards. Similar to the overall trend in Massachusetts, R&D overshadowed all other product and service types for defense contracts awarded to Institutions of Higher Education.

Role of SBIR and STTR Contracts

Massachusetts has seen a 63 percent increase from 2000–2009 in contract dollars awarded for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) from DoD and DHS. Forty-five percent of all SBIR and STTR contract awards to Massachusetts in 2009 came from DoD and DHS. The awards

▼ Four contractors received 65% of contracts

Figure 8. Top Massachusetts Defense Contractors, by Contract Value, FY2009*

Rank	Company/Institution	Amount	% of all MA contracts
1	Raytheon Company	\$4.58 b	29.5%
2	General Dynamics Corporation	\$2.14 b	13.7%
3	Massachusetts Institute of Technology	\$1.75 b	11.2%
4	General Electric Company	\$1.68 b	10.8%
5	The Charles Stark Draper Laboratory	\$475 m	3.1%
6	Northrop Grumman Corporation	\$367 m	2.4%
7	The Mitre Corporation	\$325 m	2.1%
8	BAE Systems	\$235 m	1.5%
9	L-3 Communications Holdings	\$197 m	1.3%
10	CDM/Cape Joint Venture**	\$126 m	0.8%
	All Others (n=2,614 contractors)	\$3.68 b	23.7%
	Total	\$15.58 b	100%

Source: usaspending.gov Data Feed

* Includes contract awards to Massachusetts-based facilities only. Many contractors have facilities in other geographic locations and awards to these facilities are not included in this part of the analysis.

** CDM is a consulting, engineering, construction and operations firm. Cape, Inc. is their small business partner.

▼ MIT dominates among institutions of higher education

Figure 9. Defense Contracts to Massachusetts Higher Education Institutions, FY2009

Rank	School	Amount	% of all MA contracts
1*	Massachusetts Institute Of Technology	\$1.75 b	11.23%
2	Boston College	\$7.04 m	0.0452%
3	Tufts University	\$5.06 m	0.0325%
4	Woods Hole Oceanographic Institution	\$4.33 m	0.0278%
5	Boston University	\$2.04 m	0.0131%
6	Harvard University	\$1.76 m	0.0113%
7	University Of Massachusetts	\$949 k	0.0061%
8	Northeastern University	\$713 k	0.0046%
9	Worcester Polytechnic Institute	\$144 k	0.0009%
10	New England College Of Optometry	\$123 k	0.0008%
	Other Institutions (n=10)**	\$208 k	0.0018%

Source: usaspending.gov Data Feed

*MIT total includes contracting to MIT Lincoln Laboratory, a federally funded research and development center chartered to apply advanced technology to problems of national security.

**Other includes Merrimack College, Suffolk University, Western New England College, Framingham State College, Mount Holyoke College, Wellesley College, Massachusetts Maritime Academy, Salem State College, Lasell College, and Bridgewater State College

▼ Higher education institutions provide R&D and education and training services

Figure 10. Defense Higher Education Contracts, by Major Category of Product, FY2009

Major Product & Service Category	Amount
Research and Development	\$1,761,179,062
Education and Training Services	\$5,937,301
Professional Admin and Management Support Services	\$2,201,509
Ship and Marine Equipment	\$1,573,267
Quality Control Testing and Inspection Services	\$424,784
Maintenance Repair or Alteration of Real Property	\$381,348
Special Studies and Analyses (not R & D)	\$125,845
Metal Bars Sheets and Shapes	\$87,164
Transportation Travel and Relocation Services	\$39,296
Books Maps and Other Publications	\$27,900
Automatic Data Processing and Telecom. Services	\$17,500
Instruments and Laboratory Equipment	\$15,000
Medical Dental and Veterinary Equipment and Supplies	\$13,000
Lease or Rental of Facilities	\$9,320

Source: usaspending.gov



peaked in 2004 to \$157.9 million in contract awards from defense-related agencies and have since declined to \$129.6 million in 2009.

SBIR contract awards peaked in 2004 and have since decreased from \$123 million in 2008 to \$113 million in 2009. STTR defense contracts peaked in 2005 and experienced a period of relative decline until a recent increase between 2008 and 2009 from \$14 million to \$16 million. This growth in STTR contracts has had positive impacts for firms and institutions in the state. STTR awards require small business applicants to collaborate or subcontract with non-profit research institutions. These partnerships are a win-win situation both for positive corporate publicity and educational value, making Massachusetts a strong competitor in defense-related research and development.

Charles River Analytics, Inc., a global consulting firm, was the largest SBIR and STTR recipient, accounting for 47 contracts and more than \$13 million in awards in 2009. Aptima, Inc., a human-centered engineering firm, is the second highest awarded firm for SBIR and STTR defense contracts. Rounding out the top three firms was Physical Sciences, Inc. with 29 contracts totaling \$8 million in SBIR and STTR contract awards in 2009.

In 2009, Sensors, Electronics, and Electronic Warfare accounted for \$31.8 million in defense related SBIR and STTR contracts. Physical Sciences, Inc., Charles River Analytics, and Spectral Sciences, Inc., were the three companies awarded the largest contracts in this category. Materials/Processes and Information Systems Technology followed closely with \$28.6 million and \$22.7 million in contract awards respectfully.

Minority-Owned Businesses

Contract awards to minority-owned businesses in Massachusetts have more than tripled since 2005, with a peak in 2008.⁴ From 2005 to 2007 Hispanic American-owned companies were awarded the greatest number of contracts in Massachusetts. Since then, contracts have increased to Asian-Indian American-owned companies and these firms currently represent the most frequently awarded minority group (49.9 percent of contract awards in 2009). Figure 14 shows the contract awards to minority-owned businesses from 2005 to 2009. Note that these represent a subset of small businesses, those with a distinct owner. This is a self-reported category and these values do not include publicly traded companies. Therefore, these numbers are likely modest estimates.

