

Staying Power II

A Report Card on Manufacturing
in Massachusetts 2012

Prepared by:

The Kitty and Michael Dukakis Center for Urban and Regional Policy at Northeastern University



Northeastern University
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Staying Power II

A Report Card on Manufacturing in Massachusetts
2012

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**The Massachusetts Technology Collaborative
The Greater Boston Manufacturing Partnership
RBS Citizens
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Dear Friends,

In July of 2008, the Boston Foundation published a detailed and illuminating report on the state of manufacturing in Massachusetts—researched and written by Barry Bluestone and his team at Northeastern University’s Dukakis Center for Urban and Regional Policy. We named the report *Staying Power* because, while some analysts had predicted the decline of the manufacturing sector as a major economic player, the news was surprisingly good. In 2007, the sector had employed almost 300,000 people in thousands of companies across the Commonwealth.

Within several months of the release of that report, of course, Massachusetts – along with every other state in the country – was rocked to its core by the worst global recession in seven decades, leading to layoffs and tough times for workers on almost every rung of the economic ladder. As this new report reveals, the manufacturing sector in Massachusetts did lose jobs during the recession, but far fewer than anticipated, with more than 250,000 surviving. These are jobs that pay well, with an average annual wage of \$75,000. In addition, the sheer number of manufacturing firms, which had declined every year since 2002, actually increased in 2011.

Within this positive forecast, however, there are some clouds – and one of them relates to an issue that is a major focus of our work at the Boston Foundation: educating and training our workforce. Despite the recession, more than 40 percent of the state’s manufacturing firms reported that they have difficulty finding skilled craftsmen to replace those retiring or leaving the industry. Nearly a quarter find it very difficult to recruit R&D personnel. One of the most disturbing concerns revealed here is that only one in eight of these firms consider the state’s community colleges to be a vital training ground for the workers they need.

An assessment of total job openings across all Massachusetts industries by skill level, from 2006 through 2016, shows that 38 percent of jobs require more than a high school diploma but less than a four-year degree. These “middle skill” jobs are a key component of the new economy and community colleges are crucial to preparing students for these jobs.

A 2011 Boston Foundation report, titled *The Case for Community Colleges: Aligning Higher Education and Workforce Needs in Massachusetts*, drew attention to the central role that community colleges can and should play in preparing our workforce, especially for the kinds of middle-skill jobs that manufacturing firms offer.

Because manufacturing firms have invested in new technology and have remained strong in a fiercely competitive global economy, this sector is even more robust than it was in 2008. For those of us dedicated to creating a strong education pipeline, the ultimate goal is to provide the residents of Massachusetts with rewarding careers and family-sustaining wages. If we do that successfully, this important sector will continue to have true staying power.

Paul S. Grogan
President and CEO
The Boston Foundation

PREFACE

Throughout much of 2007 and early 2008, the Dukakis Center for Urban and Regional Policy at Northeastern University led a major research project to assess the state of manufacturing in Massachusetts. This once dominant industry had been hemorrhaging jobs for years and was now overshadowed by the rise of the health care sector, higher education, financial services, and a growing array of information technology companies. Indeed, many had surmised that manufacturing was part of the Commonwealth's past and not particularly important to the Commonwealth's economic future. In the interviews we carried out with more than one hundred CEOs, owner/operators, and senior executives of manufacturing firms, we often heard of the "benign neglect" afforded their industry. Manufacturing, both in Massachusetts and the nation, seemed to be suffering from what might be called the "Rodney Dangerfield" syndrome – the sector "got no respect" and was largely overlooked in the media and by federal, state and local government.

What we found in our research and reported in our July 2008 report, *Staying Power: The Future of Manufacturing in Massachusetts*, was therefore quite surprising.¹ Manufacturing in Massachusetts was alive and well and remained a vital component of the state's economy, despite the fact that manufacturing employment had declined precipitously. What is more, we found from our survey of more than 700 manufacturers in the state that three-fifths of them expected to increase their employment over the next five years as these companies adopted advanced technology that made them competitive once again in national and global markets.

Our report received widespread media attention. In combination with another study released soon after by the New England Council that came to the same encouraging conclusion, the Patrick-Murray Administration began to devote much

more attention to manufacturing and how the Commonwealth could play a greater role in strengthening this sector.²

In May 2010, Governor Deval Patrick launched a collaborative effort by leaders in industry, academia and government to "set the state's ambitions and framework for action in manufacturing."³ In November 2011, the collaborative created under the Governor's Advanced Manufacturing Initiative released its report *Building Bridges to Growth: A Roadmap for Advanced Manufacturing in Massachusetts*. That report focused attention on five areas identified in the original Dukakis report:

- Promoting Manufacturing
- Workforce & Education
- Technical Assistance and Innovation
- Cost of Doing Business
- Access to Capital

It noted that "the public sector can play a catalytic and facilitating role by promoting conditions and strengthening the institutional infrastructure that will enable (manufacturing) businesses to self-organize and reach their full potential."⁴ The goal is to continue to "build a world-class advanced manufacturing cluster in the state."⁵

Nationwide, manufacturing's reputation was further burnished when President Obama devoted an entire section to the industry in his 2012 State of the Union Address. During the speech, he mentioned manufacturing eight separate times.⁶ Along with a section devoted to training a skilled workforce, much of it for this sector, the President focused more attention on the need to rebuild the nation's productive capacity than he allocated to comments dedicated to corporate taxes, foreign trade, education, America's global influence, the nation's infrastructure, or housing. Simultaneously, the White House released the President's *Blueprint for An America Built to Last*.⁷

The number one point in the Blueprint is to create new jobs in manufacturing in America by removing tax incentives for locating jobs abroad, lowering tax rates on manufacturers that create jobs, getting tough on trade enforcement, and forging new partnerships between community colleges and businesses to train manufacturing workers. Following his State of the Union address, the President proposed a “National Network for Manufacturing Innovation” with up to 15 Institutes of Manufacturing Innovation across the nation, funded at \$1 billion a year.⁸ A month later in April, Obama announced the launch of *Manufacturing Data.Gov*, a one-stop Web portal for anyone interested in sharing ideas and transforming emerging technologies into commercial success.⁹

Manufacturing was back in vogue.

The problem is that all of the data about manufacturing in Massachusetts that appeared in our 2007-2008 *Staying Power* report was collected just before America’s “Great Recession” began, destroying more than 8.7 million jobs nationwide between December 2007 and January 2010 – 2.3 million of them in manufacturing.¹⁰ In Massachusetts, over this same period, over one-eighth (12.7%) of its 291,000 manufacturing jobs disappeared. This loss was equivalent to six times what the original *Staying Power* report projected for the 2008-2009 period.

Was the *Staying Power* report blindly optimistic? Would employment in manufacturing continue to hemorrhage at a rate that would see the last manufacturing job disappear from the state by 2025 as a straight line trend analysis would have concluded based on data for 2000 through 2006?

This new report provides a fresh assessment of manufacturing in the Commonwealth based on

data collected in early 2012. Once again, the Dukakis Center staff combed through enormous quantities of secondary data on the sector. Once again, the staff conducted a large survey of manufacturing firms. And once again, the staff went into the field to interview CEOs, owner-managers, and other leaders of manufacturing firms operating in the state.

At the end of this research, we might have concluded as the late Gilda Radner’s *Saturday Night Live* character Emily Litella did week after week, “Never mind!” Please simply ignore the findings in our 2008 report. But that is not what we have found. Indeed, our results suggest that manufacturing in Massachusetts still has real staying power and already is showing signs of a rebound from the devastating recession. The employment data are looking up and manufacturers themselves are reporting better times ahead.

This new research would not have been made possible without the support and encouragement of the Massachusetts Technology Collaborative (MTC), Citizens Bank, and GBMP (the Greater Boston Manufacturing Partnership). These institutions not only funded the research but assisted our staff in preparing the survey instrument we used in the course of our work. In particular, we want to thank Pat Larkin and Bob Kispert of the MTC; Jerry Sargent, Lisa Murray, Joe Wadlinger, and Kimberly Dee of Citizens Bank; and Michael Tamasi who heads the GBMP.

We hope this second report on manufacturing will help encourage the Commonwealth to continue its efforts to support manufacturing in the state and help target its policies for maximum effectiveness.

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CHAPTER 1

MANUFACTURING IN MASSACHUSETTS: A NEW ASSESSMENT

When the Dukakis Center released *Staying Power: The Future of Manufacturing in Massachusetts* in July 2008, it contained a good deal of encouraging news about the current and future status of manufacturing in the Commonwealth. In the Executive Summary to the report, we wrote:

The study comes at a time when much of the conventional wisdom dismisses Massachusetts manufacturing as a dying industrial sector overtaken by competition from other regions of the country and increasingly by competitors in China and India that offer a competent workforce at bargain rates. With employment losses of more than 112,000 between 1996 and 2006 alone, a straight line projection would suggest that the remaining 300,000 manufacturing jobs in Massachusetts will completely disappear by 2025.

What we found in our analysis is almost diametrically opposite to this conventional wisdom. The results of our analysis of existing statistical data combined with more than 700 completed surveys of manufacturing firms in the Commonwealth and more than 100 personal interviews with CEOs, owner/managers, and company executives reveal that, after experiencing a sharp decline in employment, the remaining manufacturing sector has more than 8,600 firms, the large majority of which are now technologically sophisticated, plugged into strong supply chains with good customer relations, and looking forward to competing successfully for a large share of business in the region, the nation, and the world.

Our analysis suggests that future employment losses will likely be modest, and

even 10 years out we project this sector will still employ more than 250,000 workers in Massachusetts.¹¹

That, of course, was back in 2008, only months after the nation had plunged into the worst recession since the Great Depression of the 1930s. Virtually all the data for the report was collected in 2007 when the economies of the nation and the Commonwealth were still expanding. During the previous ten years (1998-2007), the nation's gross domestic product (GDP) had expanded at an annual rate of nearly 3 percent and there was not a single year in which GDP declined. More than 14 million jobs had been created nationwide and the U.S. unemployment rate stood at 5.0 percent at the end of 2007.¹² In Massachusetts, the economy was even stronger. At 4.5 percent, the state's unemployment rate was a half a point lower than the nation's.¹³

The buoyant national and regional economy furnished the economic context for our 2008 report. As such we were taking a snapshot of the manufacturing sector when the overall economy was still strong. Our conclusions at the time, driven by our analysis of secondary data through 2006 and the responses to our manufacturing survey and interviews with company managers in 2007 was that manufacturing, after a long decline, was on the verge of an economic renaissance. Based on our survey responses at the time, we concluded that:¹⁴

- Despite the high cost of doing business here, manufacturing firms were staying in Massachusetts because of the strong work ethic of their employees, the perceived difficulty of relocating without

losing good workers, and because of the proximity to their current customers and suppliers.

- More than half (55.3%) of all the firms predicted increasing production levels over the next five years in their Massachusetts operations, with another 28 percent foreseeing sustained production at current levels in the state.
- More than 70 percent of the firms anticipated introducing new products over the next five years including 90 percent of larger firms, those with more than 100 employees.
- Over 60 percent of the firms expected to increase employment over the next five years while only one firm in eight expected to reduce the size of their workforce.

Based on our research, we made a number of short-term forecasts:

- Manufacturing would continue to lose jobs through at least 2016, but at a pace of no more than 3,100 per year compared with the loss of more than 14,000 per year over the previous decade.
- Because of the aging of the workforce and normal turnover, there would be 100,000 job openings in the state's manufacturing sector over the coming decade.

When we asked about the challenges they faced in Massachusetts, there was near unanimity about the high cost of health insurance, workers' compensation, corporate taxes, and energy costs. But the greatest concern seemed to be in recruiting the next generation of workers. Two thirds of all firms reported "difficulty" or "extreme difficulty" in recruiting skilled craftsmen;

more than half reported such difficulty in recruiting scientific and R&D personnel; and more than a quarter suggested at least some difficulty in recruiting appropriately skilled and motivated entry level workers.

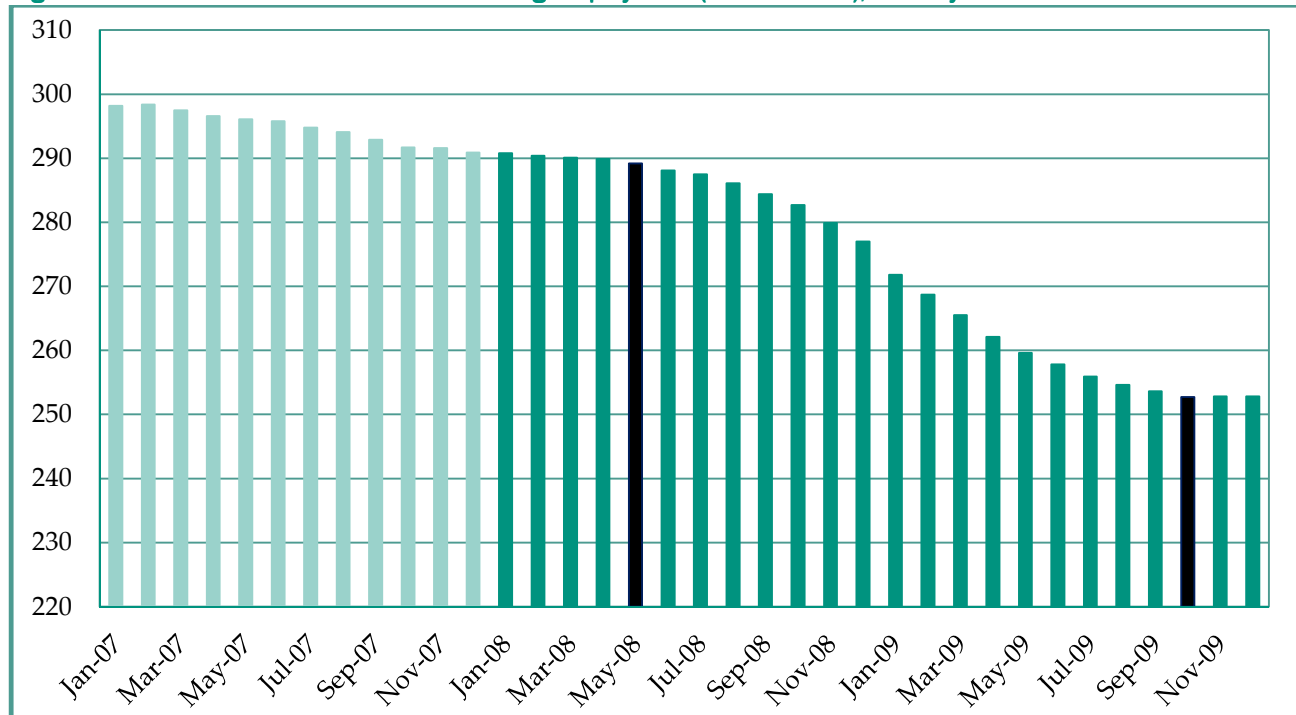
Our overall conclusion was that the major manufacturing problem in Massachusetts was not employment loss but just the opposite: job recruitment.

Massachusetts Manufacturing since 2007

As the economy plummeted into a wider and deeper recession than anyone could have imagined at the time, our short-term projection of employment in this sector proved much too optimistic. Instead of declining by a projected 3,100 jobs a year in 2007, 2008 and again in 2009, the state's manufacturing employment total plunged over those three years by 45,000 jobs – from 298,000 in December 2006 to less than 253,000 jobs in December 2009.¹⁵ In 2007, employment contracted by 6,900 jobs, more than twice our forecast level; in 2008, 13,900 jobs disappeared from this sector, more than four times our forecast; and in 2009, more than 24,000 jobs evaporated, almost eight times what we had forecast. Fifteen percent of the pre-recession manufacturing job base disappeared in the space of just 20 months (between May 2008 and October 2009), continuing the trend we had seen between 2000 and 2006 (See **Figure 1.1**).

Perhaps if we had repeated our study of manufacturing in early 2010 rather than now, we might have broadcast a major *mea culpa* for our relatively rosy employment forecast. Without foreknowledge of the depth of the coming Great Recession in early 2008, we clearly underestimated the depth of the job loss by a country mile.

Figure 1.1 Massachusetts Manufacturing Employment (in thousands), January 2007–December 2009



Source: U.S. Bureau of Labor Statistics

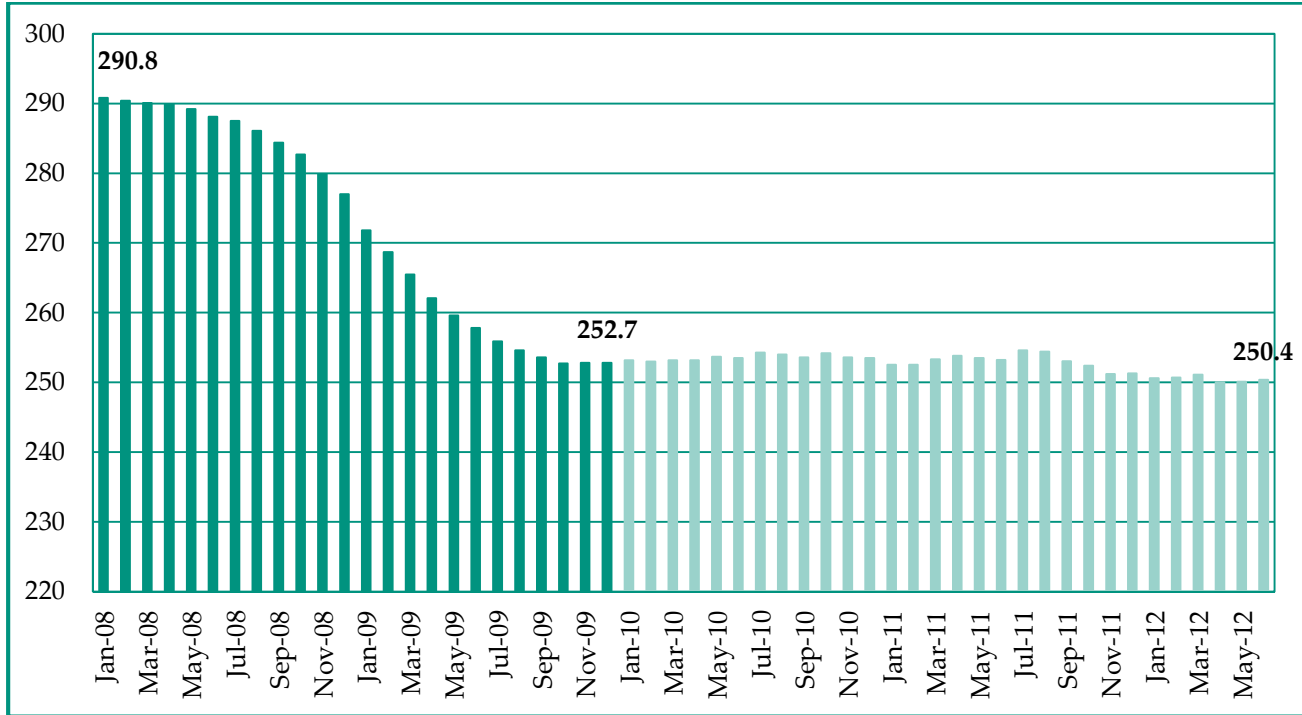
But now with more than two years of additional employment data and a brand new survey and set of interviews, we believe we can look back on our earlier report with some confidence. What we find in 2012 is that our confidence in the state’s manufacturing sector was not anywhere near off the mark as it appeared in the darkest days of the recession.

Recent Manufacturing Employment Trends

The first bit of evidence of manufacturing’s endurance is found in data on the employment trend *since* 2009. Instead of continuing to plummet, the number of manufacturing jobs in the state has stabilized.¹⁶ As **Figure 1.2** reveals, since October 2009 manufacturing employment has remained at roughly 250,000.

Hence, by June 2012, more than 250,000 people were still employed in manufacturing in the state. **Table 1.1** and **Figure 1.3** indicate that the annual rate of job loss between the beginning of 2009 and June 2012 shrank to only 0.3 percent, an annual rate well less than the nearly 5 percent annual loss rate that prevailed between 2000 and 2009. The only better annual employment growth record was during the “Massachusetts Miracle” of 1970 to 1984 when the mini-computer industry boom was in full swing. By this standard, the nearly three-year period of relative employment stability since late 2009 may bode well for the future. Manufacturing’s share of total non-farm employment in the state fell from 12.0 percent to 8.2 percent between 2000 and 2006. Since then, its share has decreased by only 0.5 percentage points.