▼ **Most small business development contracts come in the form of SBIR awards**

Figure 11. SBIR & STTR Defense Contract Awards

	SBIR Value		SBIR Contracts	
	2008	2009	2008	2009
Phase 1	\$22,579,706	\$23,388,683	251	262
Phase 2	\$100,609,375	\$89,978,136	140	124
Total	\$123,189,081	\$113,366,819	391	386

	STTR Value		STTR Contracts	
	2008	2009	2008	2009
Phase 1	\$2,864,374	\$3,727,664	32	43
Phase 2	\$11,603,154	\$12,508,380	18	17
Total	\$14,467,528	\$16,236,044	50	60

Source: U.S. Small Business Administration Technology Resources Network

Figure 12. Top Ten Firms Awarded SBIR/STTR Contracts, FY2009

Firm Name	Contracts	Contract Value
Charles River Analytics Inc.	47	\$13,441,885
Aptima, Inc.	32	\$8,506,472
Physical Sciences Inc.	29	\$8,028,185
Infoscitex Co.	25	\$7,524,285
Mayflower Communications Co., Inc.	25	\$4,953,839
Cuming Microwave Co.	18	\$4,899,807
Scientific Systems Company, Inc	15	\$4,861,154
Agiltron Co.	11	\$4,825,602
Triton Systems, Inc.	11	\$3,934,397
Spectral Sciences, Inc.	8	\$2,719,816

Source: U.S. Small Business Administration Technology Resources Network

▼ **Small business funding supports technology development**

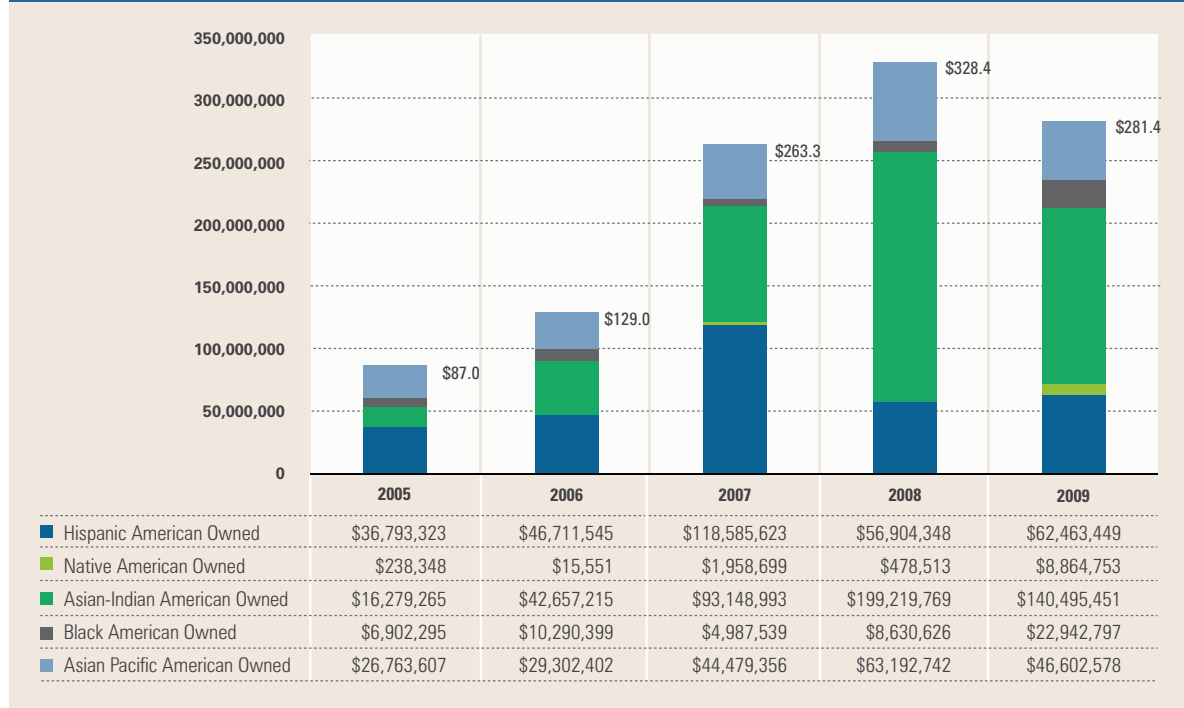
Figure 13. SBIR/STTR Defense Contracts Awarded, by Technology Sector in Massachusetts, FY2009

Category	Contracts	Value
Sensors, Electronics and Electronic Warfare	118	\$31.8m
Materials/Processes	95	\$28.6m
Information Systems Technology	66	\$22.7m
Human Systems	35	\$12.6m
Battlespace Environments	26	\$8.0m
Air Platforms	17	\$4.7m
Ground and Sea Vehicles	13	\$4.6m
Chemical/Biological Defense	20	\$4.1m
Space Platforms	19	\$4.0m
Biomedical	19	\$3.8m
Nuclear Technology	5	\$2.7m
Weapons	13	\$1.8m

Source: U.S. Small Business Administration Technology Resources Network

▼ Awards to minority-owned firms have more than tripled since FY2005

Figure 14. Contract Awards to Minority-Owned Businesses, by Dollar Value, FY2005 – FY2009



Source: usaspending.gov Data Feed

Defense is Vital to Massachusetts

This concluding section discusses how the defense industry compares to all federal contracting activities in the Commonwealth. Figures 15, 16, and 17 display the top 5 federal contracting agencies to contractors in Massachusetts, the top 5 federal contract recipients in the state, and the top 5 products and services sold to the federal government by Massachusetts contractors. As previously discussed, DoD and DHS contract values account for

approximately 85 percent of all federal contract dollars awarded to Massachusetts contractors. Defense continues to dominate, with the Raytheon Company being in receipt of the highest dollar amount of contract awards in the state. Furthermore, the top 5 federal contract recipients in Massachusetts are defense contractors. Finally, each of the top 5 products or services sold to the federal government is directly related to defense technology.⁵ There is little question that the defense industry plays a vital and significant role in the Massachusetts economy.