Figure 1.2 Massachusetts Manufacturing Employment (in thousands, seasonally adjusted), 01/2008-06/2012



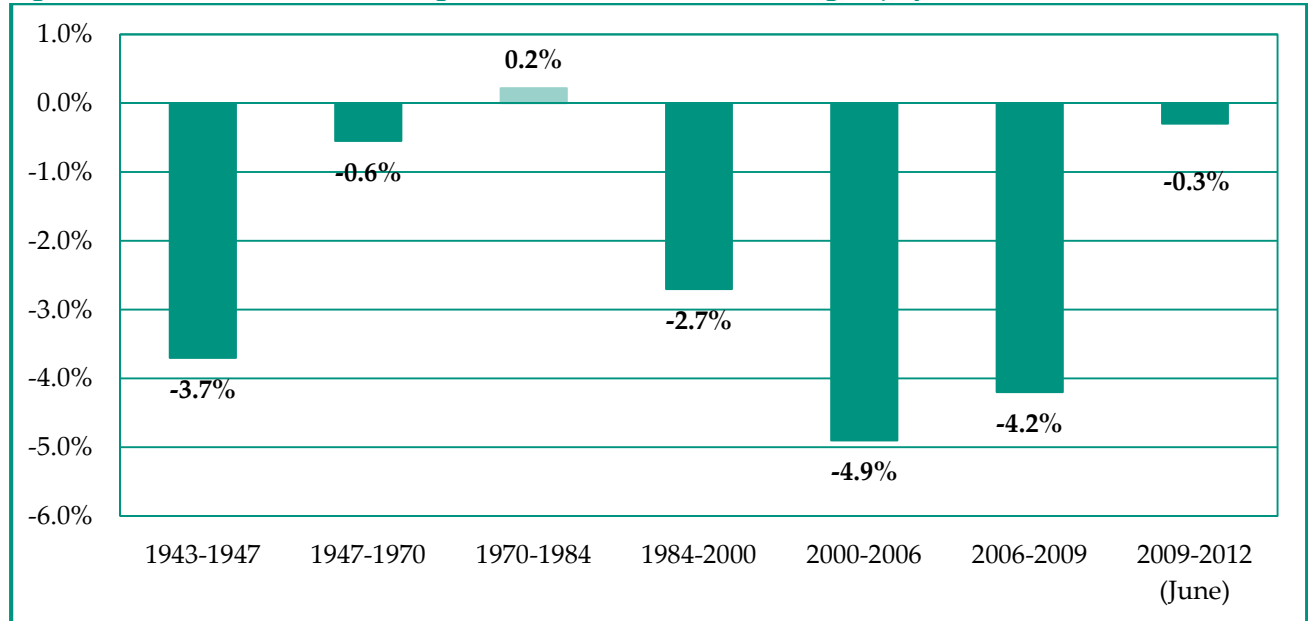
Source: U.S. Bureau of Labor Statistics

Table 1.1 Massachusetts Manufacturing Employment, 1939 - 2012

Era	Years	Initial MA Employment	Ending MA Employment	Change in MA Employment	Percentage Change	Annual Percent Change	Share of all MA Jobs at End of Era
I	1939-1943	533,700	800,900	+267,200	+50.1%	+10.7%	45.6%
II	1943-1947	800,900	689,900	-111,000	-13.9%	-3.7%	39.9%
III	1947-1970	689,900	607,500	-82,400	-11.9%	-0.6%	27.1%
IV	1970-1984	607,500	626,900	+19,400	+3.2%	+0.2%	22.0%
V	1984-2000	626,900	403,200	-223,700	-35.7%	-2.7%	12.0%
VI	2000-2006	403,200	299,200	-104,000	-25.8%	-4.9%	8.2%
VII	2006-2009	299,200	252,800	-46,400	-15.5%	-4.7%	8.0%
VIII	2009 - 2012 (June)	252,800	250,400	-2,400	-0.9%	-0.3%	7.7%

Source: U.S. Bureau of Labor Statistics, State and Local Employment Series (adjusted for change from SIC to NAICS Industry Code definitions)

Figure 1.3 Annual Rate of Change in Massachusetts Manufacturing Employment, 1943 – June 2012



Source: U.S. Bureau of Labor Statistics, *State and Local Employment Series (adjusted for change from SIC to NAICS Industry Code definitions)*

Even after the precipitous loss of jobs between 2006 and 2009, manufacturing remained the fifth largest employer statewide (see **Figure 1.4**). Manufacturing still employs 50 percent more workers than all the banks and insurance companies in the state; *double* the number of workers in wholesale trade; nearly *three times* as many as in information services; and nearly *six times* as many as in all of the arts, entertainment, and recreation firms in the Commonwealth. Only health care & social assistance; retail trade; professional, scientific and technical services; hotels, restaurants, and bars; and local government for the 351 cities and towns in Massachusetts employ more workers. Even then, manufacturing falls short of being the third largest employer in the state by less than 20,000 workers.

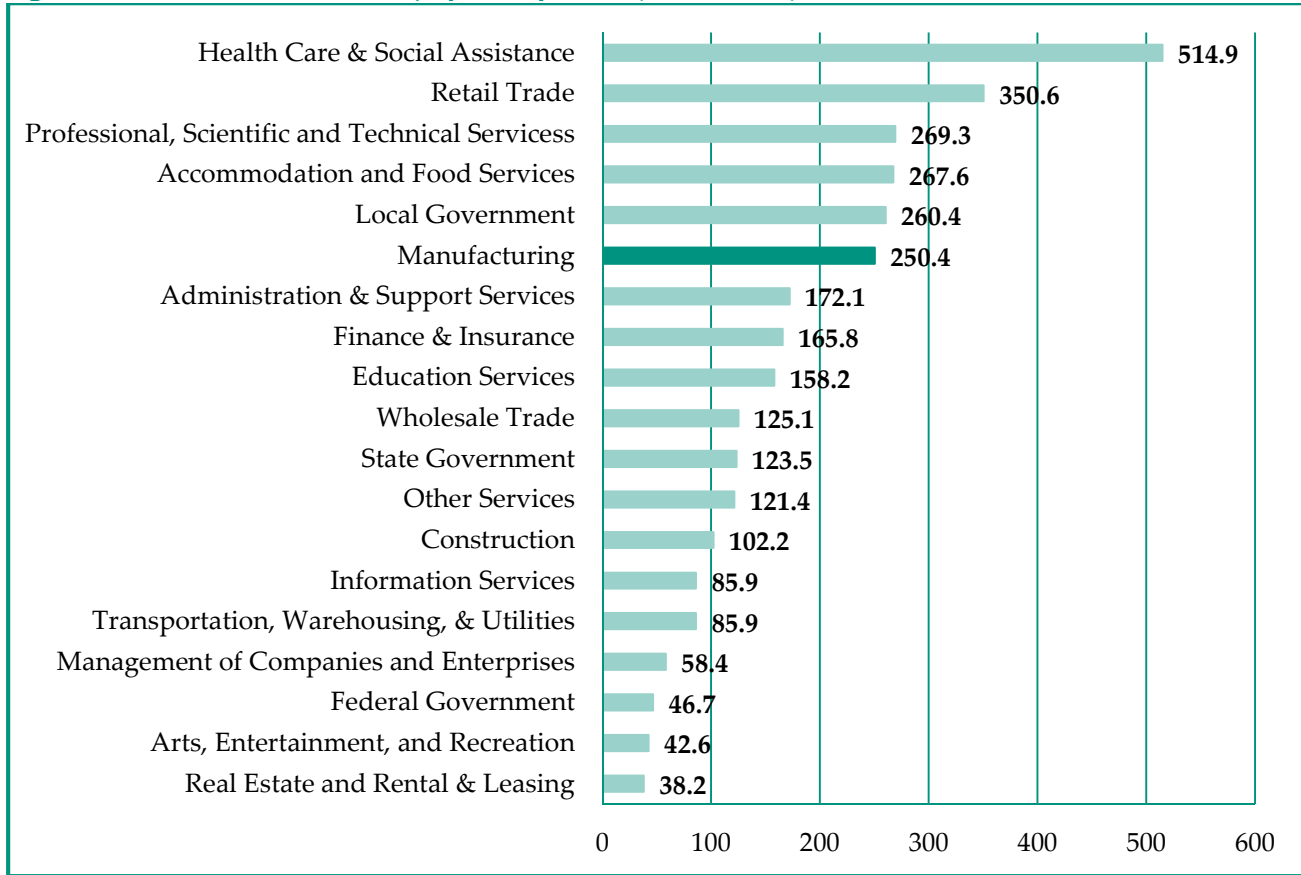
How Does Massachusetts Manufacturing Rank Nationwide?

As of 2010, Massachusetts continued to rank slightly above the national average in terms of the concentration of manufacturing employ-

ment with 38.7 manufacturing workers per 1,000 residents vs. 37.3 for the U.S (see **Table 1.2**). As such, the Commonwealth continues to be a center of manufacturing in the nation. Nevertheless, Midwestern states continue to dominate manufacturing with Wisconsin, Indiana, Iowa, Kansas, and Minnesota still having a larger share of their populations working in the manufacturing sector. Larger concentrations of manufacturing are also found in a number of southern states including Arkansas, Alabama, Kentucky, Tennessee, Mississippi, North Carolina, and South Carolina. Overall, the manufacturing concentration ratio in 2010 ranged from a high in Wisconsin of 75.2 per thousand population to just 9.6 per thousand in Hawaii. In this spread, Massachusetts ranks #25 – right in the middle of the national pack.

Table 1.2 also reveals that manufacturing concentration has declined across the country and in the Commonwealth since 2002, when there were 51.0 manufacturing workers per 1,000 residents in the U.S.

Figure 1.4 Massachusetts Employment by Sector (in thousands), June 2012



Source: Massachusetts Executive Officer of Labor and Workforce Development, Current Employment Statistics (CES 790 Series), July 2012.

Table 1.2 Manufacturing Employment per 1,000 Residents, by State

State	Manufacturing Employment Per 1,000 Residents (2002)	Manufacturing Employment per 1,000 Residents (2007)	Manufacturing Employment per 1,000 Residents (2010)	% Change 2002-2010	% Change 2007-2010
Wisconsin	92.6	87.0	75.2	-18.7%	-12.7%
Indiana	91.8	84.6	68.6	-25.2%	-17.4%
Iowa	75.9	74.6	65.9	-13.2%	-11.5%
Kansas	65.5	64.0	56.0	-14.4%	-12.1%
Minnesota	70.1	65.5	54.9	-21.7%	-15.1%
Arkansas	77.6	65.1	54.7	-29.5%	-13.4%
Ohio	76.1	66.3	53.4	-29.8%	-16.9%
Nebraska	59.6	56.1	50.2	-15.8%	-9.9%
New Hampshire	65.5	62.0	49.8	-23.9%	-18.6%
Alabama	63.3	58.8	49.5	-21.8%	-14.7%
Vermont	71.1	57.3	48.4	-31.9%	-12.4%
Kentucky	64.2	58.3	47.8	-25.5%	-16.3%
Tennessee	71.0	60.0	47.1	-33.7%	-18.1%

State	Manufacturing Employment Per 1,000 Residents (2002)	Manufacturing Employment per 1,000 Residents (2007)	Manufacturing Employment per 1,000 Residents (2010)	% Change 2002-2010	% Change 2007-2010
Michigan	73.3	57.8	47.1	-35.7%	-14.5%
Connecticut	62.1	54.5	46.2	-25.5%	-13.2%
Mississippi	63.7	54.6	46.2	-27.5%	-13.1%
North Carolina	74.9	55.8	45.2	-39.6%	-14.2%
South Dakota	48.6	51.4	45.0	-7.5%	-13.4%
South Carolina	70.6	54.9	44.6	-36.9%	-14.7%
Pennsylvania	58.0	52.3	44.1	-23.9%	-14.2%
Illinois	58.9	51.6	43.5	-26.1%	-13.8%
Oregon	52.3	49.1	42.7	-18.3%	-12.2%
Missouri	56.4	50.2	40.4	-28.4%	-17.5%
Utah	47.5	46.6	40.2	-15.4%	-13.5%
Massachusetts	54.3	44.8	38.7	-28.8%	-11.4%
Washington	43.7	41.7	38.2	-12.5%	-7.9%
Maine	52.3	44.7	38.2	-26.9%	-12.4%
Rhode Island	58.2	50.8	38.0	-34.7%	-22.0%
Georgia	52.9	43.1	35.2	-33.4%	-14.8%
Idaho	45.9	43.2	33.8	-26.3%	-20.5%
California	46.0	39.6	33.3	-27.6%	-13.7%
North Dakota	36.9	41.2	33.3	-9.7%	-21.4%
Oklahoma	42.9	39.4	32.5	-24.1%	-15.9%
Texas	39.3	37.4	32.1	-18.2%	-13.4%
Louisiana	33.6	34.5	30.6	-8.9%	-11.5%
New Jersey	43.0	35.8	29.4	-31.7%	-14.8%
Delaware	46.2	40.3	29.1	-37.1%	-24.4%
Virginia	42.7	36.0	28.9	-32.3%	-16.5%
West Virginia	37.4	33.1	26.4	-29.4%	-17.9%
Colorado	33.0	28.4	24.9	-24.7%	-10.6%
New York	33.5	27.7	23.6	-29.5%	-12.1%
Arizona	30.8	27.2	23.3	-24.3%	-12.6%
Maryland	27.7	22.7	20.0	-27.7%	-9.8%
Montana	20.4	20.4	16.6	-18.7%	-18.7%
Florida	22.6	19.5	16.4	-27.5%	-13.6%
Alaska	17.0	19.5	15.5	-8.9%	-23.3%
Wyoming	19.3	22.8	15.3	-20.9%	-38.9%

State	Manufacturing Employment Per 1,000 Residents (2002)	Manufacturing Employment per 1,000 Residents (2007)	Manufacturing Employment per 1,000 Residents (2010)	% Change 2002-2010	% Change 2007-2010
Nevada	19.6	20.3	14.1	-27.8%	-31.2%
New Mexico	17.8	18.0	14.1	-20.6%	-21.6%
Hawaii	10.6	11.0	9.6	-9.8%	-13.7%
District of Columbia	3.5	3.4	1.8	-47.8%	-45.6%
US	51.0	44.5	37.3	-27.0%	-14.2%

Source: U.S. Bureau of Labor Statistics, U.S. Census Bureau

As of 2010, the manufacturing concentration was already down to 37.3 as other sectors absorbed a greater share of the workforce. Between 2002 and 2007, the drop in concentration in Massachusetts actually exceeded drop in the U.S. rate. However, since 2007 Massachusetts has fared better than the nation and all but four other states (Washington, Nebraska, Maryland, and Colorado). Between 2007 and 2010, Massachusetts concentration fell 11.4 percent while nationwide the concentration rate deteriorated by 14.2 percent.

Manufacturing Births and Deaths

In our 2008 report, we noted that it was important “to recognize that despite the loss of manufacturing firms in the state, there are still a substantial number of new manufacturing establishments that are created each year.”¹⁷ As such, the net change in employment in the industry is a product of four distinct phenomena: (1) new jobs created by new firms entering the sector, (2) additional jobs generated by existing firms, (3) job loss in existing firms, and (4) job loss due to the cessation of local production by firms either going out of business or relocating to other states. These are typically referred to employment emanating from “births,” “expansions,” “contractions,” and “deaths.” The U.S. Census Bureau keeps track of these events in

the *Statistics of U.S. Business* reports that come out each year with a three year lag.¹⁸

As **Table 1.3** demonstrates, the process of job creation and destruction is quite dynamic. Even in the recession years of 2000 and 2001, 1,000 new manufacturing firms were “born” in Massachusetts. These were offset by 1,258 companies that closed their Massachusetts doors. All in all, between 1995 and 2009, there were nearly 6,400 new manufacturing companies created in the Commonwealth while nearly 9,100 went out of business or moved.

The Massachusetts Executive Office of Labor and Workforce Development tracks the number of establishments in each industry in the state.¹⁹ Since a firm can have more than one establishment, the number of establishments exceeds the number of firms. As **Figure 1.5** demonstrates, the number of manufacturing establishments in the Commonwealth declined each year for most of the last decade. In 2001 there were 9,608 manufacturing establishments in the state. By 2010, the official number of manufacturers had declined to 7,462 – a loss of nearly 2,150 companies. However, in 2011, the number of manufacturing firms actually increased, marking the first positive growth in at least ten years.

Table 1.3 Manufacturing Births and Deaths in Massachusetts (1995-2009)

Year	Initial Year Firms	Births	Deaths	Birth:Death Ratio
1995	9,544	584	691	0.85
1996	9,437	722	686	1.05
1997	9,473	419	876	0.48
1998	9,016	481	701	0.69
1999	8,796	523	646	0.81
2000	8,673	546	612	0.89
2001	8,607	454	804	0.56
2002	8,257	447	681	0.66
2003	8,023	387	622	0.62
2004	7,788	360	625	0.58
2005	7,523	385	550	0.70
2006	7,358	394	516	0.76
2007	7,236	365	508	0.72
2008	7,093	304	579	0.53
2009	6,818	N/A	N/A	N/A
Total		6,371	9,097	
	Net Change	-2,726		

Source: US Census Bureau, Statistics of U.S. Businesses, 2003-2009

<http://www.census.gov/econ/susb/data/susb2009.html>

Figure 1.5 Change in the Number of Massachusetts Manufacturing Establishments, 2002-2011



Source: Massachusetts Department of Labor and Workforce Development, ES-202 Employment and Wage Statistics

Massachusetts' Key Manufacturing Industries

There has been a dramatic shift in the prevalence of specific industries within the Commonwealth's manufacturing base. Back in 1947, more than 60 percent of those employed in this sector were working for *non-durable manufacturers* with the largest concentrations in textile mill products, leather & leather products, apparel, and food & kindred products.²⁰ The remaining 40 percent were employed in durable goods production in such industries as non-electrical machinery, electrical equipment and supplies, fabricated metal products, and primary metals production.

Today, the ratio of non-durable to durable manufacturing has more than reversed. Now, 63 percent of all manufacturing establishments in the state are producing durable goods and these establishments employ nearly two-thirds (66%) of the state's manufacturing workforce.

Table 1.4A Top Ten Manufacturing Industries in Massachusetts (2010)

4-Digit Industry (2010)	Employees
Navigation, measuring, medical, and control instruments	26,139
Semiconductor and other electronic components	17,022
Printing and related support activities	12,532
Computer and peripheral equipment	12,253
Aerospace product and parts	11,978
Plastics products	11,309
Medical equipment and supplies	10,759
Machine shops, turned product and screw, nut & bolt	9,957
Bakeries and tortilla	9,356
Pharmaceutical and medicine	9,136

Source: Massachusetts Department of Labor and Workforce Development, ES-202 Employment and Wage Statistics

According to **Table 1.4A**, the single largest 4-digit manufacturing industry in the state produces navigation, measuring, medical, and control instruments. With over 26,000 employees in 2010, this single industry (out of fifty-one) accounts for more than 10 percent of the jobs in manufacturing in the Commonwealth.

Note the range of products from semiconductors to tortillas, and the continued importance of such industries as computer and peripheral equipment, aerospace products, plastic products, medical equipment, and machine shops.

Table 1.4B provides information on the *change* in employment across the 4-digit manufacturers between 2002 and 2010. Of the 51 specific industries, eight actually experienced an increase in employment despite an average loss of nearly 27 percent for manufacturing as a whole. Note that three of these are related to food products.