▼ **Eighty-five percent of all federal contracts to Massachusetts are defense related**

Figure 15. Top Five Massachusetts Contracting Agencies, FY2009

Agency	Amount
Department of Defense	\$15.1b
US Agency for International Development	\$514.2 m
Department of Homeland Security	\$465.3m
Department of Health and Human Services	\$391.0m
General Services Administration	\$349.9m
All Other Agencies	\$1.5b

Source: usaspending.gov Data Feed

▼ **The top 5 federal contract recipients in Massachusetts are defense contractors**

Figure 16. Top Five Federal Contract Recipients, by Value, FY2009

Company/Institution	Amount
Raytheon Company	\$4,593,630,604
General Dynamics Corporation	\$2,114,278,631
Massachusetts Institute of Technology	\$1,757,220,005
General Electric Company	\$1,677,037,410
The Charles Stark Draper Laboratory, Inc	\$483,308,175

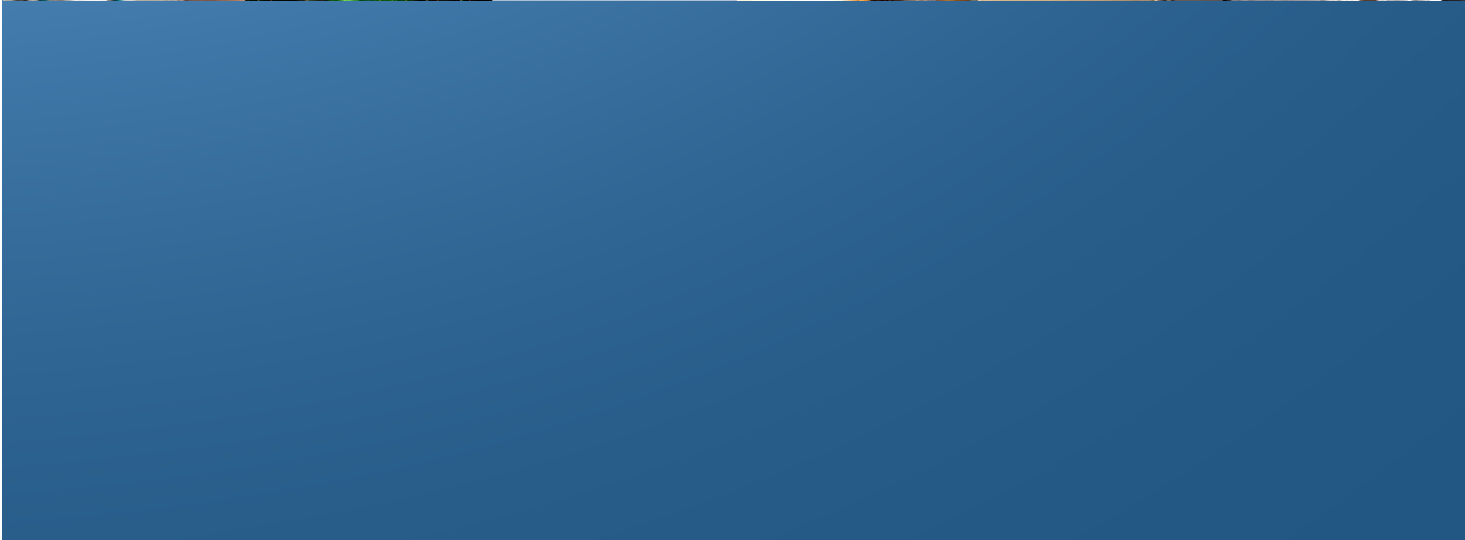
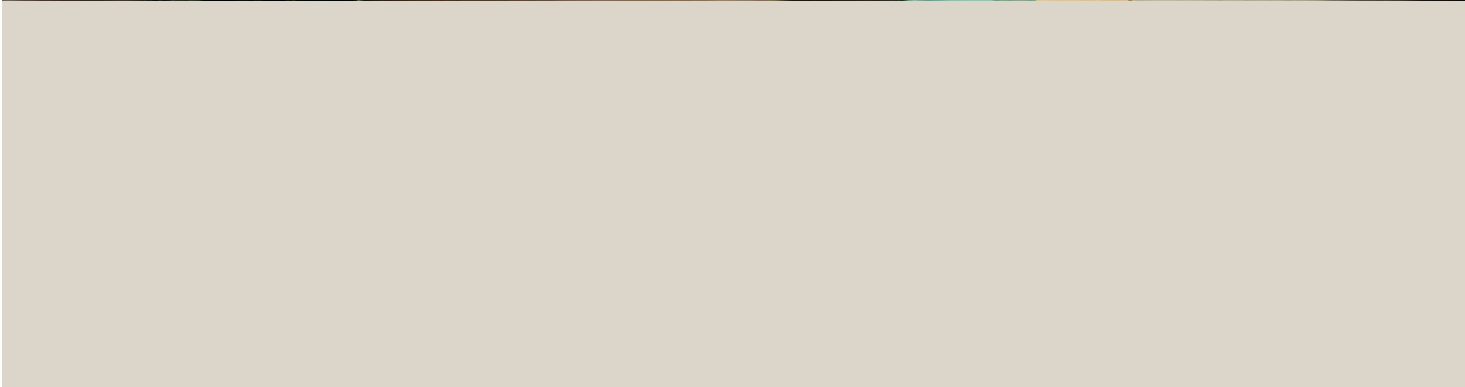
Source: usaspending.gov Data Feed

▼ **Each of top 5 products or services sold to the federal government is directly related to defense technology**

Figure 17. Top Five Products or Services Sold, FY2009

Product or Service	Amount
Gas Turbines and Jet Engines, Aircraft; Prime Moving, and Components	\$1,389,370,545
Engineering-Advanced Development (R&D)	\$1,264,268,956
Other Research and Development- Advanced Development (R&D)	\$984,527,726
Defense Electronics and Communication Equipment-Basic Research (R&D)	\$806,896,477
Guided Missiles	\$655,458,411

Source: usaspending.gov Data Feed



Part 2

ECONOMIC IMPACTS OF DEFENSE IN MASSACHUSETTS

Introduction

This section measures the contributions of defense industry activities within the state. We use an economic impact analysis software program to measure economic impacts of defense industry spending across Massachusetts, allowing us to model and estimate how this spending affects economic relationships throughout the state. The sections that follow quantify three different types of effects resulting from defense-related production and employment in Massachusetts: direct, indirect, and induced.

The three effects come into play as defense-related production activities flow through the economy, resulting in a multiplier effect. Direct impacts are inputs into the state economy — in this case, we express them as the total dollar value of the defense contracting activity. Indirect impacts are the ripple effects that result from spending to supplier firms in other sectors. For example, a \$300,000 defense contract to a manufacturer (a direct impact of \$300,000) would lead to additional spending on goods

and services from other sectors, thus generating additional revenue in the economy. Finally, induced effects are the impacts of household expenditures from wages and salaries of employees of defense contractors. Household spending generates new business activity and new, higher levels of production. New income generates more spending, which, in turn, necessitates more production.