Table 1.4B Manufacturing Industries in Massachusetts with Increased Employment (2002-2010)

4-Digit Industry (2010)	% Change in Employment 2002-2010
Other food manufacturing	54.7%
Engine, turbine, and power transmission equipment	28.4%
Resin, synthetic rubber, and artificial fibers & filament	22.7%
Seafood product preparation and packaging	18.6%
Office furniture (including fixtures) manufacturing	15.1%
Pharmaceutical and medicine	10.2%
Bakeries and tortilla	4.8%
Basic chemical manufacturing	3.8%

Source: Massachusetts Department of Labor and Workforce Development, ES-202 Employment and Wage Statistics

Percentage-wise, the largest employment losses have been in apparel and textile manufacturing along with communication equipment, motor vehicle parts, and household and institutional furniture production. Each of these industries has experienced a loss of jobs of 50 percent or more since 2002, with more than two-thirds of the 2002 employment base gone in communications equipment and fabric mills.

Employment trajectories for the most recent period, 2007-2010, are found in **Table 1.4C**. While manufacturing as a whole experienced nearly a 14 percent reduction in employment during this recession period, there were five industries that were able to buck the trend and expand employment while an additional eight were able to hold job losses to less than five percent. While a small industry with just a little over 600 employees in 2010, leather and allied product manufacturing led all other industries nearly doubling its employment (+49.3%). Three of the net job producers were in the food manufacturing sector.

For a complete list of the 51 manufacturing industries in Massachusetts with their 2010 employment levels, please see **Appendix 1A**.

Table 1.4C **Manufacturing industries in Massachusetts with Increased Employment (2007-2010)**

4-Digit Industry (2010)	% Change 2007-2010
Other leather and allied product manufacturing	49.3%
Other food manufacturing	12.8%
Bakeries and tortilla manufacturing	12.4%
Seafood product preparation and packaging	7.9%
Aerospace product and parts manufacturing	0.7%

Source: Massachusetts Department of Labor and Workforce Development, ES-202 Employment and Wage Statistics

Massachusetts Manufacturing: Low-Tech, Middle-Tech, and High Tech Sectors

As we noted in our last report, “dividing the manufacturing sector into non-durable and durable goods industries and disaggregating industries according to the NAICS system is a crude method for distinguishing among the types of industries in the manufacturing sector.”²¹ We found a more useful taxonomy was provided by the Organization for Economic Cooperation and Development (OECD).²²

The OECD uses the concept of “technology intensity” to classify industrial sectors as:

- Low-technology
- Medium-low-technology
- Medium-high-technology
- High-technology

The level of technology specific to an industrial sector is measured by the ratio of research and development (R&D) expenditure to value-added in an industry and the technology embodied in purchases of intermediate and capital goods.

Applying the OECD methodology to the 22 broad manufacturing industries in the International Standard Industrial Classification (ISIC), four industries fall into the high-technology sector; six in the medium-high sector; eight in the medium-low sector; and four in the low-technology sector. **Table 1.5** lists these industries.

Using this four-category classification system, we can trace employment trends within the Massachusetts manufacturing sector by allocating the employment in each of the fifty-one industries in **Table 1.3** into the 22 broad OECD manufacturing categories. Aggregating over the four OECD tech sectors, **Figure 1.6** provides employment trends for the period between 1970 and 2010.

Table 1.5 OECD Manufacturing Industries Classified by Global Technological Intensity (ISIC Revision 2)

Technology classification	Manufacturing industries
High technology	Aerospace
	Computers, office machinery
	Electronics-communications
	Pharmaceuticals
Medium-high-technology	Scientific instruments
	Motor vehicles
	Electrical machinery
	Chemicals
	Other transport equipment
	Non-electrical machinery
Medium-low-technology	Rubber and plastic products
	Shipbuilding
	Other manufacturing
	Non-ferrous metals
	Non-metallic mineral products
	Fabricated metal products
	Petroleum refining
	Ferrous metals
Low-technology	Paper printing
	Textile and clothing
	Food, beverages, and tobacco
	Wood and furniture

Source: Thomas Hatzichronoglou, "Revision of the High-Technology Sector and Product Classification," STI Working Papers 1997/2 (Paris: Organization for Economic Cooperation and Development, 1997).

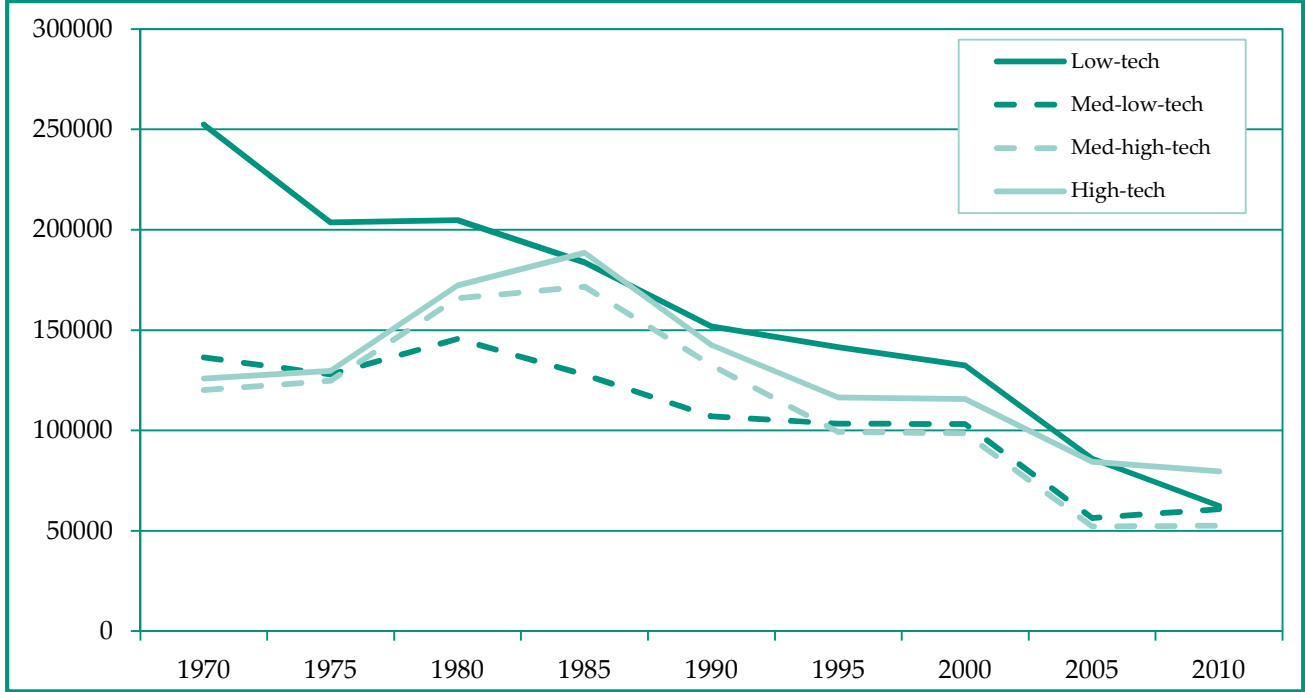
Figure 1.6 reveals the following trends:

- *Low-tech employment* in such industries as textiles, clothing, and food has fallen precipitously in Massachusetts from 252,000 workers in 1970 to 132,000 in 2000 to only 62,500 in 2010.

- *Medium-low-tech* industries, including rubber and plastic products and fabricated metal operations, began with 136,000 workers in 1970 and maintained that level for the most part through 1985. By 2000, employment in this sector had fallen to 103,000. By 2010, employment in this medium-low tech sector declined by another 40,000 to around 61,000.
- *Medium-high-tech* industries, including motor vehicle parts, scientific instruments, and electrical equipment, experienced an *employment boom* between 1970 and 1985, increasing from 123,000 workers to 172,000. From then on, however, the sector has sustained large employment losses right through 2010. By the end of this period, Medium- high-tech firms employed 52,500 workers, fewer than either low-tech or medium-low tech industries.
- *High-tech* companies in such industries as aerospace, electronics, computers, and pharmaceuticals experienced an even sharper rise in employment between 1970 and 1985. Since then, this sector has also sustained a contraction. From a peak of 189,000 employees in 1985, this sector employed just shy of 80,000 workers in 2010.

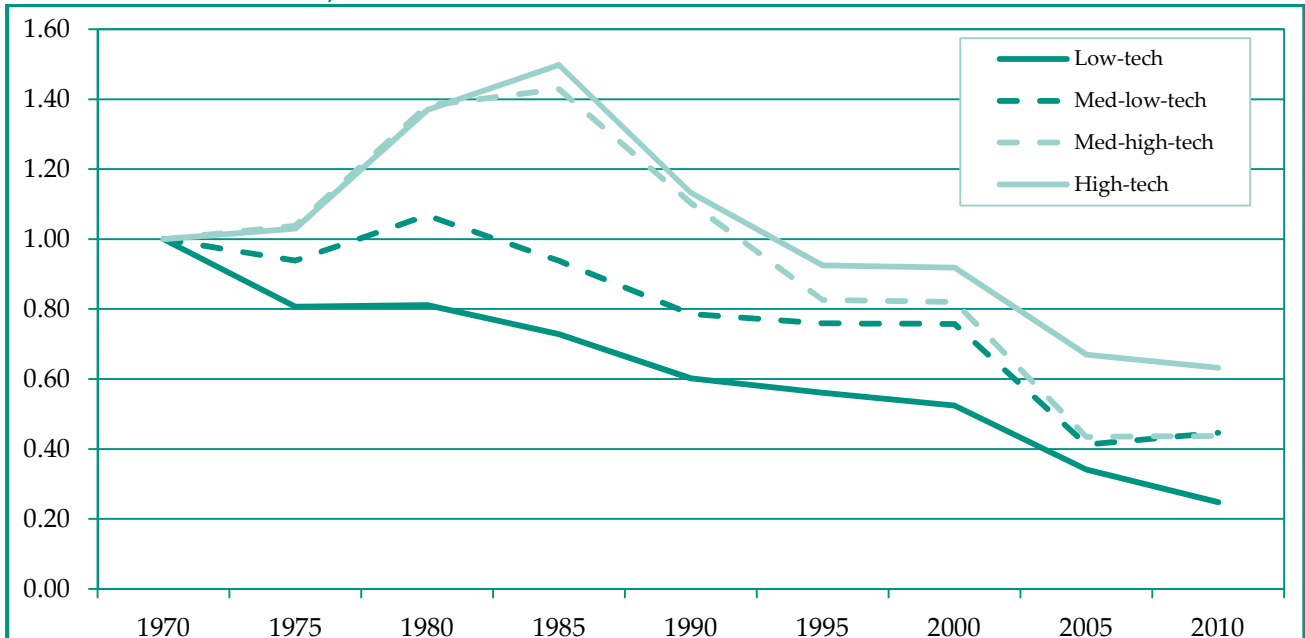
Relative to where each of these four technology-specific subsectors was in 1970, however, the decline in employment has been sharpest for the low-tech industries and most gradual for the high-tech sector (although, given the rapid increase in high-tech employment between 1970 and 1985, it has experienced the sharpest decline since then). Figure 1.7 converts these absolute employment levels to indexes with employment in 1970 set to 1.00 for each industry sector.

Figure 1.6 Massachusetts Manufacturing Employment by Technological Intensity, 1970- 2010



Source: Author's calculations based on U.S. Bureau of Labor Statistics employment data, using OECD categories reported in Hatzichronoglou (1997).

Figure 1.7 Massachusetts Manufacturing Employment by Technological Intensity, 1970- 2010 (Indexed to 1970 Level)



Source: Author's calculations based on U.S. Bureau of Labor Statistics employment data, using OECD categories reported in Hatzichronoglou (1997).

Over the long run, between 1970 and 2010, the low-tech sector declined by 75 percent; the medium-low and medium-high tech sectors by 55 percent; while the high-tech sector declined by just one-third (33 percent).

As a result of these subsector trends, the high tech sector has increased its share of Massachusetts manufacturing employment from less than 20 percent in 1970 to over 31 percent in 2010 (see **Table 1.6**). Almost all of this gain has come at the expense of the low-tech sector which moved from having nearly 40 percent of all manufacturing employment in the state in 1970 to less than a quarter (24.5%) in 2010. The medium-low and medium-high tech sectors both have increased their employment shares modestly. *This suggests that while there is truth in the conventional wisdom that manufacturing is*

becoming more R&D intensive, there is still a wide variety of goods produced in the Commonwealth in industries of varying technological intensity.

Output and Productivity in Massachusetts Manufacturing

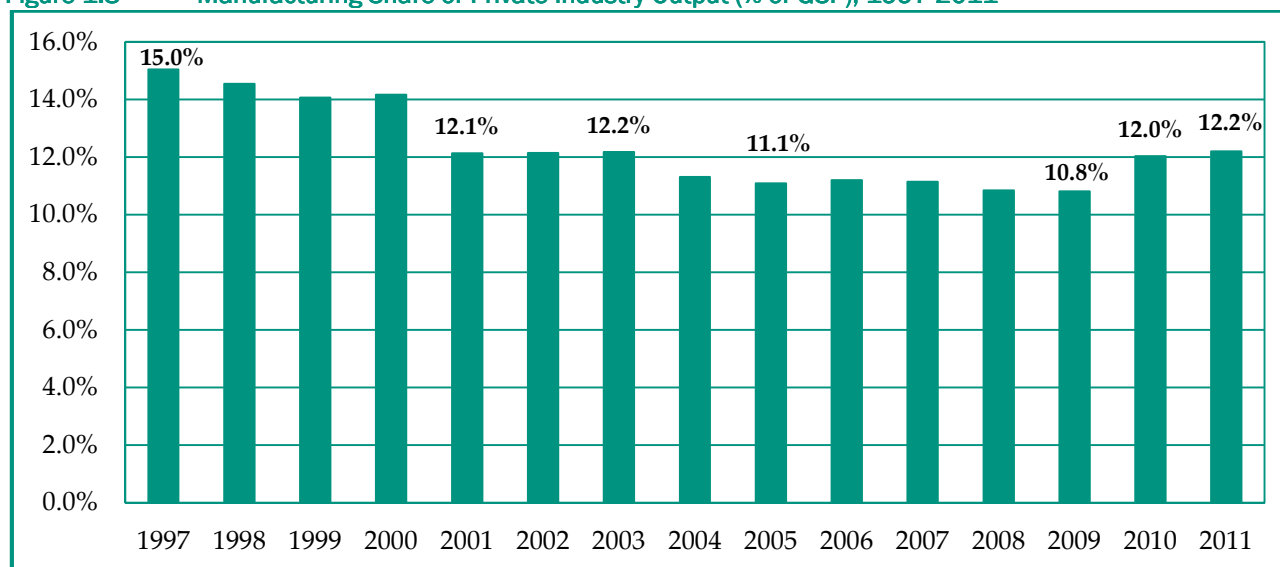
The truly remarkable story about Massachusetts manufacturing is its recent growth in terms of its total output as measured by its contribution to Gross State Product (GSP) (see **Figure 1.8**). In 1997, manufacturing accounted for 15.0 percent of total state output. By 2005, this share had shrunk to 11.1 percent. It would continue to decline to 10.8 percent in 2009. But it began to recapture ground in 2010 and by 2011, its share of GSP was back to 12.2 percent.²³ *At least in Massachusetts, manufacturing has been leading the economic recovery.*

Table 1.6 Shares of Massachusetts Manufacturing Employment by Technological Intensity (1970 - 2010)

Tech Level	1970	1980	1990	2000	2006	2010
Low-tech	39.8%	29.7%	28.4%	29.4%	30.6%	24.5%
Medium-low-tech	21.5%	21.1%	20.1%	22.9%	20.4%	23.8%
Medium-high-tech	18.9%	24.1%	24.8%	21.9%	18.3%	20.5%
High tech	19.8%	25.0%	26.7%	25.7%	30.6%	31.2%

Source: Author's calculations based on U.S. Bureau of Labor Statistics data, using OECD categories reported in Hatzchronoglu (1997)

Figure 1.8 Manufacturing Share of Private Industry Output (% of GSP), 1997-2011



Source: U.S. Bureau of Economic Analysis

Table 1.7 Productivity in Massachusetts, All Industries vs. Manufacturing

Productivity	1997	1998	2000	2004	2007	2011	1997-2007 Annual Growth Rate	2007-2011 Annual Growth Rate
GSP/Worker – Private Sector	\$83,839	\$86,058	\$94,096	\$104,936	\$107,025	\$114,568	+2.3%	+1.7%
GSP/Worker - Manufacturing	\$48,666	\$53,042	\$72,589	\$101,141	\$127,739	\$178,625	+9.7%	+8.7%

Source: U.S. Bureau of Economic Analysis (Updated June 5, 2012 with revised estimates for 1997-2010) (Gross State Product (GSP) is in \$millions of chained (real) 2005 dollars)

How did manufacturing produce such an expansion in output despite a smaller workforce? The answer lies in the extraordinary gains in this sector’s productivity. Between 1997 and 2007, productivity in the total private sector (as measured by GSP per worker) increased at an average annual rate of 2.3 percent – a quite respectable increase in efficiency. *But the state’s manufacturing sector experienced a remarkable 9.7 percent growth in productivity (see Table 1.7).* In the most recent period between 2007 and 2011, annual productivity growth slipped a bit to a still very respectable 8.7 percent. For the private sector as a whole, it was just 1.7 percent.

Part of this exceptional growth was due to the simple fact that low productivity producers left the industry, automatically boosting the average productivity of the firms still producing in the state. Yet, even within individual companies, there has been an impressive increase in efficiency as a result of the implementation of advanced technology in their operations. This has often been driven by the need to remain competitive in a global economy where labor costs are lower – often much lower – in other countries.

Massachusetts Manufacturing Exports

Exports play an important role in the success of the Commonwealth’s manufacturing sector and the state’s economy as a whole. According to the National Association of Manufacturers (NAM), in 2010, manufactured goods were re-

sponsible for 94 percent of all Massachusetts exports.²⁴ NAM reports that exports supported 28 percent of all Massachusetts’ manufacturing jobs – higher than the 22 percent export share for manufacturing jobs nationwide. The Business Roundtable notes that computers and electronics was Massachusetts’ leading export category in 2008, accounting for 27.6 percent of total exports.²⁵ The leading export products from Massachusetts are:

- Computers and Electronics (28%)
- Chemicals (19%)
- Medical Equipment & Miscellaneous Manufacturing (11%)
- Machinery (9%)
- Primary Metal Manufacturing (7%)

In addition, the Roundtable also reports that primary metal manufacturing was one of the fastest growing export categories in the state, increasing at an annual rate of 48 percent between 2002 and 2008.

Exports are becoming more important to the manufacturing sector as the world economy globalizes. As one indication of this trend, since 2002, the Commonwealth’s exports have increased more than twice as fast as the state’s Gross State Product. Moreover, exports are not confined to Massachusetts’ largest manufacturers. Nearly 90 percent of Massachusetts’ manufacturing exports in 2007 were produced by small- and mid-size companies employing no

more than 100 workers. While the state’s producers export to more than 230 countries, the state’s main foreign customers are in Canada, the United Kingdom, China, Germany, Japan, Mexico, the Netherlands, the Republic of Korea, Taiwan, Hong Kong, France, Singapore, Belgium, Italy, Switzerland, Ireland, and Brazil. Nearly 40 percent of total Massachusetts exports go to the 27 European Union countries, compared with just 18 percent for the U.S. as a whole.²⁶

As such, the expansion of international trade has helped fuel manufacturing’s renaissance in Massachusetts, although its substantial Europe-

an share may pose a problem as Europe’s economies continue to weaken.

The Massachusetts Manufacturing Workforce

The extraordinary record of manufacturing output growth and productivity in Massachusetts is explained by:

- the shift to advanced manufacturing industries within the sector,
- the *use of advanced manufacturing technologies* in traditional manufacturing industries, and
- the relatively well-educated and highly-skilled employees who work there.