In the impact analysis of defense contracts, we use the total dollar value of all contract activities performed in Massachusetts.⁶ In general, Massachusetts defense contractors perform the vast majority of contracts awarded to them in state.⁷ But Massachusetts also serves as the principal place of performance for contracts awarded to out-of-state contractors. In 2009, contractors from every other state interacted with Massachusetts facilities for contract work totaling \$630.8 million dollars. Figure 25 in Appendix I illustrates that Virginia, Tennessee, Ohio, Florida, and California are the states that sent the highest values of contracts to be performed in the Commonwealth in 2009.

Total Economic Contributions

Overall, economic contributions made by the industry have increased by 146 percent since 2001, from \$10.6 billion to \$26.0 billion in 2009. Direct impacts have the highest values, followed by indirect and, then, induced impacts. Figure 18 demonstrates the trends of the past decade. Total economic output has increased every year since 2002 after experiencing a slight dip after 2001.

Employees Supported by Defense

Employees supported by the defense industry have increased since 2001, with a total count of approximately 115,563 jobs in 2009. As displayed in Figure 19, the largest category of employees supported by the defense industry are those directly employed by defense contractors. In

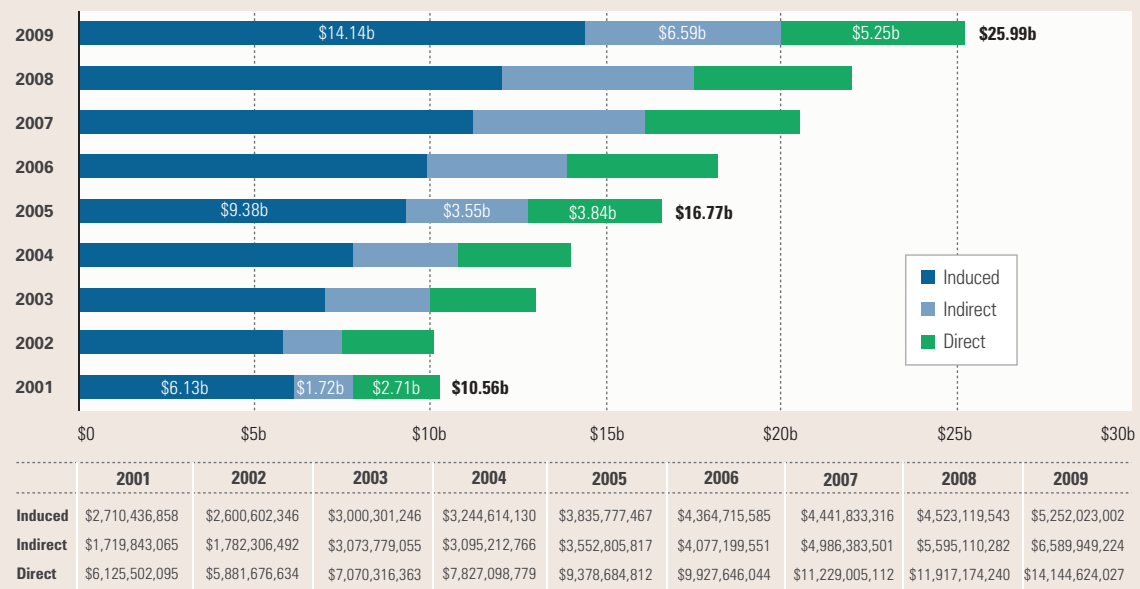
2007 overall employment experienced a decline, which can likely be attributed to the state of the national economy.

However, by 2009 Massachusetts had recovered favorably to exceed the previous high in 2006 by about 12,300 jobs.

In 2009, through the multiplier effect, every dollar spent on defense-contract work in the Commonwealth generated an additional 84 cents. Thus, the \$14.1 billion in defense contracts generated an additional \$11.8 billion of indirect and induced activities in Massachusetts. Defense contracting work also has a strong impact on job creation. In 2009, the employment multiplier for defense contracting activity was 2.42, which means that for every job attributable to defense contracting, 1.42 additional jobs were created in the state. According to our estimates, in 2009, Massachusetts defense contracts directly supported approximately 47,738 jobs in the state. Through the multiplier effect,

▼ Total economic output has increased every year since 2002

Figure 18. Total Economic Output, FY2001 – FY2009*

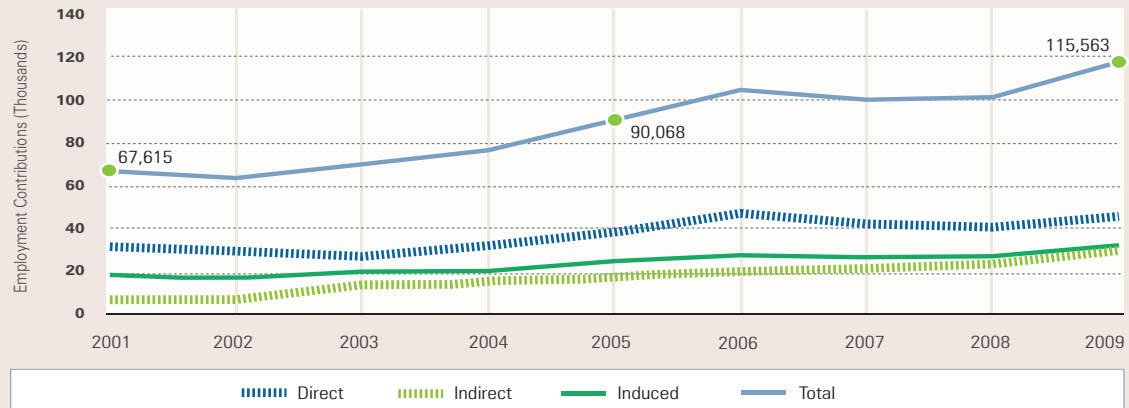


Source: UMDI Calculations; IMPLAN Economic Analysis Software, Minnesota IMPLAN Group

*Dollar values have been adjusted to reflect current (2010) dollars. 2007 Numbers were adjusted- See Methodological Details in Appendix II

▼ **The defense industry supports over 115,000 workers in Massachusetts**

Figure 19. Massachusetts Employees Supported by the Defense Industry, FY2001 – FY2009



Source: UMDI Calculations; IMPLAN Economic Analysis Software, Minnesota IMPLAN Group. The 2007 Numbers are adjusted. See Methodological Details in Appendix II.

▼ **FY2009 defense contracting generated \$26b in economic output and approximately 115,563 jobs in Massachusetts**

Figure 20. FY2009 Output and Employment Multipliers

	Direct	Indirect	Induced	Total	Multiplier
Output*	\$14,144,624,027	\$6,589,949,224	\$5,252,023,002	\$25,986,596,124	1.84
Employment	47,738	32,765	35,060	115,563	2.42

Source: UMDI Calculations; IMPLAN Economic Analysis Software, Minnesota IMPLAN Group

*Reported in 2010 dollars

Figure 21. Economic Impacts of the Top Ten Defense Industry Sectors, FY2009*

IMPLAN Sector	Direct	Indirect	Induced	Total
All Other Misc Professional - Scientific	\$2,200,788,992	\$239,503,648	\$18,914,988	\$2,459,207,424
Aircraft Engine and Engine Parts Manufacturing	\$1,790,331,776	\$410,282,528	\$251,578	\$2,200,865,792
Architectural – Engineering – and Related Services	\$1,896,791,680	\$201,179,520	\$16,015,902	\$2,113,987,072
Scientific Research and Development Services	\$1,813,027,968	\$110,816,008	\$11,759,890	\$1,935,603,968
Guided Missile and Space Vehicle Manufacturing	\$1,348,377,472	\$141,098,240	\$15,849	\$1,489,491,584
Wholesale Trade	\$201,979,600	\$448,057,184	\$293,360,416	\$943,397,184
Search – Detection – and Navigation Instruments	\$709,677,568	\$28,750,362	\$204,299	\$738,632,256
Rental Activity for Owner Occupied Dwellings	\$0	\$0	\$715,333,632	\$715,333,632
Telecommunications	\$371,660,416	\$187,218,080	\$79,788,568	\$638,667,136
Real Estate Establishments	\$3,246,465	\$265,454,784	\$263,025,968	\$531,727,200
All Others	\$3,808,742,090	\$4,557,588,870	\$3,853,351,912	\$12,219,682,876
Total	\$14,144,624,027	\$6,589,949,224	\$5,252,023,002	\$25,986,596,124

Source: UMDI Calculations; IMPLAN Economic Analysis Software, Minnesota IMPLAN Group

*Reported in 2010 dollars

defense-related economic activity generated an additional 67,826 jobs, yielding an estimated total of 115,563 jobs generated in the Commonwealth.

Figure 21 illustrates the defense industry sectors that have the greatest total economic impact on the Massachusetts economy. Highly technical and technology-based industry sectors have high levels of economic output. The Professional Scientific Services sector generates the highest level of economic impact within the state.⁸ This sector alone generates more than \$2.4 billion in annual economic activity in the Commonwealth. Contracts to the next top-ranked industry sectors — Aircraft Engine and Engine Parts; Architectural Engineering and Related Services; and Scientific Research and Development Services — together contribute another \$8.7 billion annually. In total, contracts to the four top-ranked industry sectors

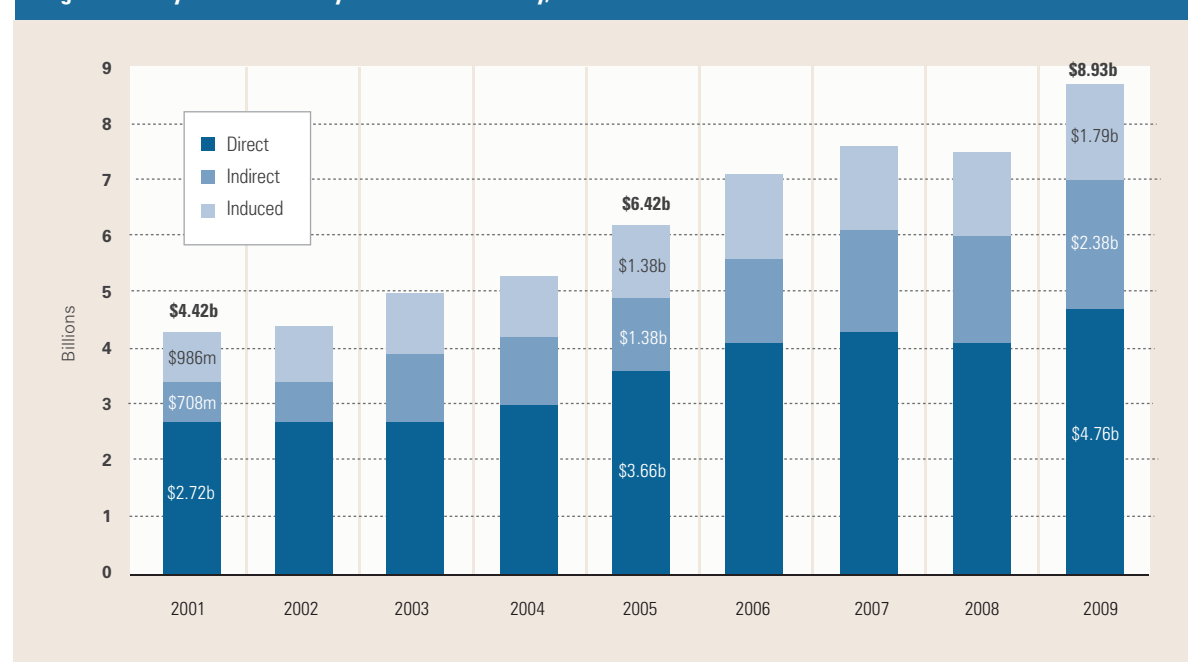
account for 33.5 percent of all defense-related impacts within the Commonwealth.

Payroll Generated by Defense

The defense industry has had a positive overall effect on the payroll generated in Massachusetts between 2001 and 2009, demonstrating an estimated increase of 102.2 percent, and total estimated payroll impacts of \$8.9 billion in 2009. Direct payroll impacts have a positive effect on local economies wherever defense employees spend their paychecks. Induced impacts, generated by this household spending, have increased steadily over the ten-year period. Despite a dip in direct payroll value in 2008, induced and indirect payroll still experienced moderate increases, thus producing a slight increase in total payroll impacts in the state.