Table 1.8A Occupational Distribution (MANUFACTURING) Massachusetts vs. U.S. (2010)

Occupation	MA	U.S.
Managers	14.9%	11.7%
Business Operations/Finance	6.5%	4.3%
Computer & Mathematical Occupations	3.9%	2.9%
Architecture & Engineering	8.9%	6.8%
Life, Physical, and Social Science Occupations	2.6%	1.4%
Community and Social Science Occupations	0.0%	0.0%
Legal Occupations	0.5%	0.2%
Education, Training, Library Occupations	0.3%	0.2%
Arts, Design, Entertainment, Sport, & Media	1.3%	1.2%
Healthcare Practitioners and Technical Occupations	0.2%	0.2%
Healthcare Support Occupations	0.1%	0.0%
Protective Service Occupations	0.2%	0.3%
Food Preparation and Serving Occupations	0.4%	0.2%
Building & Grounds Cleaning & Maintenance	1.0%	1.2%
Personal Care and Service Occupations	0.0%	0.0%
Sales & Related Activities	6.2%	4.5%
Office & Administrative Support Personnel	11.5%	10.0%
Farming, Fishing, and Forestry Occupations	0.0%	0.1%
Construction & Extraction Occupations	0.8%	1.9%
Installation, Maintenance, & Repair Occupations	3.0%	4.5%
Production Occupations	33.3%	39.8%
Transportation & Material Moving Occupations	4.5%	8.7%
Military Specific Occupations	0.0%	0.0%

Source: American Community Survey

Even relative to manufacturing nationwide, the typical manufacturing worker in Massachusetts is more productive than his or her national counterpart. In 2011, for example, the average output per worker in manufacturing nationwide was \$156,530. In Massachusetts, the average output was \$169,961 – 8.6 percent higher.²⁷

Part of this greater output has to do with the occupational distribution within the industry. **Table 1.8A** provides information on the occupational composition of the Commonwealth’s manufacturing sector vs. that nationwide.

Added together, more than 21 percent of the Massachusetts manufacturing workforce are in managerial positions vs. just 16 percent for the U.S. as a whole (**Table 1.8B**). Similarly, more than 15 percent of the manufacturing jobs in the state are held by engineers and scientists compared to 11 percent nationwide. At the other end of the occupational spectrum, more than half (54.9%) of the U.S. manufacturing workforce are “blue collar,” working in construction and extraction; installation, maintenance, & repair; production occupations; or in transportation and material moving jobs. In Massachusetts, less than 42 percent of the manufacturing workforce is found in such occupations.

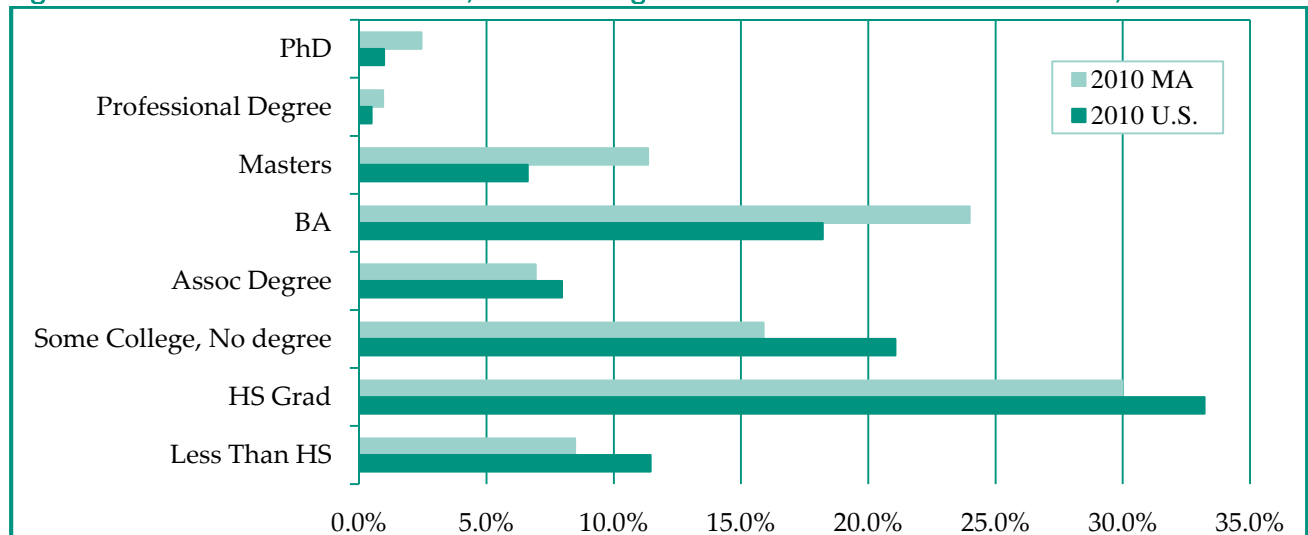
Table 1.8B Shares of Manufacturing Workforce: MA vs. U.S.

Managerial Occupations	
MA	US
21.4%	16.0%
Engineering & Science Occupations	
MA	US
15.4%	11.1%
"Blue-Collar"	
MA	US
41.6%	54.8%

Source: American Community Survey

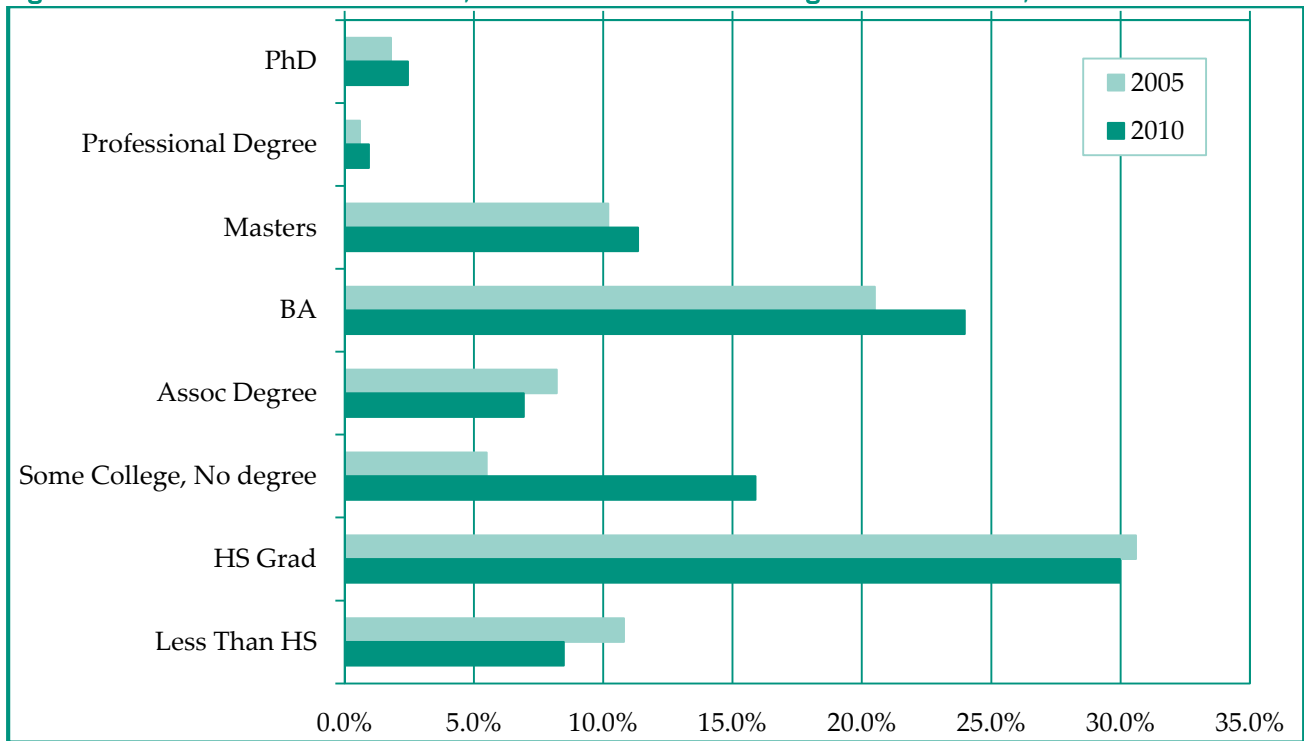
Consistent with the occupational breakdown of the Massachusetts manufacturing workforce and its high productivity is the educational background of the workforce as shown in the following two figures. Note two facts. First, Massachusetts manufacturing workers are substantially more likely than their U.S. counterparts to have completed college, received a Master’s degree, a professional degree, or a Ph.D. (see **Figure 1.9A**). In 2010, nearly 39 percent of the state’s manufacturing workers had at least a Bachelor’s degree, compared with just 26 percent in the U.S.

Figure 1.9A Educational Attainment, Manufacturing Full-Year Workers Massachusetts vs. U.S., 2010



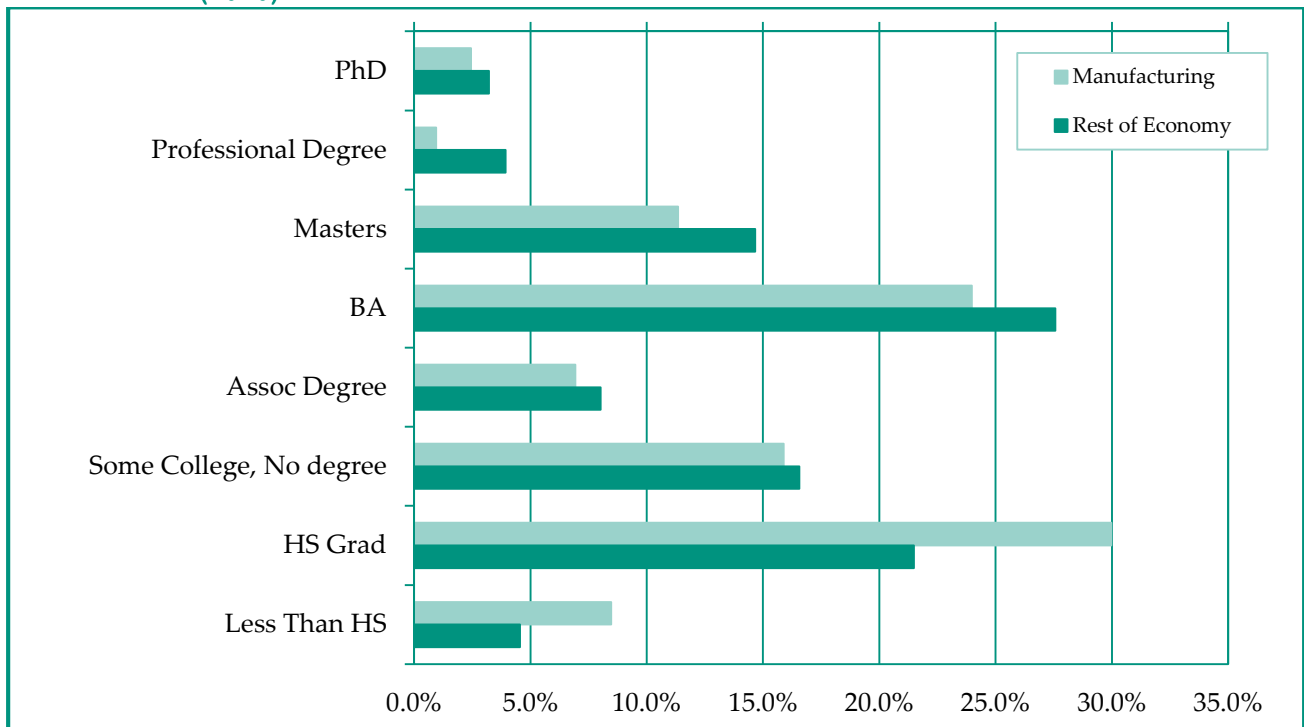
Source: American Community Survey

Figure 1.9B Educational Attainment, Massachusetts Manufacturing Full-Year Workers, 2005 vs. 2010



Source: American Community Survey

Figure 1.9C Educational Attainment, Massachusetts Full-Year Workers, Manufacturing vs. Rest of Economy (2010)



Source: American Community Survey

Second, even between 2005 and 2010, the educational background of the Massachusetts workforce improved (see **Figure 1.9B**). In 2005, 33 percent of the workforce had at least a B.A.; five years later, 39 percent. The younger workers joining the industry are coming in with more education, taking the place of older retiring workers who were much less likely to have gone beyond high school.

Still, as **Figure 1.9C** suggests, manufacturing provides a large number of well-paying jobs for those with less than a 4-year college education. Nearly 39 percent of this sector’s workforce in 2010 had no more than a high school degree compared with 26 percent of the rest of the state’s workforce. As such, this is one industry that supplies excellent job opportunities for a broader range of the state’s population.

Wages and Salaries in Massachusetts Manufacturing

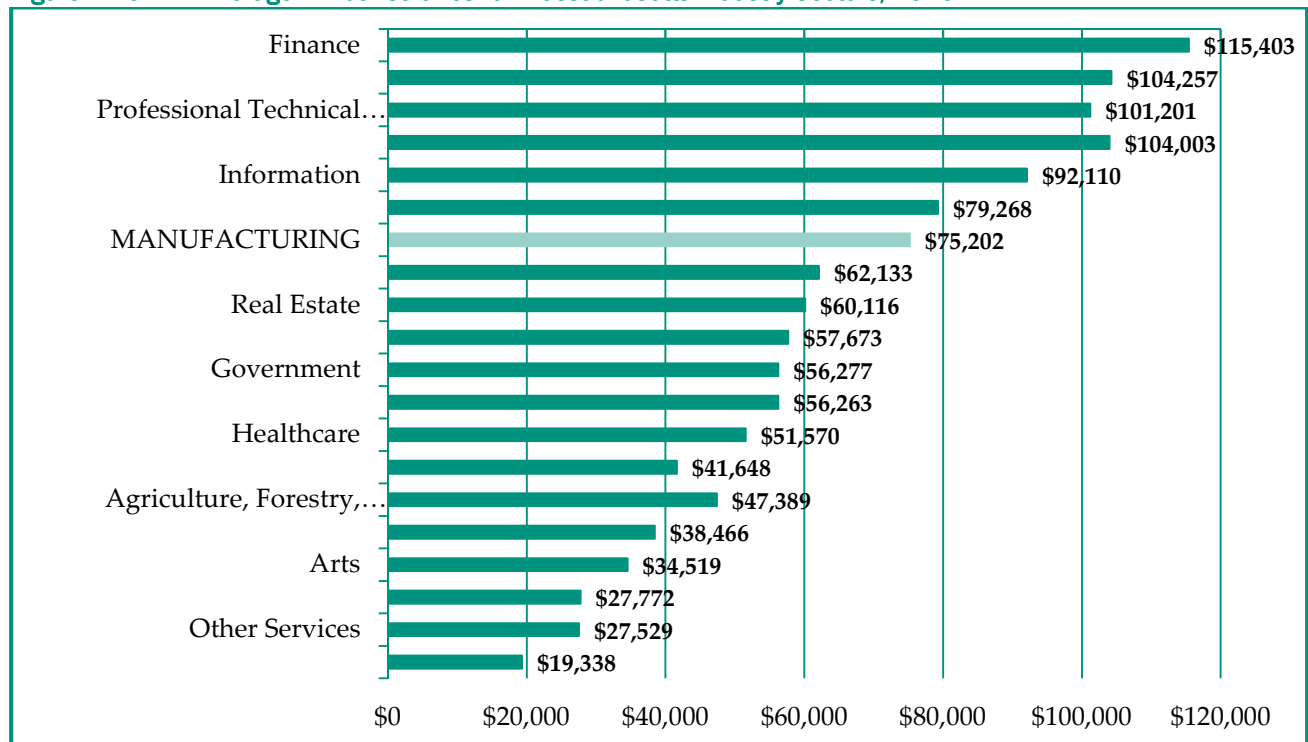
Despite the fact that the typical manufacturing worker has less formal education than the typi-

cal worker in the rest of the Massachusetts economy, wages and salaries tend to be relatively high, reflecting the high productivity level in this sector. As **Figure 1.10** reveals, the average annual salary in manufacturing was in excess of \$75,000 in 2010.²⁸ As such, it was higher than that of workers in construction, real estate, education, government, and the health care sector.

Average wages have also been rising faster in manufacturing as a result of faster growing productivity. Between 2006 and 2010, as **Table 1.10** demonstrates, the average annual salary in the state’s manufacturing sector increased by over 15 percent. This was larger than the increase in banking and insurance, construction, real estate, government, and health care and more than *three times* the state average increase.

Table 1.11 provides data on the weekly wage paid for the 5 highest paying and 5 lowest paying manufacturing industries in Massachusetts as of the 3rd quarter of 2011.

Figure 1.10 Average Annual Salaries for Massachusetts Industry Sectors, 2010



Source: US Bureau of Labor Statistics, *Quarterly Census of Employment and Wages, Employment and Wages, Annual Wages, 2010*, table 8 & 10, <http://www.bls.gov/cew/cewbultn10.htm#Tables>

Appendix 1B provides average wage data for all manufacturing industries in the Commonwealth. Overall, the average weekly wage in manufacturing was \$1,418 – 27 percent higher than the prevailing average wage across all industries in the state. The highest manufacturing wages are found in the high tech and medium-tech durable goods industries including computers and peripheral equipment, pharmaceutical & medicine production, aerospace

products, electrical equipment, and industrial machinery. The lowest are virtually all in the non-durable sector including such industries as leather product manufacturing, textile furnishings, apparel, and bakeries. The average weekly wage in the top five durable goods industries is \$2,119, almost four times the comparable wage in the five poorest paying non-durable industries (\$562).

Table 1.10 **Salary Increases for Massachusetts Industries (2006-2010)**

Industry	2006	2010	% Change
Finance	\$103,834	\$115,403	11.1%
Management of Companies	\$88,469	\$104,257	17.8%
Professional Technical Services	\$87,920	\$101,201	15.1%
Utilities	\$80,369	\$104,003	29.4%
Information	\$77,517	\$92,110	18.8%
Wholesale Trade	\$72,813	\$79,268	8.9%
Manufacturing	\$65,333	\$75,202	15.1%
Construction	\$54,938	\$62,133	13.1%
Real Estate	\$54,402	\$60,116	10.5%
Education	\$46,555	\$57,673	23.9%
Government	\$53,973	\$56,277	4.3%
Mining	\$53,689	\$56,263	4.8%
Healthcare	\$45,647	\$51,570	13.0%
Transportation & Warehousing	\$43,480	\$41,648	-4.2%
Agriculture, Forestry, Fishing	\$43,075	\$47,389	10.0%
Administrative Services	\$35,680	\$38,466	7.8%
Arts	\$31,086	\$34,519	11.0%
Retail	\$27,312	\$27,772	1.7%
Other Services	\$26,773	\$27,529	2.8%
Hotels & Food Services	\$18,215	\$19,338	6.2%
Massachusetts State Average Salary	\$52,396	\$54,740	4.5%

Source: U.S. Bureau of Labor Statistics, *Quarterly Census of Employment and Wages, Employment and Wages, Annual Wages, 2010*, table 8 & 10, <http://www.bls.gov/cew/cewbultn10.htm#Tables>

Table 1.11 Average Weekly Wage, 4-Digit NAICS Code Massachusetts Manufacturing Industries, 3rd Quarter 2011 (Top 5/Bottom 5)

NAICS	Description	Average Weekly Wages
31-33	All Manufacturing	\$1,418
5 Highest Wage 4-Digit Manufacturing Industries		
3341	Computers and Peripheral Equipment	\$2,782
3254	Pharmaceutical & Medicine Manufacturing	\$1,998
3345	Electronic Instrument Manufacturing	\$1,939
3342	Communications Equipment Manufacturing	\$1,851
3364	Aerospace Product & Parts Manufacturing	\$1,812
5 Lowest Wage 4-Digit Manufacturing Industries		
3152	Cut and Sew Apparel Manufacturing	\$622
3113	Sugar/Confectionery Product Manufacture	\$610
3141	Textile Furnishings Mills	\$609
3169	Other Leather Product Manufacturing	\$523
3111	Animal Food Manufacturing	\$447

Source: Massachusetts Executive Office and Labor and Workforce Development

Table 1.12 Share of Massachusetts Payroll (2011:3rd Quarter) - Top 4 Sectors

Employment Sector	Total Employment	Percent of Massachusetts Workforce	Percent of Massachusetts Total Payroll
Health Care	532,934	16.6%	15.3%
Retail Trade	344,751	10.8%	5.3%
Education	282,818	8.8%	8.7%
Manufacturing	254,300	8.0%	10.1%

Source: Massachusetts Office of Labor and Workforce Development, *Employment and Wages*

http://lmi2.detma.org/lmi/lmi_es.asp#IND_LOCATION

While manufacturing in Massachusetts accounts for 8.0 percent of the state’s total employment, its workers enjoy the second highest payroll in the state because of the higher annual wages paid. In terms of total payroll, manufacturing trails only the health care sector, which has more than twice the employment of manufacturing. Retail trade and education have more employees, but manufacturing eclipses both in terms of the total value of wages and salary paid to its workers (see **Table 1.12**). In part this is due to higher weekly wages and in part a result of a higher proportion of the work-

force employed full-time full-year rather than part-time or part-year.