▼ Payroll generated by FY2009 defense contracts reached \$8.93b

Figure 22. Payroll Generated by the Defense Industry, FY2001 – FY2009*

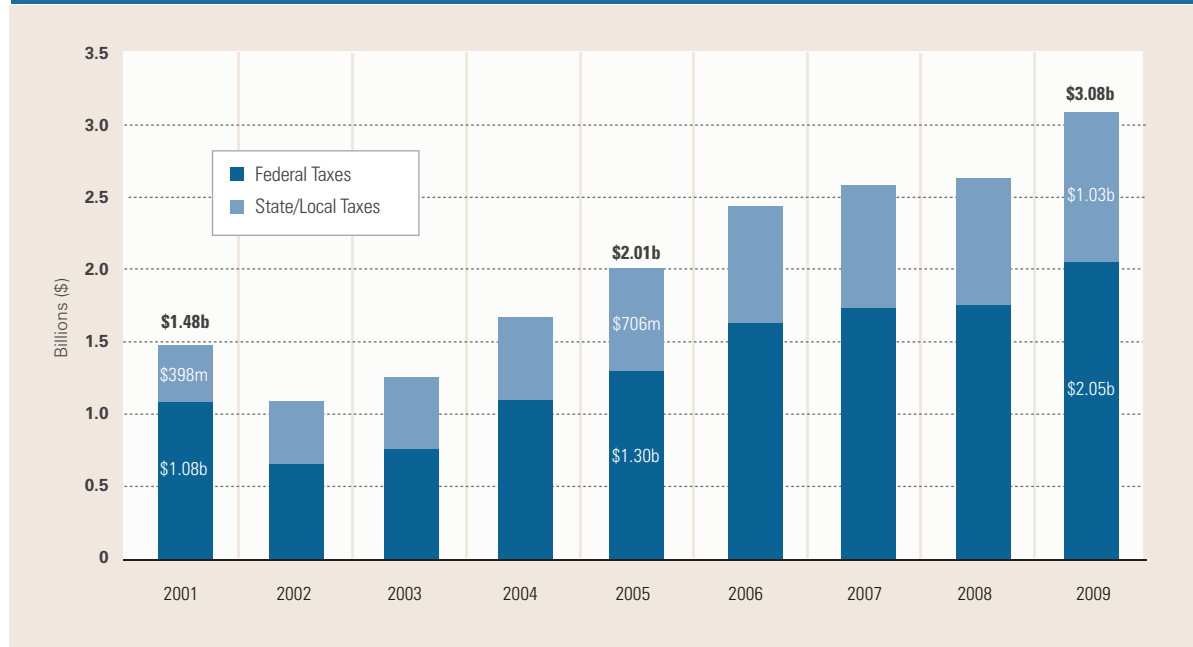


Source: UMDI Calculations; IMPLAN Economic Analysis Software, Minnesota IMPLAN Group

*Dollar values have been adjusted to reflect current (2010) dollars 2007 Numbers were adjusted- See Methodological Details in Appendix II

▼ **Defense contracting generates over \$3b in federal and state & local taxes**

Figure 23. Total Tax Impacts, FY2001 – FY2009



Source: UMDI Calculations; IMPLAN Economic Analysis Software, Minnesota IMPLAN Group

Taxes Generated by Defense

The defense industry makes substantial contributions to the total tax revenues in Massachusetts. Estimated tax revenues related to defense industry spending have increased by 108 percent since 2001, with the most significant percentage increases occurring in state and local taxes over that span. Despite significant gains in state and local tax revenue, federal taxes continue to account for the greatest amounts of taxes generated by the defense industry in the Commonwealth.⁹ Most of these tax impacts are generated through payroll taxes.

Defense has a Significant Economic Impact on Massachusetts

The defense industry in Massachusetts comprises mainly technical fields. High technology based industry sectors create highly valued products and services, and therefore contribute largely to the Commonwealth's economy. With over 115,000 jobs generated and \$25.9 billion in total economic impact in FY 2009, the defense industry remains an integral part of the Massachusetts economy.



Conclusion

The defense industry is increasingly important and continually developing within the Massachusetts economy. The industry is responsible for billions of dollars in contract awards to Massachusetts, as well as the generation of significant employment, payroll, and taxes. In addition, the growing number and value of contracts awarded to the state in the past decade illustrates the increasingly important role the state plays in meeting the needs of the DoD and DHS.

Contract awards associated with highly specialized, technical services and technology production continue to dominate the defense industry in the Commonwealth, and will likely be increasingly important for the future development and cultivation of the industry within the state. According to the *2010 Quadrennial Defense Review*,¹⁰ many defense priorities and initiatives will lean heavily on new technology development and technology-based research and development. The Department of Defense also produced the *2008 Strategic Basic Research Plan*.¹¹ Its detailed science, technology and research priorities demonstrate the importance of an economy that is technology-based.

Impacts generated by the defense industry to the Commonwealth have increased from 2001–2009. In particular, the increases in total jobs created and payroll generated are especially important to the vitality of the Massachusetts economy in its current condition. The estimated number of employees supported by the defense industry has increased by nearly 50,000 jobs since 2001, which in turn has increased the total payroll generated within the state by an additional \$4.5 billion since 2001. The greatest increase is visible in the total output to Massachusetts with a total increase of \$15.4 billion since 2001, representing tremendous economic activity throughout the Commonwealth.

As the defense sector continues to increase, so too has its importance to the state economy. During a time of serious economic downturn in many areas of the economy, defense has provided stability and reliability while other sectors have faltered. The Commonwealth's unique qualities — home to a highly trained and educated workforce and a density of high-tech companies, world class firms and research institutions — make it a uniquely strategic location for federal defense contracting.