Where is Manufacturing Located in the Commonwealth?

One of the true benefits of manufacturing to the Commonwealth is its geographic distribution within the state. Manufacturing firms are found throughout Massachusetts with concentrations in many of the state’s older industrial cities and towns which have not been the primary beneficiaries of the growth of such sectors as biotech, finance, and health care. Hence, a manufacturing renaissance is particularly im-

portant to these communities. **Figure 1.11** provides a map indicating those communities where there is a relatively large ratio of manufacturing employment to population.

Appendix 1C provides the same data in tabular form. Manufacturing concentrations range from 340 per 1,000 residents in Andover, 308 in Avon, and 291 in Wilmington to less than 10 per 1,000 residents in Newton, Medford, and Quincy. Among the state's 24 *Gateway cities*, the manufacturing concentration ranges widely from a low of 6.7 in Quincy to a high of 94.9 in Taunton.²⁹ Still, the large Gateway Cities almost all have concentration ratios higher than the 44.8 state average for 2007. These include: Taunton, Westfield, Chicopee, New Bedford, Leominster, Fall River, Pittsfield, Lawrence, Fitchburg, Holyoke, Lynn, Chelsea, and Worcester.

The Demographics of the Massachusetts Manufacturing Workforce: Race and Ethnicity

The relatively high wage in manufacturing is shared by a workforce that is generally more diverse than the rest of the Commonwealth's workforce – and it is becoming more diverse over time. As **Table 1.13** reveals, more than quarter (26%) of manufacturing employees in the state are foreign born compared with 18.3 percent of non-manufacturing employees. By 2010, Hispanics represented 9.3 percent of all manufacturing workers, up from 8.3 percent five years earlier. The Asian population is also overrepresented in manufacturing with just slightly less than 9 percent of the workforce (8.9%), up from 6.5 percent in 2005. Only the African-American population continues to be “underrepresented” in manufacturing with just 3.4 percent of the total workforce (compared with 5.8% of the non-manufacturing workforce.)

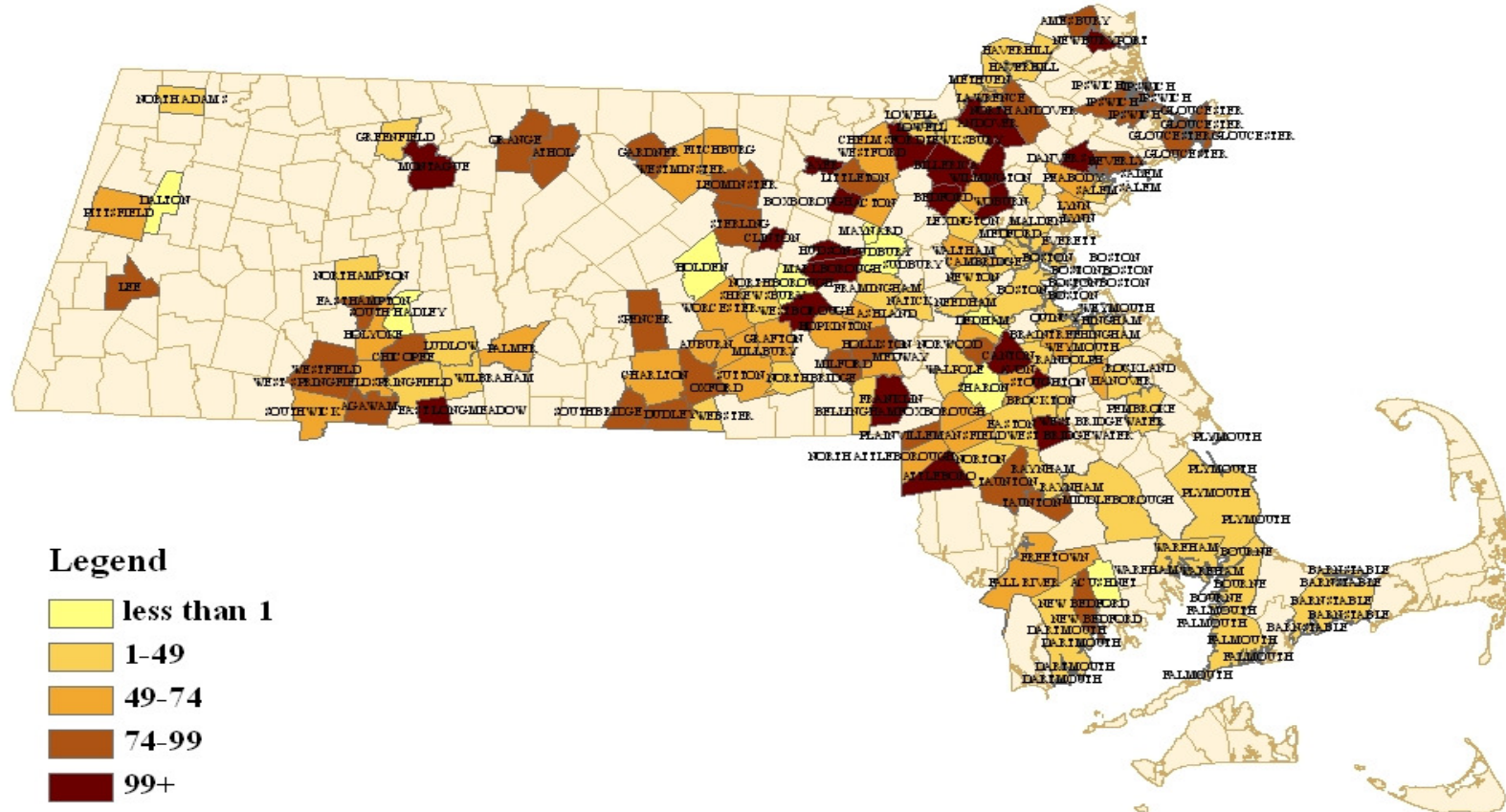
Table 1.13 Massachusetts Manufacturing – A Diverse Workforce

Ethnicity	2005		2010	
	Share of Non-Manufacturing Workforce	Share of Manufacturing Workforce	Share of Non-Manufacturing Workforce	Share of Manufacturing Workforce
Foreign Born	15.9%	24.4%	18.3%	26.0%
Hispanic ³⁰	5.8%	8.3%	7.3%	9.3%
Asian	4.1%	6.5%	5.0%	8.9%
African-American	4.9%	3.8%	5.8%	3.4%

Source: 2010 American Community Survey

Figure 1.11 Map of Massachusetts Manufacturing Employment Density

Manufacturing Employment per 1,000 Residents



Source: 2007 Economic Census

The Aging of the Manufacturing Workforce

What is most unique demographically about the Massachusetts manufacturing workforce is its age. Manufacturers employ an aging workforce and one that is aging faster than that of the rest of the economy. As **Table 1.14** demonstrates, the average age of the manufacturing workforce in the Commonwealth reached 45 in 2010, up 1.2 years since 2006 and up a full 3 years since 2000. By comparison, in the rest of the economy the average age in 2010 is the same as the average age in manufacturing a decade ago and it has increased during that decade by just 2.1 years.

An even starker picture of the age distribution discrepancy between manufacturing and the rest of the economy is found in **Table 1.15**. In 2000, 40.5 percent of the manufacturing workforce was age 45 or older compared with 36.1 percent of the employees in all other Massachusetts industries. Thus the age differential was 4.4 percentage points. A decade later the dif-

ferential had swollen to 9.3 percentage points: 53.9% vs. 44.6%.

A finer age breakdown is provided in **Table 1.16** and **Figure 1.12**. Note that the proportion of the manufacturing workforce in Massachusetts age 45 and above has swelled from 40.5 percent in 2000 to nearly 54 percent in 2010. More than a fifth of the workforce – nearly 59,000 of the current 250,000 employees in this sector -- are now at least 55 years old. Assuming most of these workers retire within the next ten years, manufacturing employers will be seeking a large number of replacement workers just to offset retirements, let alone normal turnover among workers younger than age 55.

With such a large cadre of manufacturing workers approaching retirement, there is a serious question as to whether there will be a sufficient number of younger workers to take their place.

Table 1.14 Average Age of Massachusetts Workforce (In Years)

	2000	2006	2010	2000-2006 change	2006-2010 change	2000-2010 change
Manufacturing	42.0	43.8	45.0	1.8	1.2	3.0
All other industries	39.9	41.1	42.0	1.2	0.9	2.1

Source: American Community Survey, Public Use Files, 2006, 2010, Tabulations by Center for Labor-Market Studies and Dukakis Center for Urban and Regional Policy, Northeastern University

Table 1.15 Proportion of Workforce Age 45 or Older

	2000	2006	2010
Manufacturing	40.5%	49.6%	53.9%
All other industries	36.1%	41.4%	44.6%
Difference between manufacturing and all other industries (% point)	4.4%	8.2%	9.3%

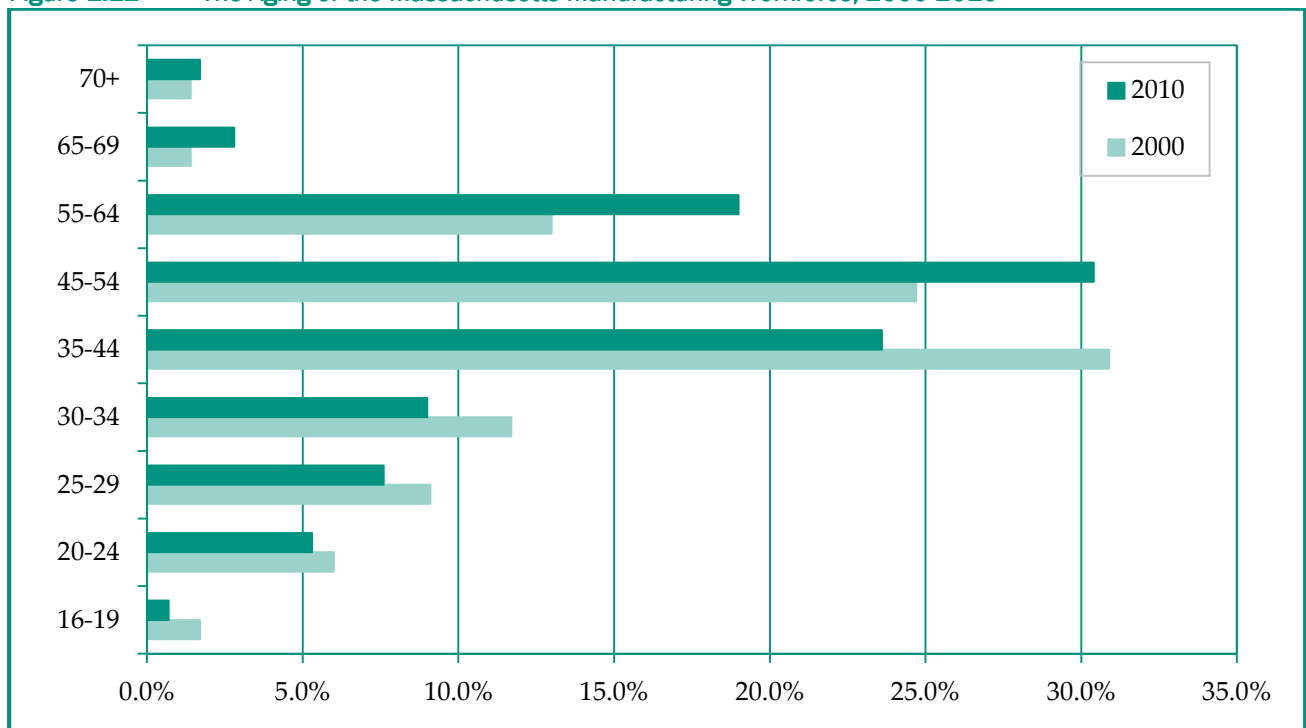
Source: American Community Survey, Public Use Files, 2006, 2010, Tabulations by Center for Labor Market Studies and Dukakis Center for Urban and Regional Policy, Northeastern University

Table 1.16 Age Distribution of Massachusetts Manufacturing Workforce

Age Group	2000	2006	2010
16-19	1.7%	1.5%	0.7%
20-24	6.0%	4.8%	5.3%
25-29	9.1%	7.5%	7.6%
30-34	11.7%	9.9%	9.0%
35-44	30.9%	26.6%	23.6%
45-54	24.7%	30.7%	30.4%
55-64	13.0%	15.8%	19.0%
65-69	1.4%	1.8%	2.8%
70+	1.4%	1.3%	1.7%
Mean Age	42.0	43.8	45.0

Source: American Community Survey, Public Use Files, 2006, 2010, Tabulations by Center for Labor Market Studies and Dukakis Center for Urban and Regional Policy, Northeastern

Figure 1.12 The Aging of the Massachusetts Manufacturing Workforce, 2000-2010



Source: American Community Survey, Public Use Files, 2006, 2010, Tabulations by Center for Labor Market Studies and Dukakis Center for Urban and Regional Policy, Northeastern University

Potential Job Openings in Massachusetts Manufacturing – 2012 -2022

Given the aging of the manufacturing workforce, we can expect a minimum of 50,000 retirements by 2022. But the total number of job vacancies in the manufacturing sector will be much higher since younger workers also quit their firms before retirement in order to take jobs in other companies. Nationally, according to the U.S. Bureau of Labor Statistics, the annual voluntary separation rate from manufacturing establishments was 9.6 percent in 2011, down from 16.5 percent in 2006 when the economy was much stronger and jobs more plentiful.³¹ Some of these workers move from one manufacturing firm to another; some move from manufacturing into other industrial sectors; and some leave the labor force altogether. In each of these cases, however, unless a firm is downsizing, it needs to replace those workers who quit. While the 9.6 percent annual separation rate in manufacturing may seem high, it is actually much lower than the all-industry 2011 rate of 17.9 percent. The higher rate in the rest of the economy is driven by extremely high turnover rates in such industries as retail trade (24%) and the accommodation and food service industry (38%).

No other private industry sector had a lower quit rate than manufacturing. Even then, if this quit rate continues for the next ten years, the total number of job openings in manufacturing will be much larger than the expected 50,000+ retirements. If we assume that as many as half of the voluntary quits move from one manufacturing employer to another reduces the annual manufacturing industry quit rate to 4.8 percent. This would be the proportion of workers who neither retire nor are laid off, but leave manufacturing altogether. Over ten years, this translates into an industry quit rate of 48 percent of the non-retirement manufacturing workforce.

In early 2012, there were roughly 115,500 workers in the state's manufacturing workforce who

were under the age of 45. If we assume none of them will retire before they turn 55, but 48 percent of them will leave the industry sometime during the next decade, there will be approximately 55,000 members of the current non-retirement age manufacturing workforce who will leave the industry by 2022.

Adding this number to the estimated 50,000 retirements yields a total of 115,000 projected job openings between now and 2022 assuming overall industry employment does not shrink between now and then. However, as the next section suggests, there is reason to believe that because of continued increases in productivity in Massachusetts manufacturing, the total number of jobs will decline at an average rate of 1,900 per year for the foreseeable future. Thus by 2022, we project total employment in the sector will be approximately 231,000, 19,000 below the current level.

As such, our best estimate for job openings in Massachusetts manufacturing over the coming decade (2012-2022) is (115,000 – 19,000) or 96,000 – very close to the 100,000 estimate we made in our 2008 report.

Whether Massachusetts education and training institutions will turn out a sufficient number of new workers to fill all of these positions – or whether Massachusetts can attract training manufacturing workers from other states or nations to fill the gap – is still up in the air.

Manufacturing's Future in Massachusetts

What does the future hold for Massachusetts manufacturing employment? Making long-term projections is always tricky, but given the data we have presented in this chapter, we are reasonably confident that any further decline in the number of jobs in manufacturing will be relatively small. The Massachusetts Executive Office of Labor and Workforce Development has projected manufacturing employment by specific industry through 2018. Their projec-

tions are found in **Table 1.17**. The research is based on a “shift-share” analysis of national data covering 700 occupations and 150 industries. The assumption behind these projections is that individual manufacturing industries in Massachusetts will grow at the same rate as the industry nationwide, but because the relative size of specific industries differs between the state and nation, the state numbers have to be adjusted.

According to these “official” projections, there will be roughly 238,600 manufacturing jobs in Massachusetts in 2018. This is down from 286,420 jobs in 2008 and approximately 250,000 jobs as of early 2012. If the 2018 projection is correct, over the remaining six years in the projection period, manufacturing will shed an additional 11,400 jobs or an average of 1,900 per year as we noted earlier. By 2022, four years past the projection and ten years from now, there would still be nearly 231,000 jobs in the Commonwealth’s manufacturing sector. Of course, given the recent stability of the manufacturing sector, it is altogether possible that improved markets for Massachusetts firms and somewhat slower increases in productivity could yield even more manufacturing jobs than forecast here.

Two specific industries are projected to actually expand employment (Chemicals and Medical Equipment and Supplies) and there are seven

industries that should shed less than 10 percent of their 2008 job base by 2018. These include food manufacturing, aerospace products and parts, miscellaneous manufacturing, navigational and measuring equipment manufacturing, transportation equipment production, communication equipment, and non-metallic mineral product manufacturing.

The projected big losers, at least percentage wise, are a combination of durable and non-durable industries including apparel manufacturing, textile mills, paper manufacturing, computer and peripheral equipment manufacturing, motor vehicle parts manufacturing, machinery manufacturing, and semiconductor production. All of these are projected to shed 30 percent or more of their 2008 workforce.

Of course, with a resumption of demand for these products in the coming years and continued improvements in productivity in these industries, it is altogether possible that a good share of these projected losses could be avoided.

Figure 1.13 provides a graphical image of this forecast through 2018. Note that between 1996 and 2012, Massachusetts lost 160,000 manufacturing jobs. All but 8,000 of these were gone before 2009. Since 2009, the loss rate has been cut sharply resulting in the forward projection we see here.