Appendix I

Figure 24. Value of Contracts Performed in Massachusetts, by State, FY2001 and FY2009

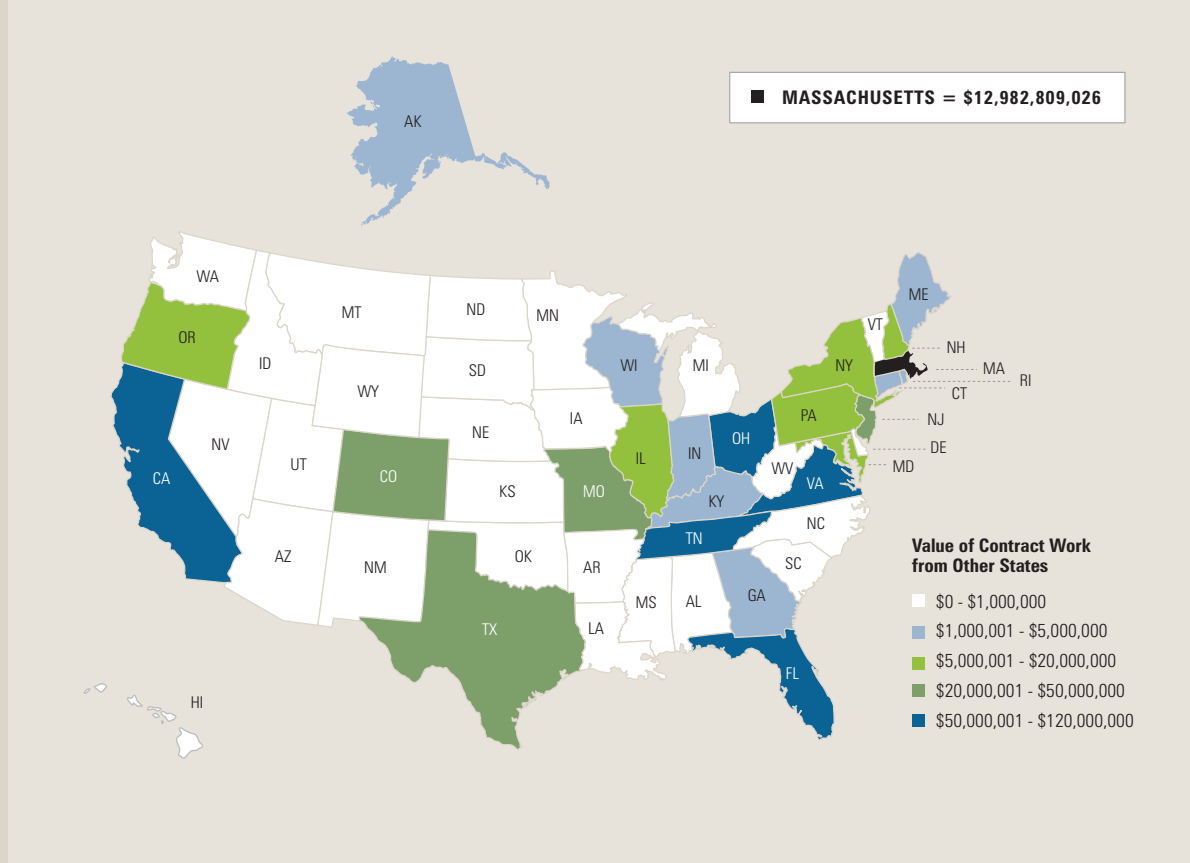
FY2001			FY2009		
Rank	State	Contract Values	Rank	State	Contract Values
1	Massachusetts	\$4,981,949,046	1	Massachusetts	\$12,982,809,026
2	California	\$96,606,181	2	Virginia	\$113,097,916
3	Virginia	\$59,073,090	3	Tennessee	\$103,266,788
4	Ohio	\$28,532,523	4	Ohio	\$94,809,209
5	New Hampshire	\$25,695,445	5	Florida	\$72,718,373
6	Texas	\$24,424,703	6	California	\$56,557,566
7	New Jersey	\$22,349,542	7	New Jersey	\$26,039,690
8	Maryland	\$18,070,185	8	Texas	\$25,748,647
9	Colorado	\$10,879,764	9	Colorado	\$24,714,138
10	New York	\$9,258,158	10	Missouri	\$21,198,319
11	Pennsylvania	\$8,944,253	11	Pennsylvania	\$16,639,627
12	Georgia	\$7,361,076	12	Maryland	\$16,242,846
13	Illinois	\$3,680,748	13	New York	\$10,371,774
14	District of Columbia	\$3,086,292	14	Illinois	\$6,990,331
15	Florida	\$2,832,172	15	Oregon	\$5,638,604
16	Kentucky	\$2,208,120	16	New Hampshire	\$5,605,333
17	Tennessee	\$2,151,197	17	Connecticut	\$4,045,254
18	Rhode Island	\$2,127,831	18	Indiana	\$3,825,843
19	Maine	\$1,561,900	19	Alaska	\$3,422,826
20	Connecticut	\$1,479,834	20	Rhode Island	\$2,849,710
21	Oregon	\$1,292,213	21	District of Columbia	\$2,828,025
22	Mississippi	\$1,251,710	22	Kentucky	\$2,630,219
23	Nebraska	\$1,221,492	23	Georgia	\$2,046,770
24	Alabama	\$635,367	24	Maine	\$1,867,013
25	North Carolina	\$535,963	25	Wisconsin	\$1,045,928
	<i>Other</i>	\$3,652,934		<i>Other</i>	\$6,619,702
Total		\$5,320,861,739	Total		\$13,613,629,473

Source: usaspending.gov Data Feed

Massachusetts defense contractors perform the vast majority of contracts awarded to them in state. But Massachusetts also serves as the principal place of performance for contracts awarded to out-of-state contractors. In 2009, contractors from every other state interacted with Massachusetts facilities for contract work totaling \$630.8 million dollars.

Appendix I, CONTINUED.

Figure 25. Value of Contracts Performed in Massachusetts, by State, FY2009



Source: usaspending.gov Data Feed

Appendix II

IMPLAN Methodology

The method used in this study to calculate economic impacts is an input-output analysis, conducted using IMPLAN Professional software. Input-output models estimate the level of economic exchange between various industries in a local economy, in this case, in the Massachusetts economy. This analysis measures the importance of economic activity primarily in terms of output impacts, employment impacts, and tax impacts:

- Output is the total value of spending in Massachusetts attributable to spending in an industry (in this case, the defense industry).
- Employment refers to the number of people employed in the state as a result of defense contracting. This includes wage and salary employees and self-employed individuals.
- Labor income (Payroll) is the total estimated salary generated by defense spending in the regional economy.
- Tax Impact is the total estimated tax contributions generated by defense spending to federal, state and local government.