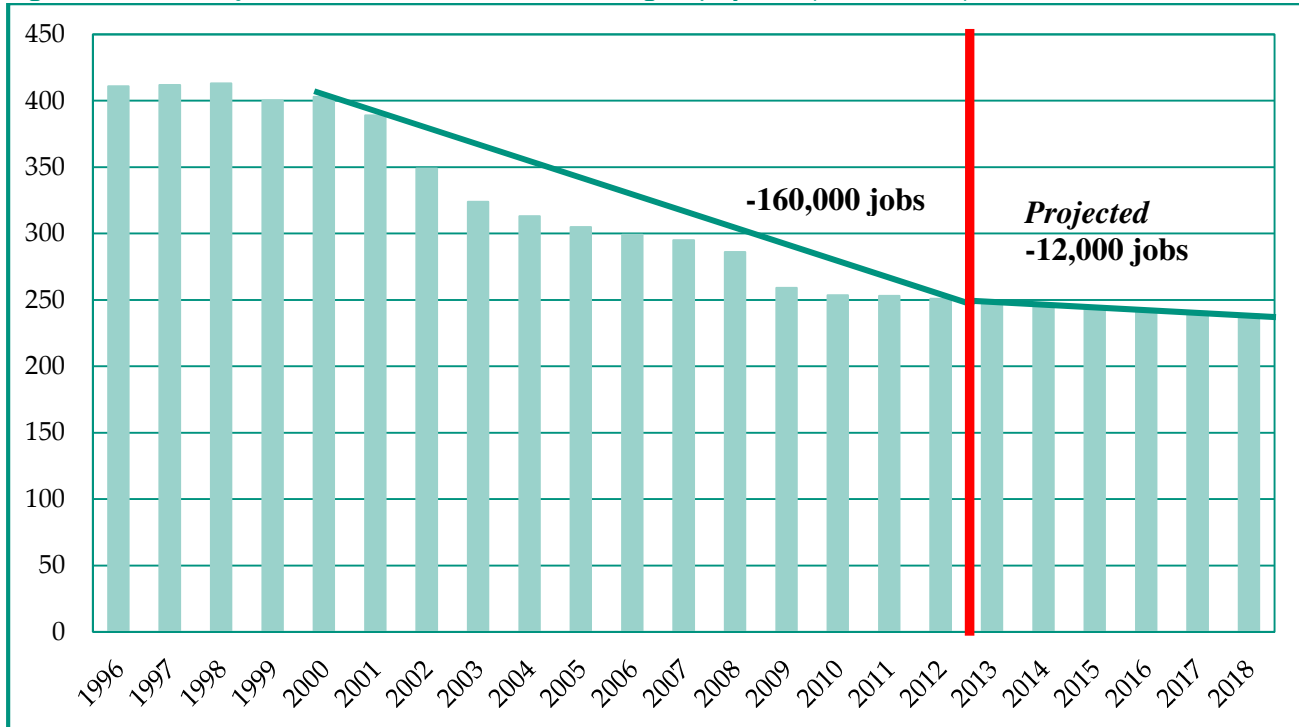
Table 1.17 Projected Manufacturing Employment in Massachusetts (2008 – 2018)

NAICS code	4-Digit Industry	Actual 2008 Employment	Projected 2018 Employment	Change 2008-2018	Percent Change 2008-2018
310000	Manufacturing	286,420	238,560	-47,860	-16.7 %
325000	Chemical Manufacturing	18,310	19,230	920	5.0 %
339100	Medical Equipment and Supplies Manufacturing	11,000	11,500	500	4.5 %
311000	Food Manufacturing	22,700	22,600	-100	-0.4 %
336400	Aerospace Product and Parts Manufacturing	12,160	11,900	-260	-2.1 %
339000	Miscellaneous Manufacturing	21,460	20,500	-960	-4.5 %
334500	Navigational, Measuring, Electromedical, and Control Instruments	28,300	26,900	-1,400	-4.9 %
336000	Transportation Equipment Manufacturing	14,350	13,500	-850	-5.9 %
334200	Communications Equipment Manufacturing	4,000	3,700	-300	-7.5 %
327000	Nonmetallic Mineral Product Manufacturing	6,320	5,750	-570	-9.0 %
337000	Furniture and Related Product Manufacturing	5,380	4,800	-580	-10.8 %
321000	Wood Product Manufacturing	2,590	2,300	-290	-11.2 %
325500	Paint, Coating, and Adhesive Manufacturing	2,030	1,800	-230	-11.3 %
312000	Beverage and Tobacco Product Manufacturing	2,600	2,290	-310	-11.9 %
312100	Beverage Manufacturing	2,600	2,290	-310	-11.9 %
325200	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and	2,820	2,450	-370	-13.1 %
339900	Other Miscellaneous Manufacturing	10,460	9,000	-1,460	-14.0 %
324000	Petroleum and Coal Products Manufacturing	960	800	-160	-16.7 %
324100	Petroleum and Coal Products Manufacturing	960	800	-160	-16.7 %
323000	Printing and Related Support Activities	15,100	12,300	-2,800	-18.5 %
335000	Electrical Equipment, Appliance, and Component Manufacturing	11,600	9,450	-2,150	-18.5 %

NAICS code	4-Digit Industry	Actual 2008 Employment	Projected 2018 Employment	Change 2008-2018	Percent Change 2008-2018
326000	Plastics and Rubber Products Manufacturing	13,900	11,230	-2,670	-19.2 %
334000	Computer and Electronic Product Manufacturing	69,180	55,750	-13,430	-19.4 %
331000	Primary Metal Manufacturing	4,550	3,540	-1,010	-22.2 %
332000	Fabricated Metal Product Manufacturing	34,500	26,500	-8,000	-23.2 %
314000	Textile Product Mills	3,010	2,280	-730	-24.3 %
325100	Basic Chemical Manufacturing	1,190	900	-290	-24.4 %
325900	Other Chemical Product and Preparation Manufacturing	1,590	1,200	-390	-24.5 %
325400	Pharmaceutical and Medicine Manufacturing	9,590	12,100	2,510	26.2 %
316000	Leather and Allied Product Manufacturing	1,720	1,240	-480	-27.9 %
334400	Semiconductor and Other Electronic Component Manufacturing	19,200	13,400	-5,800	-30.2 %
333000	Machinery Manufacturing	20,000	13,700	-6,300	-31.5 %
336300	Motor Vehicle Parts Manufacturing	1,170	800	-370	-31.6 %
334100	Computer and Peripheral Equipment Manufacturing	14,000	9,400	-4,600	-32.9 %
322000	Paper Manufacturing	11,220	7,400	-3,820	-34.0 %
313000	Textile Mills	4,190	2,200	-1,990	-47.5 %
315000	Apparel Manufacturing	2,780	1,200	-1,580	-56.8 %

Source: Executive Office of Labor and Workforce Development, Commonwealth of Massachusetts, "Long-Term Industry Projections," January 2012

Figure 1.13 Projected Massachusetts Manufacturing Employment (in thousands), 1996-2018



Source: Calculations based on Massachusetts Department of Labor

What Could Affect this Projection?

There are, of course, scores of factors that will affect the actual trend in manufacturing, the majority of which are outside the control of individual firms or the state government.

Encouraging as this forecast may be, there are a number of reasons why manufacturing may do even better than our forecast.

1. Our original projection completed in late 2007 expected a continued erosion of employment through 2016, but at an average rate of only 3,100 per year. Based on the fact that there were 299,000 manufacturing jobs in 2006, we saw employment falling to 268,000 by 2016. Adding two more years to this forecast would have brought the projected 2018 employment level to 261,000 – about 11,000 *higher* than in 2012. The sharp reduction in jobs due to the “Great Recession” drove employment levels much lower than we could have expected. Yet now as the economy begins to re-

cover, it is possible that some of those recession losses can be recaptured so that we actually see some short-term increases in employment over the next year or two providing a higher plateau from which further losses would be calculated. As such, by 2018, it is still possible that we may see as many as 250,000 to 260,000 jobs in the manufacturing sector.

2. With the increase in labor costs in foreign markets (e.g. China) and continued high transportation costs, some production may return from overseas. This would augment domestic employment.
3. Productivity growth may not be able to be sustained at the high level attained over the past decade. Somewhat lower productivity growth would likely mean the need to keep more workers on the job if demand can be sustained.
4. Increased attention to the manufacturing sector both by Washington and by the Commonwealth may result in pro-

grams that enhance American competitiveness and improve the domestic business climate, encouraging Massachusetts firms to expand in state rather than relocate production elsewhere.

5. Increased attention to workforce development through improved community college curricula and vocational school courses could provide a replacement skilled workforce that Massachusetts firms need.

Of course, it is possible that the manufacturing sector could expand at a slower pace than we have projected with less employment. This certainly occurred following the release of our 2008 report. Indeed, in that report, we noted at the end of Chapter 1 that our projections could be overly optimistic if “the current slowdown in the U.S. economy (turns) into a full-blown recession weakening employment in all sectors.”³²

One caution concerns international trade. As noted above, approximately 40 percent of Massachusetts exports go to Europe compared with about 18 percent of total U.S. exports.

Hence, the state’s exporting firms are much more susceptible to reduced sales abroad as the European economies continue to grow slowly or contract.

Domestically, the apparent slowdown in the U.S. economy in the first half of 2012, if it continues for much longer, will invariably affect the entire Massachusetts economy along with its manufacturing sector. While Massachusetts continues to outperform the rest of the nation in terms of GDP growth and unemployment, it cannot completely avoid any economic doldrums that stem from national or international economic turmoil.

On balance, however, we continue to be encouraged by the progress of the state’s manufacturing sector. It has been in the forefront of new technological advances which place it in a position to succeed at home and abroad. In the process, it will provide excellent job opportunities in the years to come for those with appropriate talent and skill.

CHAPTER 2

AN UPDATED MASSACHUSETTS MANUFACTURING SURVEY AND INTERVIEW SAMPLE

In 2007, we conducted a survey of Massachusetts manufacturers to delve deeper into the dynamics of the industry than existing published statistics allow. The additional information gleaned through the survey gave us the ability to better explore how business owners and managers viewed the prospects for their firms in light of existing and future competition, the challenges they encountered in terms of the cost structures they faced in the state, and the types of assistance they believed they needed in order to sustain their operations in Massachusetts.

Since the survey was concluded immediately before the Great Recession began in December 2007, the follow-up survey that we administered in the spring of 2012 was designed to address changes in the status of the industry over the five year period between surveys as well as probe the near-term expectations of manufacturers in the post-Recession period. The updated survey included in-depth questions about their sources and uses of capital, each firm's workforce, perceived impediments to growth, and the firm's plans for possible expanded production.

As in the case of the 2007 survey, the 2012 survey could be completed and returned by mail or filled out electronically. The survey was once again followed up with personal interviews with owners, executives, and managers from a subset of the surveyed establishments. We succeeded in obtaining survey results from 689 manufacturers in Massachusetts and subsequently conducted interviews of 56 of these 689 respondents. We compared the sample of establishments surveyed with the entire array of

manufacturers in Massachusetts to ensure that the information we present from the survey sample and from the interviews is generally representative of the entire population of Massachusetts manufacturers. In this chapter, we outline the methodology used to gather establishment-level data along with the details of the final samples we surveyed and interviewed.

Survey Design

In conjunction with representatives from a large number of economic development and manufacturing industry organizations, researchers at the Dukakis Center for Urban and Regional Policy updated and improved upon the 2007 survey instrument. The 2012 survey asks for more detail on topics like access to capital, workforce training and recruitment, market and institutional barriers to growth, innovations introduced into the production process, and the future plans of Massachusetts manufacturers related to possible expanded production and employment. While many questions are new, the 2012 survey instrument maintained some questions from the 2007 questionnaire in order to track changes in industry characteristics and dynamics. Before being used in the field, the 2012 survey instrument was piloted with ten manufacturers in order to improve on the wording and order of the survey questions. The final survey was organized into seven thematic categories and collected the following information:

- *Company profile*: name; year founded; location; ownership structure; industry sector(s); primary products/service; location of manufacturing facilities; number of employees; annual gross revenue

- *Market dynamics*: location of competitors, suppliers and customers; expected changes in technology, outsourcing, labor, products, prices, and markets
- *Operational issues and access to capital*: factors affecting the decision to continue to operate manufacturing facilities in Massachusetts; use of state and local incentive programs; sources of capital and credit; ability to access capital in the past; anticipated ability to finance future growth
- *Workforce profile*: education requirements for employment; average age; anticipated job openings; hourly wage
- *Workforce recruitment and training*: sources of recruitment; institutions used for workforce training; factors in recruitment of experienced and entry-level shop floor employees; ease of recruitment;
- *Experience and expectations*: projected production and employment levels (2012-2017); likelihood of merger and acquisition activities; possible expansion locations; current and projected exports to foreign countries
- *Promoting manufacturing*: workforce development activities; internship and other job-related programs for students; broad-based initiatives

The complete survey instrument can be found as an **Appendix** at the end of this report.

Sample Design

The sample of manufacturing firms for this study was drawn from a commercial database available from InfoUSA.com.³³ For the year 2011, the database contained information on 12,345 manufacturing establishments in Massachusetts. These establishments were hand-checked to remove obvious non-manufacturers (e.g. retail establishments listed under manufacturing) and improve the quality of the data. The resulting universe of manufacturing establishments

was 9,463. We mailed the survey questionnaire to all of these establishments.

Included in the mailed package to each manufacturer were the survey questionnaire, an introductory letter from Governor Deval Patrick, and a stamped return envelope. The letter outlined the goals for this project and requested that the manufacturer return a completed survey to the Dukakis Center. The letter also referenced a website address providing the option of completing the survey electronically. The online survey was hosted on the Zoomerang website, a commercially-available web software product that provides the ability to create custom surveys online. The mailings were followed up with a reminder post-card after one week.

Of the mailed surveys, 891 were returned undelivered, and an additional 59 returned the survey indicating that they were not a manufacturer. This represented a ten percent non-delivery rate, standard for commercial databases, and very similar to the 2007 survey (9%). Altogether, 689 useful surveys were returned and served as the sample we analyzed for this study. Of this total, 427 were returned via mail, and 262 through the online survey. This represented a 38 percent online response rate, compared with just 14 percent in 2007. The final sample of 689 represents eight percent of the 8,513 mailed questionnaires that reached their destination (virtually identical to the response rate from 2007).³⁴

Representativeness of the Survey Sample

While the overall response rate was low, it corresponded with the response rate from the 2007 survey, and was once again generally representative of the *InfoUSA* establishments. With few exceptions, the 2012 sample was consistent with both the 2007 sample and the 2011 *InfoUSA* distribution when analyzed by industry sec-

tor, sales volume, employment level, and geographic location.

Representativeness by Manufacturing Industry (NAICS categories)

As shown in **Figure 2.1**, the 2012 sample does a reasonable job of capturing the industry composition of the state’s manufacturing sector when compared to the *InfoUSA* 2011 database as well as the survey sample from 2007. In general, manufacturers of each industry participated in the study at a level proportionate to their percentage of the total population of manufacturers in Massachusetts.

There were, however, some exceptions. For example, printing, chemical, computer/electronic products, and machinery manufacturers responded at a lower rate than would be expected given their distribution in the *InfoUSA* database. Some of these lower rates are off-set by the increases in “miscellaneous manufacturing” (a NAICS classification) and “other” (survey classification) reports. There are a number of companies who manufacture in more than one

sector as defined by NAICS codes, and a number who self-identify as a sector not covered by NAICS codes.

In addition, printing manufacturers specifically may be going out of businesses at a higher rate than in other sectors due to the proliferation of digital publishing, so the *InfoUSA* numbers in the printing sector may be somewhat inflated.

Representativeness by Employment Size

As demonstrated in **Figure 2.2**, the 2012 sample is fairly consistent by employment size with both *InfoUSA* and the 2007 survey sample. The only exception are the very small companies (one to four employees), which comprise over 35 percent of the manufacturing firms in Massachusetts according to *InfoUSA*, but comprise only 17.5 percent of the 2012 sample. However, this response rate is remarkably consistent with the 2007 response rate.

As a result, the 2012 sample slightly over-represents establishments in all other size categories.

Figure 2.1 Industry Distribution: InfoUSA Database vs. Survey Sample 2007 vs. Survey Sample 2012

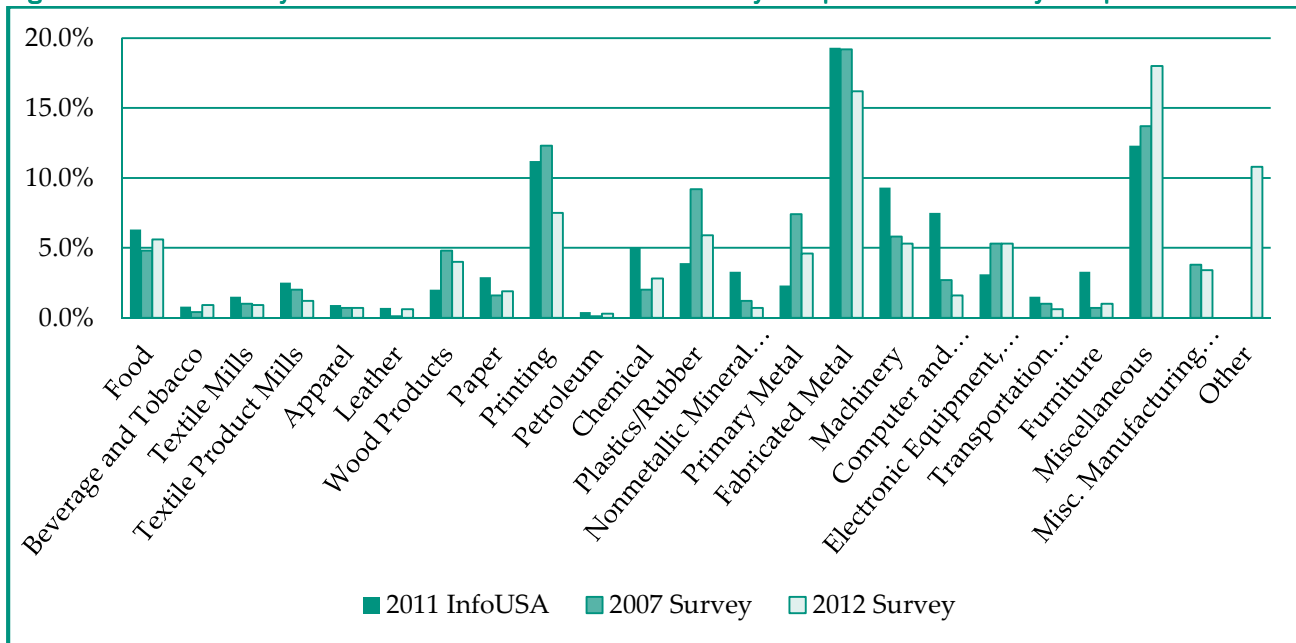


Figure 2.2 Size of Establishment by Employment: *InfoUSA* Database vs. Survey Sample 2007 vs. Survey Sample 2012

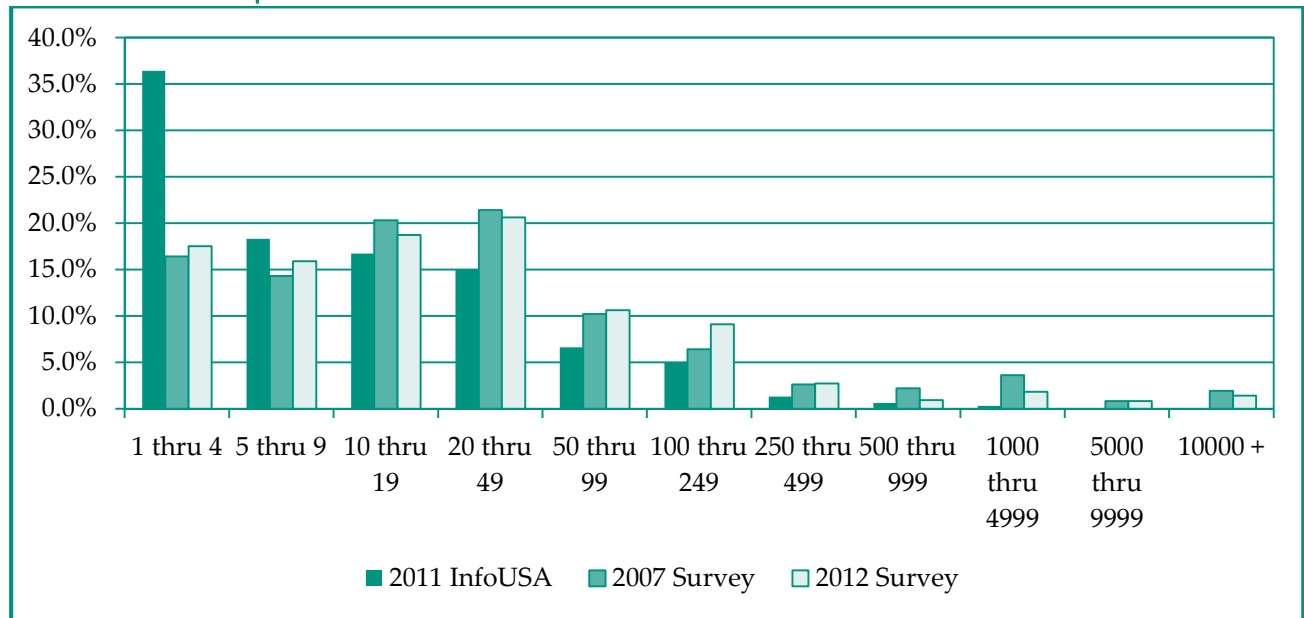
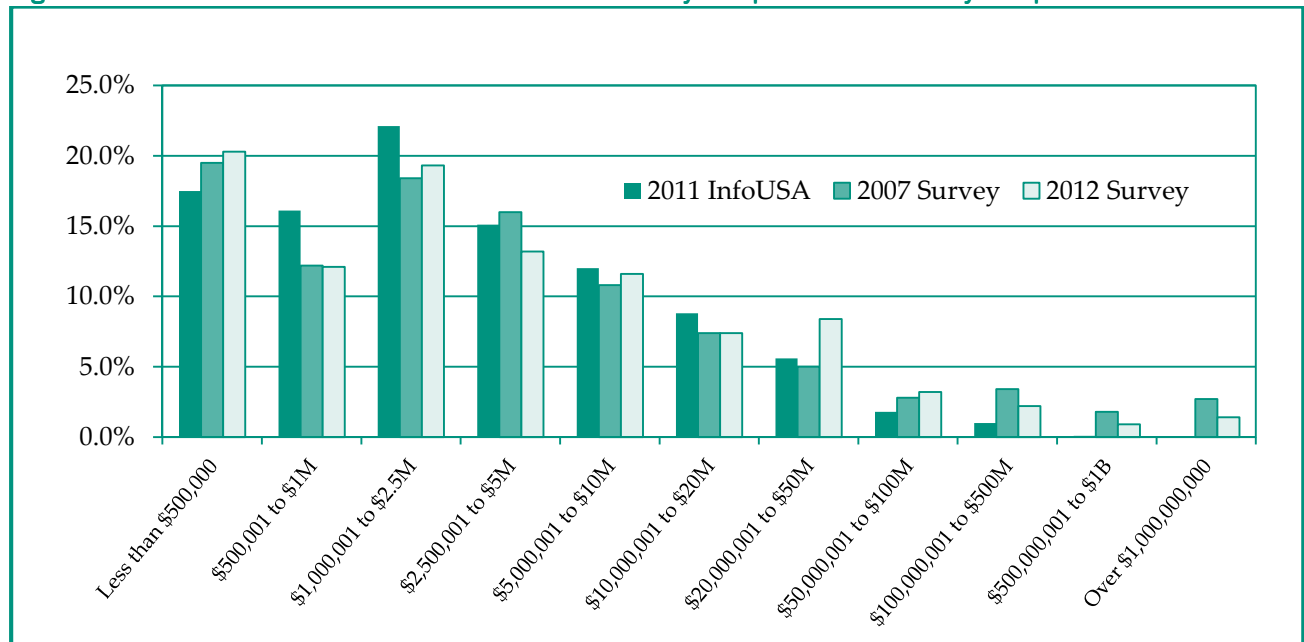


Figure 2.3 Sales Volume: *InfoUSA* Database vs. Survey Sample 2007 vs. Survey Sample 2012



Representativeness by Sales Volume

The volume of sales found in the 2012 sample establishments is virtually identical to that of the overall population of Massachusetts establishments and to the 2007 sample (see **Figure 2.3**). Several categories are slightly under-sampled (\$0.5 million to \$1 million, \$1 million

to \$2.5 million, and \$5 million to \$20 million), and a few are slightly over-sampled (under \$500,000, \$20 million to \$50 million, and the categories with the highest reported income), but overall, the distribution of the 2012 sample is in line with both the 2007 sample and with the population.

Representativeness by Geography

As with the other categories, the sample is also representative of manufacturers' geographic distribution. Using the economic regions of Greater Boston, Western MA, Central MA, Northeastern MA, and Southeastern MA as delineated by UMass Lowell's *Massachusetts Economic Assessment and Analysis Project (MEAAP)*, **Figure 2.4** reveals that the 2012 sample is consistent with both the 2007 sample and with the 2011 *InfoUSA* database. As expected from the database, the largest percentage of responding firms are located in the Greater Boston region, although the response rate from Greater Boston is slightly lower than expected. The response rate from Western MA is slightly higher; the response rates from Central MA, Northeastern MA, and Southeastern MA are right on track.

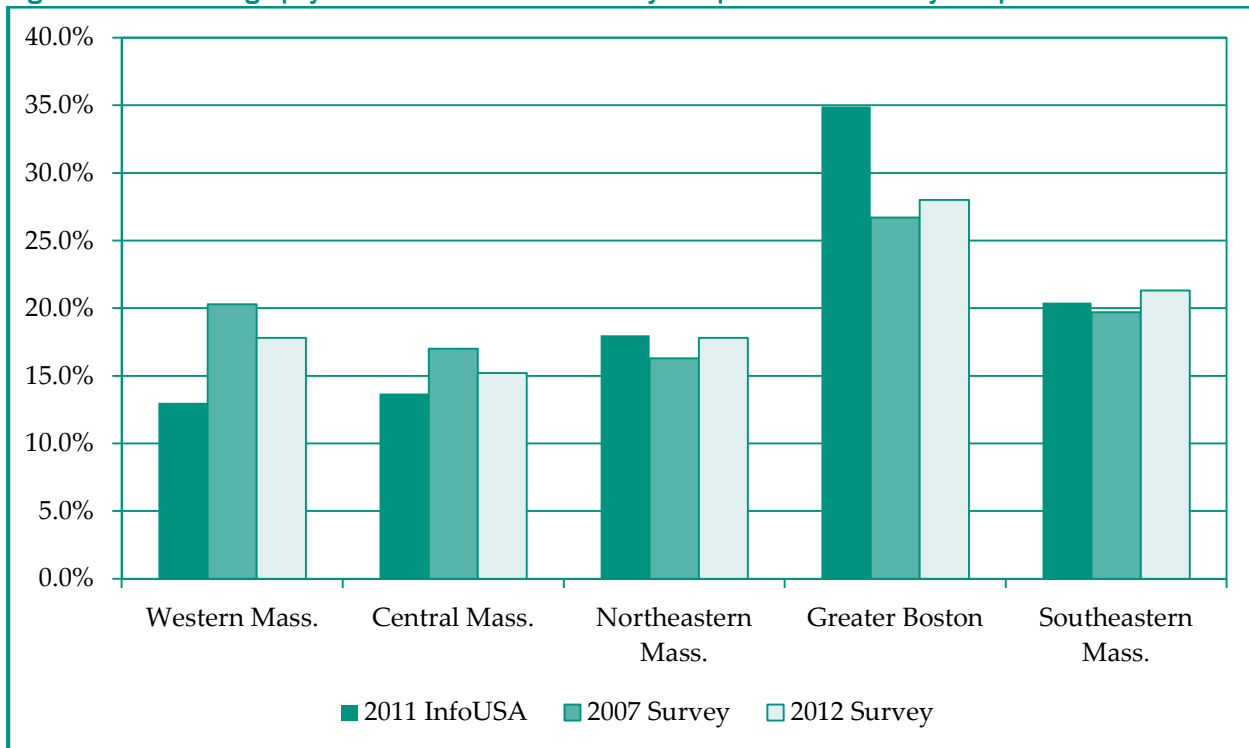
Overall, the final sample of 689 respondents appears to be representative of the full popula-

tion of manufacturing establishments in Massachusetts. Furthermore, the 2012 sample is consistent with the distribution of the 706 responses from the 2007 survey.

Interviews with Manufacturers

At the end of the survey questionnaire, respondents were asked to indicate whether they would be amenable to follow-up contact. Approximately half of all respondents were willing to participate in further conversation after the survey. Dukakis Center staff followed up with 56 of these respondents, conducting in-depth, in-person interviews. The interview questions were more open-ended than the written survey format allowed and resulted in the elaboration of survey responses. Moreover, the interviews permitted us to obtain additional information on a number of topics not included in the survey.

Figure 2.4 Geography: *InfoUSA* Database vs. Survey Sample 2007 vs. Survey Sample 2012



As with the written/on-line survey, our goal was to obtain a reasonably representative distribution of firms based on geography, industry, and employment.

Representativeness by Manufacturing Industry (NAICS categories)

It is difficult to achieve true representation with a sample of 56, but as shown in **Figure 2.5**, the interview sample is generally consistent with the distribution in the *InfoUSA* database distribution. Some of the exceptions include under-representation in the printing, and computer/electronics products industries, and over-representation in the electronic equipment, appliances and components industry, as well as in plastics/rubber.

The under-representation in printing is likely a consequence of the under-representation of printing in the survey itself, as the interview participants were selected from the survey respondents. Due to the overlap between computer/electronic products and electronic equipment, we are not overly concerned

about the distribution discrepancies in those categories.

Representativeness by Employment Size

With regard to the distribution by employment size, the interview sample suffers from the same problem as the survey sample: the under-representation in the one to four employee category leads to a slight over-representation of larger firms (see **Figure 2.6**). However, the interview sample is fairly well-distributed among the remaining categories.

Representativeness by Geography

Similar to the survey data, the geographic dispersion of the manufacturers interviewed reflects the geographic distribution in the population (see **Figure 2.7**). Western MA and Northeastern MA are slightly over-represented in the interview sample, while Central MA and Greater Boston are slightly under-represented, but overall the distribution of the interview sample is very much in line with the firm distribution in *InfoUSA*.

Figure 2.5 Industry Distribution: *InfoUSA* Database vs. Interview Sample 2012

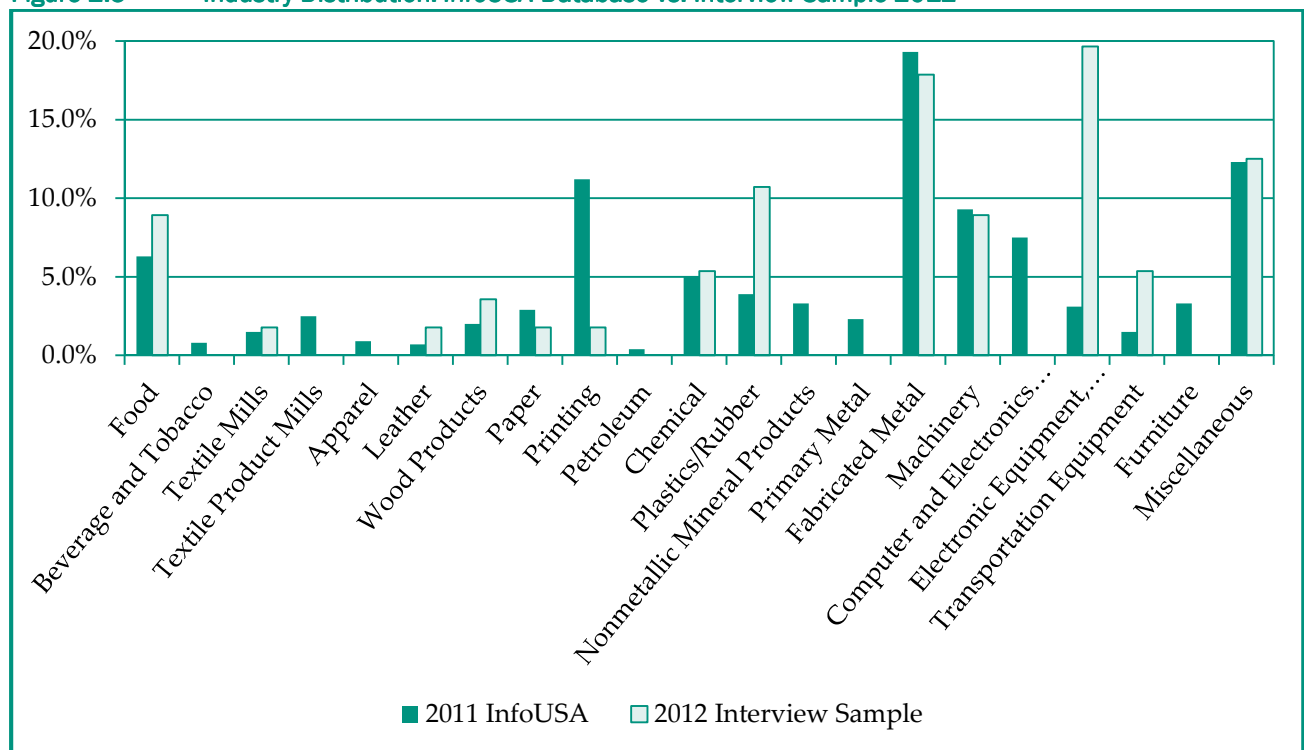


Figure 2.6 Size of Establishment: *InfoUSA* Database vs. Interview Sample 2012

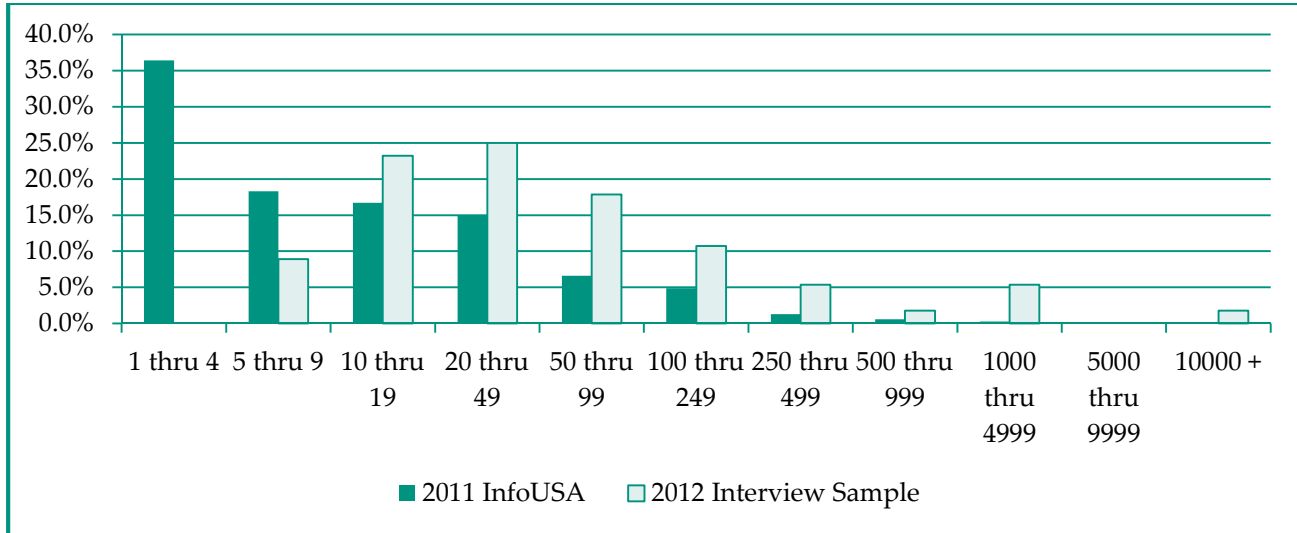
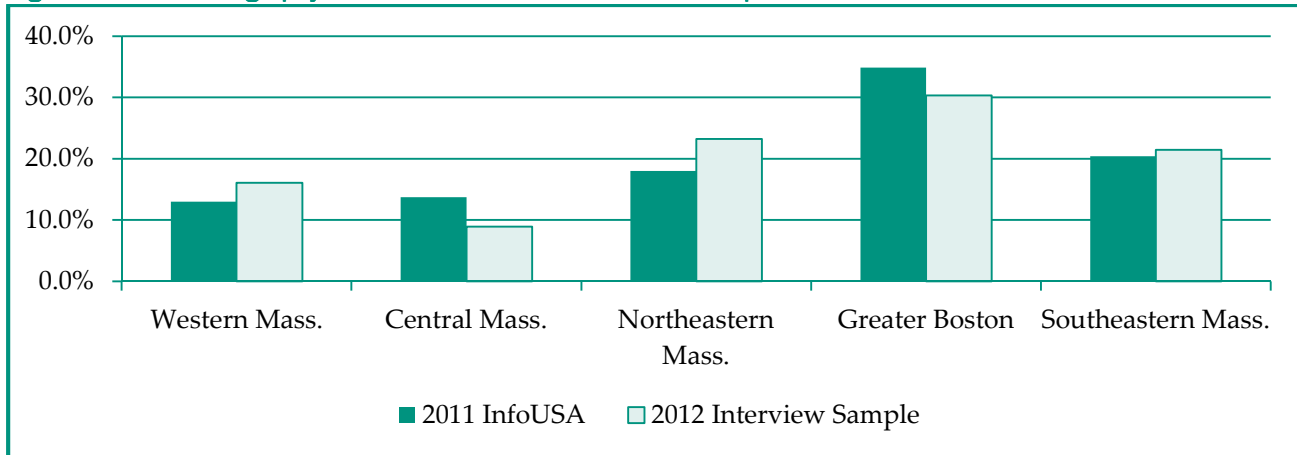


Figure 2.7 Geography: *InfoUSA* Database vs. Interview Sample 2012



Summary

While the survey and interview samples did not precisely match the distribution of the database, both were reasonably representative. Most of the discrepancies in the interview sample’s representativeness can be attributed to discrepancies in the survey sample, since the interview sample was selected from survey respondents. Nearly all of the discrepancies between the survey sample and the database are

consistent with the small discrepancies we observed in the previous report in 2007.

Overall, especially due to the consistent nature of the few discrepancies we find, we have a high degree of confidence that our survey and interview samples are satisfactorily representative of the reality of the full population of manufacturers in Massachusetts.

CHAPTER 3

THE CONTINUING EVOLUTION OF MASSACHUSETTS MANUFACTURING

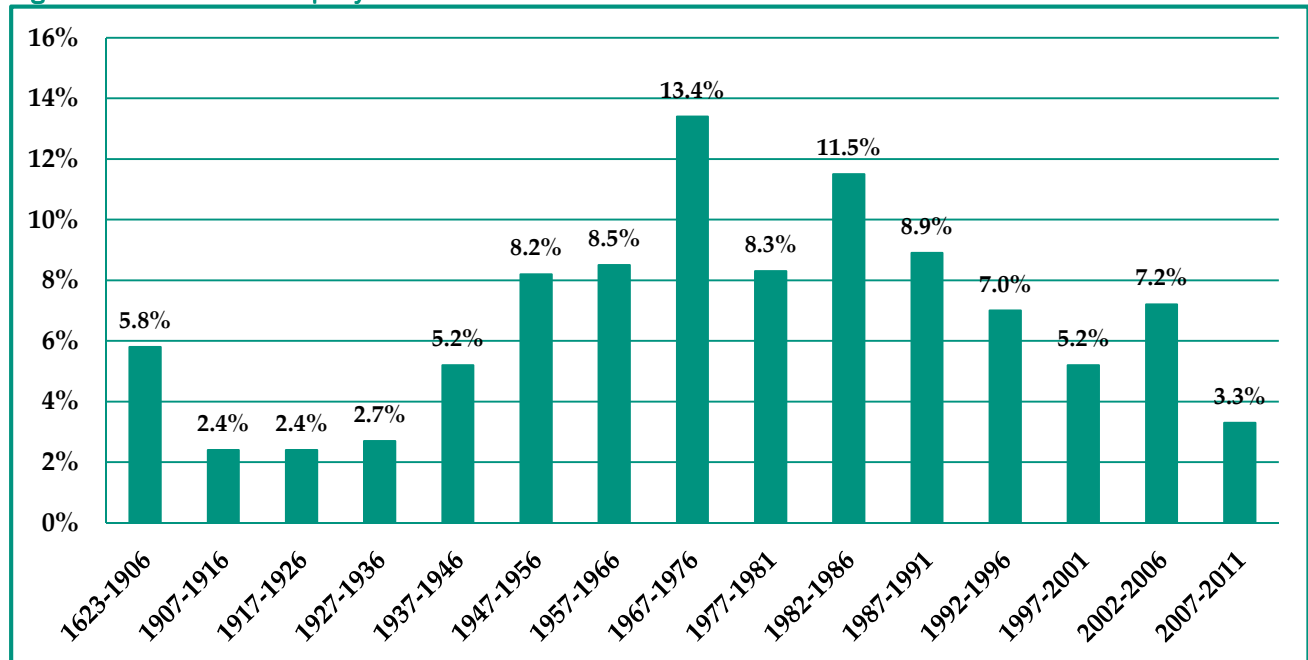
The official statistical data we reviewed in Chapter 1 provided a solid overview of how manufacturing is faring in the Commonwealth today. We have learned a great deal more, however, from the new survey of nearly 700 manufacturers we carried out in the spring of 2012. Drawing on these survey data and information from the *InfoUSA* database, this chapter is devoted to a more fine-grained analysis of how small, medium, and large-sized manufacturers are coping with the exigencies of increasing global competition.