Direct, Indirect, and Induced Effects

Direct impacts are inputs into the state economy — in this case, we express them as the total dollar value of the defense contracting activity. Indirect impacts are the ripple effects on supporting economic activity in other sectors that the defense contracting activity generates. Finally, induced effects are the impacts of household expenditures from wages and salaries that result in new business activity and new, higher levels of production. New income generates more spending, which, in turn, necessitates more production.

Multipliers

The economic impact of new spending in an industry is typically a multiple of the actual investment because a portion of the dollars that are spent locally are then respent locally. Dollars that are not spent locally, but on goods and services produced elsewhere, are said to have “leaked” out of the local economy. These dollars do not have an opportunity to be locally respent and to create a “ripple” effect in the local economy.

The ratio of each dollar of income and spending generated within the region to each initial new dollar of spending in the region is used to calculate a multiplier. A multiplier is a quantitative expression of the total amount of new spending generated in a local economy from each initial new dollar of spending. For example, in an industry sector with a multiplier of 1.46, \$0.46 in new spending is generated from each initial new dollar spent in the industry.

Two types of multipliers exist: income multipliers and employment multipliers. The employment multiplier works the same way as the income multiplier. If the number of new jobs created by an industry sector is multiplied by the employment multiplier, then the result is the total new employment generated in the local economy.

Methodological Decisions

NAICS to IMPLAN Crosswalk

NAICS codes were aligned to IMPLAN codes for each of the years using an IMPLAN crosswalk bridge. Several different versions of NAICS codes were used to match to IMPLAN codes for each of the years. The 2001 file used

Appendix II, CONTINUED.

1997 NAICS codes and some of these codes were still used in subsequent years. The overall NAICS coding scheme was revised both in 2002 as well as 2007. Even after a NAICS code revision, some early codes were used to classify some defense contracts. Therefore, several different merges were used to accurately assign NAICS codes to IMPLAN codes.

In 2007, IMPLAN changed from a 509 coding scheme to a 440 coding scheme (440 codes reduced from 509 codes). A smaller number of IMPLAN codes required a different merge from the existing NAICS code list. Another set of merges were made for the 440 coding scheme used from 2007 to 2009.

Reporting Total Output and Labor Income in 2010 dollars

In order to make valid trend comparisons over time, total economic output and labor income were reported in 2010 dollars. Using an inflationary adjustment, actual contractual value changes can be displayed without confounding the effect of inflation. No inflationary adjustment can be made for employment changes and tax impact changes.

Missing NAICS Codes

Each yearly file contained contractual actions that had missing NAICS codes. In order to capture as much economic activity as possible, a methodology was employed to fill in missing NAICS codes for these records. Several different strategies were used to capture all of the contractual dollars being spent by the defense industry in Massachusetts.

Using Product or Service Codes

Each record in the contractual database contained a code for the product or service associated with that contractual action. While NAICS codes categorize industry types, product or service codes specify the particular type of activity associated with that industry. We can assume that there is an association between the industry sectors (NAICS code) and the services that a specific industry provides (product or service code). By aggregating the contract database by product or service code, we can take the modal value of the NAICS code associated with each product or service code. Then, we can use that NAICS code to fill in cases where there is a valid product or service code but no NAICS code. By using the product or service codes we were able to fill a majority of the missing NAICS codes.

Inputting missing data into the general defense sector

Some NAICS codes still could not be assigned an IMPLAN code because they were missing both a NAICS code and a product or service code. Only a small percentage of all contractual actions were left unclassified. In these cases, we used a general “defense sector” IMPLAN code to model these contractual actions. The default defense sector category models secondary economic activity in a similar pattern for how the federal military purchases goods and services overall.

Negative Contractual Actions

The contract database contains some negative value contract actions that reflected changes from previous years. For example, a multiple year contract might have changed in the current fiscal year and this contractual adjustment is

Appendix II, CONTINUED.

now reflected as a negative action. Since defense spending only for the specific fiscal year was used in the analysis (and there is no way to match contract actions across time), only actual spending was used for the analysis. No negative contractual adjustments were used in our analysis.

Missing IMPLAN Sectors

IMPLAN sectors are specific for each geographic region and all of the subsequent economic activity is generated for sectors within that region. Each year, a small number of IMPLAN sectors are assumed not to exist within the Massachusetts economy. In the few cases where a NAICS code matched to an IMPLAN sector that was assumed not to exist in Massachusetts, a closely related IMPLAN sector was used to model the contract actions.

2007 Model Adjustments

We used the 2008 IMPLAN model to analyze 2007 impacts because the relationships in the 2007 model presented questionable results. The year 2007 model was the first year utilizing new industrial relationship tables from the Bureau of Labor Statistics. There were questionable aspects of the 2007 model that had been corrected in the 2008 model. Consequently, we relied upon the 2008 model to run a more reliable set of estimates for 2007.

Endnotes

1. The latest annual data available for analysis during the study period are for Fiscal Year 2009.
2. The data we use in this analysis of contract values are in nominal dollars not inflation adjusted dollars.
3. This section of the analysis is based on federal product and service categories which comprise detailed product codes. For more information see the *Federal Procurement Data System Product and Service Codes Manual*.
4. Reliable data for this analysis did not exist until 2005.
5. We refer here to individual product codes rather than the broader product categories discussed previously in the analysis.
6. We use the total dollar value of all contract activities performed in Massachusetts regardless of where the contractor is headquartered. As a result, the dollar values for each year differ from the value of Massachusetts contracts reported in the same year. In addition, output values have been adjusted to 2010 dollars to allow comparisons over time.
7. In 2009, for example, Massachusetts contractors performed 83 percent of defense contracts within the Commonwealth.
8. The sector categories in this section are IMPLAN economic impact software codes and while based on NAICS industry sectors, vary somewhat from the NAICS industry sectors discussed earlier.
9. Figure 27 in Appendix II provides more detail about the elements included in the federal, state and local tax estimates.
10. United States. Department of Defense. *Quadrennial Defense Review Report 2010*. Retrieved November 2, 2010. <http://www.defense.gov/qdr/images/QDR_as_of_12Feb10_1000.pdf>
11. United States. Department of Defense. Defense Research and Engineering. *2008 Department of Defense research and Engineering Strategic Basic Research Plan*. Retrieved November 2, 2010. <www.aau.edu/WorkArea/DownloadAsset.aspx?id=8908>





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