The Age and Size Distribution of Massachusetts' Manufacturing Firms

One would normally surmise that the manufacturing establishments that have survived in the

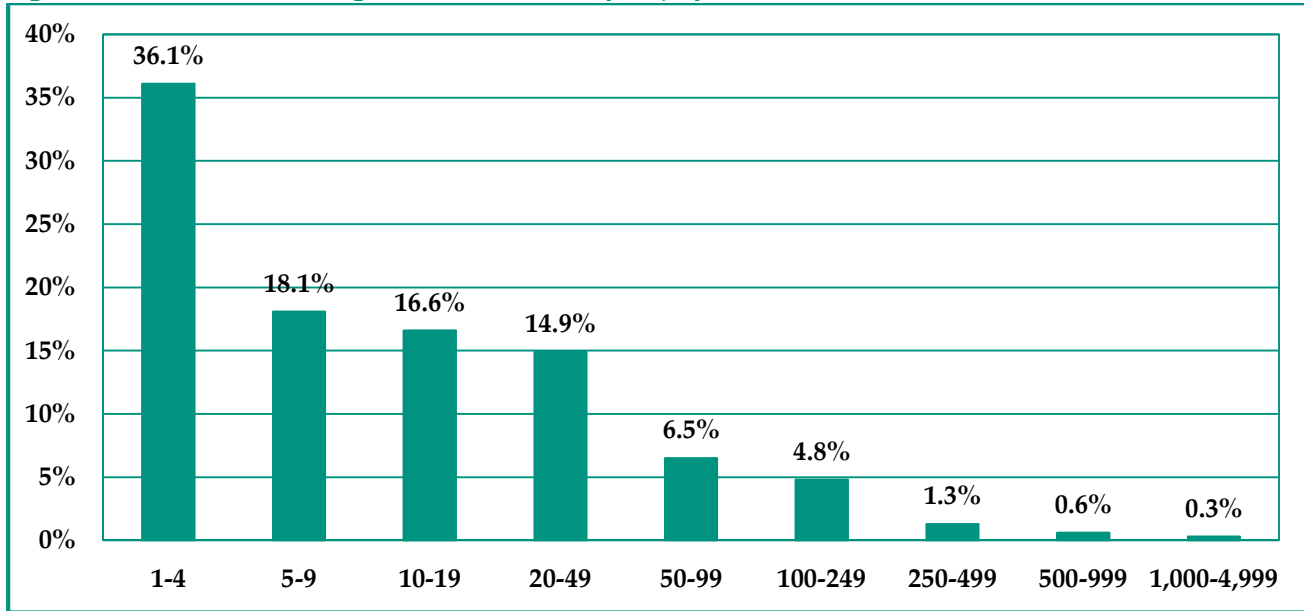
state were founded some time ago. Based on the “births” and “deaths” data we summarized in Chapter 1, this is only half true. Indeed, nearly one in five (18.5%) of Massachusetts' manufacturing firms was established before 1947 and a small number are more than a century old. Nonetheless, a near equal proportion of manufacturing establishments (15.7%) in the state have been around only since 1997 and more than one in ten (10.5%) are no more than ten years old (see **Figure 3.1**). Hence, the state continues to nurture new manufacturing firms as this sector continues to evolve.

Figure 3.1 Year Company Founded



Source: Dukakis Center Manufacturing Survey, 2012

Figure 3.2 Manufacturing Establishment Size by Employment Level, 2011



Source: InfoUSA Database, 2011

A large proportion of the state’s manufacturing firms remain quite small. Nearly 72 percent of the more than 7,500 establishments in the Commonwealth have fewer than 20 employees and only 7 percent have 100 or more, as shown in **Figure 3.2** and **Table 3.1**. Less than one percent of all firms – essentially the 75 largest manufacturers in the Commonwealth with 500 employees or more – employed more than a quarter (27.1%) of the state’s total manufacturing workforce of 250,000.

Table 3.1 Manufacturing Firms by Size of Employment, 2011

Size of Firm (Employees)	Share of Manufacturing Firms	Share of Total Manufacturing Workforce
1-4	36.1%	2.7%
5-19	35.7%	10.3%
20-99	21.4%	25.6%
100-499	6.1%	34.3%
500+	0.9%	27.1%

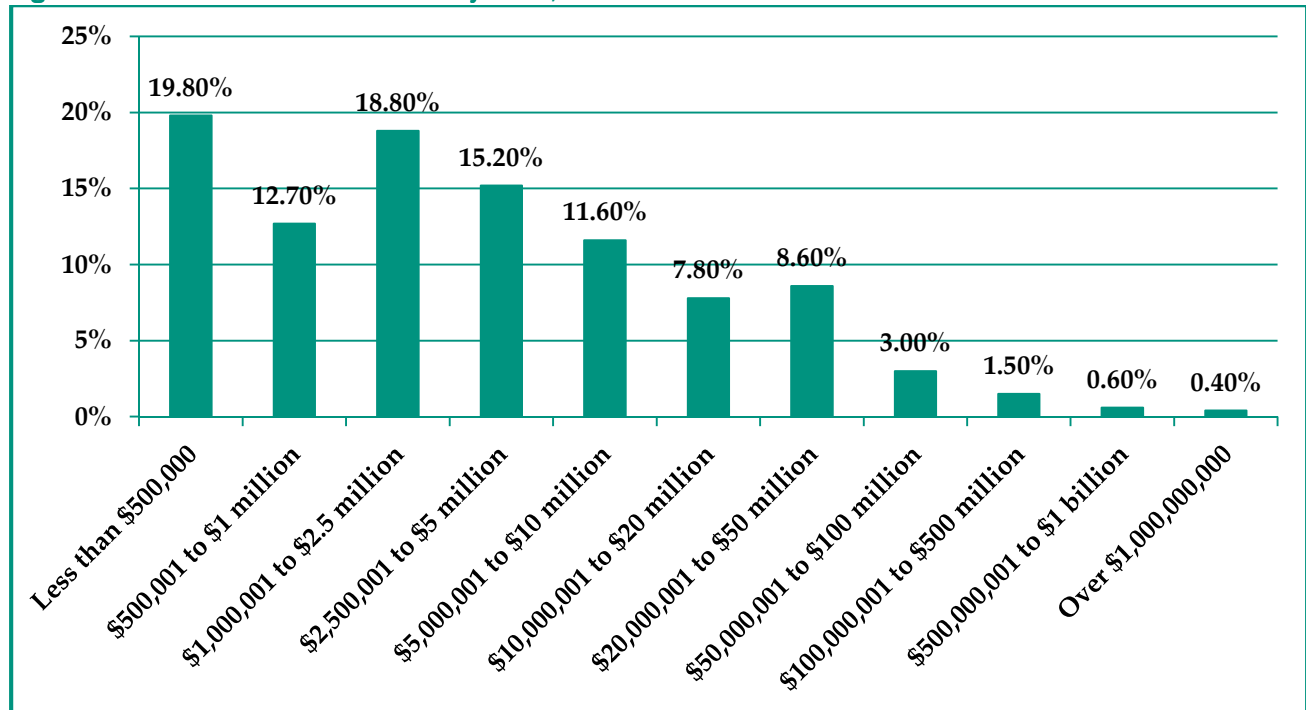
Source: Info USA Database; Dukakis Center Manufacturing Survey, 2011

The smallest firms in the state – those with no more than 4 employees – account for more than

a third of all establishments (36.1%) but employ less than 3 percent of the total workforce. Nearly 60 percent of the workforce is found in establishments with 20 to 499 employees. This distribution differs only slightly from what we found in our 2007 survey.

As we noted in our original *Staying Power* report, there is a strong symbiotic relationship between the large and small firms operating in the state.³⁵ Our personal interviews with CEOs, owner-managers, and other company officials confirmed that many of the smaller firms are key suppliers of parts and assemblies for large firms in the state while larger firms find it profitable to outsource to smaller companies that provide specialized products for them. The size distribution of Massachusetts manufacturers is also reflected in sales revenue figures. According to **Figure 3.3** and **Table 3.2**, nearly a third (32.5%) of all firms in the state report no more than \$1 million in sales revenue annually. Nearly half (45.6%) post sales of between \$1 million and \$10 million a year. Fewer than 6 percent of the 7,500 manufacturers had revenues exceeding \$20 million in 2011.

Figure 3.3 Sales Revenue of Survey Firms, 2011



Source: InfoUSA Database, 2011

The small number of firms with more than \$100 million in annual sales accounted for nearly a third (31.1%) of total manufacturing sales revenue. More than half of all firms (51.3%) – those with no more than \$2.5 million in annual sales – generated a grand total of under 6 percent of total sales volume.

Table 3.2 Distribution of Massachusetts Manufacturing Sales Volume, 2011

Firm Size by Annual Sales Volume	Percent of Total Massachusetts Manufacturing Sales Volume
Under \$2.5 million	5.9%
\$2,501-\$20 million	29.4%
\$20,001-\$100 million	33.7%
\$100 million +	31.1%

Source: Info USA Database, 2011

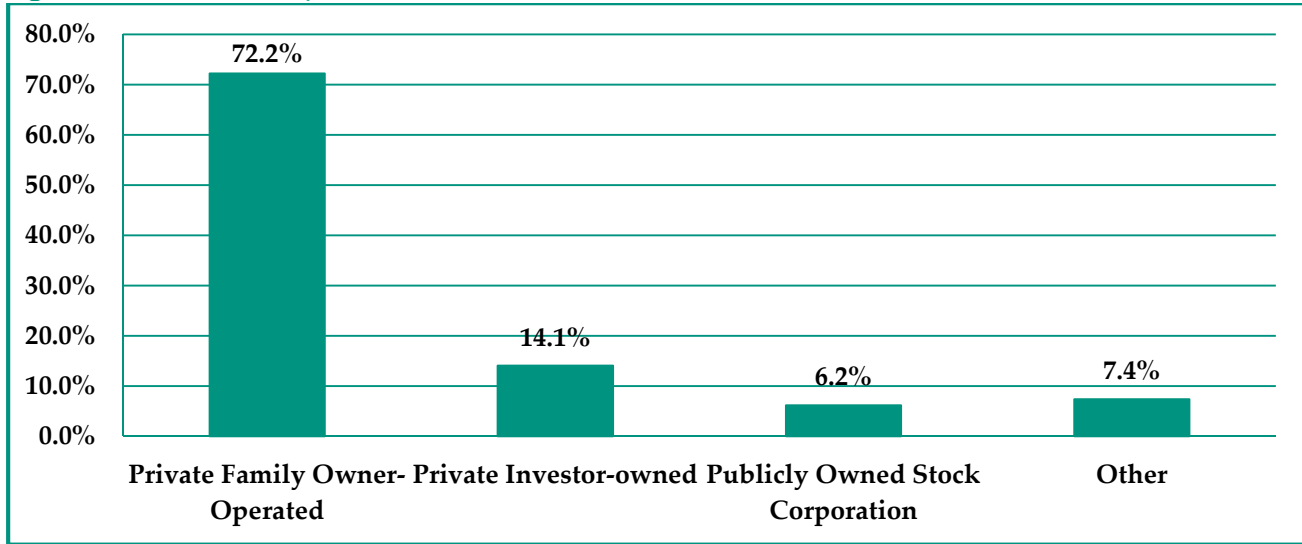
Consistent with the size distribution of firms, more than 70 percent of all the manufacturing firms operating in the state are family-owned enterprises, as shown in **Figure 3.4**. Another 14

percent are owned by private investors, with only 6 percent public-traded corporations. The remainder (7.4%) are employee-owned firms or controlled by venture capital firms.

As **Table 3.3** reveals, ownership varies substantially by size of firm. Less than 2 percent of the smallest firms are publicly-traded while more than 30 percent of the largest firms are stockholder-controlled.

All of this is largely unchanged from the size and ownership structure we found in the 2007 survey data. The one exception seems to be a larger number of family-owned firms with more than 100 employees. Back in 2007, our survey suggested that only 38 percent of such firms were family-owned. In 2012, nearly half (48.7%) of such larger firms were “family businesses.” This may suggest that some of the state’s family-owned manufacturing firms increased their employment over the past five years and were now fairly large operations.

Figure 3.4 Ownership Structure of Massachusetts Manufacturers, 2012



Source: Dukakis Center Manufacturing Survey, 2012

Table 3.3 Ownership by Size of Establishment

Ownership	ALL	1-19	20-100	101+
Private Family Owner-Operated	72.2%	79.3%	69.6%	48.7%
Private Investor-owned	14.1%	11.9%	17.3%	16.7%
Publicly Owned Stock Corporation	6.2%	1.6%	4.7%	30.8%
Other	7.4%	7.2%	8.4%	3.8%

Source: Dukakis Center Manufacturing Survey, 2012

Education of the Manufacturing Workforce

As we noted in our 2008 report, a large proportion of the manufacturing workforce requires no more than a high school degree. The formal education required by these workers has not changed appreciably since then. As **Table 3.4** demonstrates, manufacturing firms in the Commonwealth report that about one in six of their jobs can be performed by someone with less than a high school degree. Half of all jobs (49.7%) require a high school diploma or a GED. That leaves only one-third of the jobs (33.4%) requiring some college, a Bachelor’s de-

gree, or more education, while only one job in five (19.6%) requires a B.A. or more.

Larger firms typically require more education of their workers, perhaps because they are engaged in a broader range of occupations. *But still, even in the largest firms, nearly 60 percent of the workforce requires no more than a high school education.* Hence, as we noted in our earlier report, “manufacturing remains a sector where workers with limited schooling have the opportunity to obtain good jobs at reasonably high pay, often with an array of job benefits.”³⁶

Table 3.4 Percentage of Jobs Requiring a Given Level of Education in Massachusetts Manufacturing

Education Level	All	1-19	20-100	101+
Less than a high school degree	16.8%	16.7%	16.6%	16.0%
High school diploma/GED	49.7%	51.4%	49.5%	43.5%
Some college	13.8%	14.6%	13.1%	11.8%
Bachelor's Degree or more	19.6%	17.2%	20.8%	28.7%

Source: Dukakis Center Manufacturing Survey, 2012

Table 3.5 Average Hourly Wages for Unskilled, Semi-Skilled, and Skilled Production Workers in Massachusetts Manufacturing – 2012

Employee Level	All	1-19	20-100	101+
Skilled	\$25.83	\$27.81	\$24.77	\$23.93
Semiskilled	\$18.37	\$20.10	\$17.45	\$17.41
Unskilled	\$13.95	\$15.66	\$12.56	\$13.63

Source: Dukakis Center Manufacturing Survey 2012

Hourly Wages in Massachusetts Manufacturing

According to our survey results, the average wage for *unskilled* production workers across all Massachusetts manufacturing firms was \$13.95 in early 2012. As such, the typical unskilled worker in this industry now makes considerably more than the state's minimum wage of \$8.00 per hour. *Semi-skilled workers* who operate more sophisticated industrial machinery averaged \$18.37 per hour, while *skilled production workers* are now earning nearly \$26.00 per hour (see **Table 3.5**). Given that many of the least skilled workers have no more than a high school degree – and some have not completed high school at all – these wages are considerably higher than those for similar workers in other industries including food service and retail trade.

What is somewhat peculiar is that small firms pay somewhat higher wages for all three types of labor and particularly for skilled workers. This may reflect a need to pay higher wages in order to retain current workers and attract new

ones who might see greater job security in larger firms.

Table 3.6 compares the average hourly wages for unskilled workers and skilled workers found in our 2007 survey and in the 2012 survey (we did not ask about semiskilled workers in the earlier survey). Adjusting for inflation, *unskilled production workers* earned \$0.44 more per hour in 2012, an increase of just 3.3 percent over the 2007 average real wage rate. Skilled production workers experienced a \$3.78 increase in real wages, an increase of over 17 percent during this five year time span.

The small increase in *unskilled production workers'* real average hourly wage between 2007 and 2012 was not unexpected given the weakness in the overall economy during this period. During the same period, the real average hourly wage of all private sector employees nationwide increased by just 1.1 percent, a third as much as the unskilled manufacturing workers in the Dukakis Center survey. U.S. manufacturing workers gained even less – 0.6 percent over five years.³⁷

Table 3.6 Real Wage Increases for Unskilled and Skilled Production Workers in Massachusetts Manufacturing Firms 2007 - 2012

Employee Level	Real Wages (2012\$)		Difference	% Difference
	2007	2012		
Unskilled Production Workers	\$13.51	\$13.95	\$0.44	3.3%
Skilled Production Workers	\$22.05	\$25.83	\$3.78	17.1%

Source: Dukakis Center Manufacturing Surveys, 2007 and 2012

Real Wages adjusted for U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers 1st Half 2007 (205.7) vs. 1st Half 2012 (228.85) (1982-1984 = 100.0)

That skilled production workers experienced a 17 percent increase in real hourly wages during this period is quite notable. It suggests that even in the face of the worst economic recession in decades, Massachusetts manufacturers found it necessary to boost wages for these workers in order to retain or attract them. Standard economics tells us that this could only be the case if the supply of such workers continued to lag behind demand.

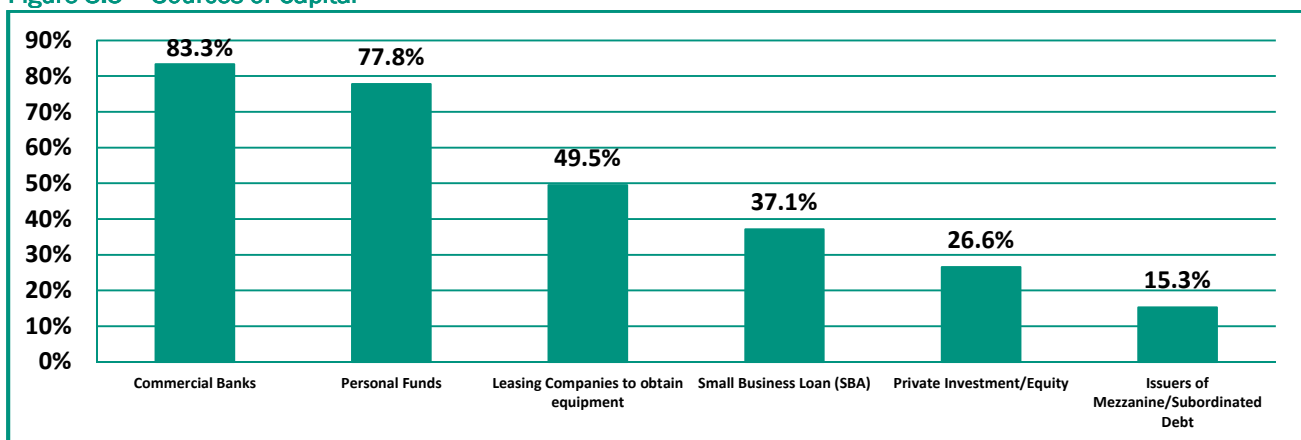
Sources and Uses of Capital

Acquiring and retaining skilled labor to build their products is one of the key management tasks faced by Massachusetts manufacturers in their quest to remain competitive in the global economy. An equally important task is acquiring the financial capital they need to pay for their physical plant and equipment.

Figure 3.5 provides information on the various sources of funds that have been used by Massa-

chusetts manufacturers to underwrite their operations. Across all manufacturing firms, five out of six (83%) have used commercial banks to provide at least a portion of the capital they needed for their operations. More than three out of four (78%) used some personal funds. Nearly half (49.5%) leased rather than bought their equipment, essentially borrowing from the leasing agent. More than a third (37%) have used Small Business Administration (SBA) loans while a little more than a quarter (27%) have relied on funds from private investment or private equity firms. A small proportion of firms (15%) have resorted to the use of mezzanine or subordinated debt. Mezzanine financing is normally repaid only after all other debt obligations have been satisfied. For this added risk, issuers of such debt instruments normally require a higher return on their investments and therefore this represents a more expensive form of capital finance for manufacturers.

Figure 3.5 Sources of Capital



Source: Dukakis Center Manufacturing Survey, 2012

Table 3.7 Sources of Capital by Size of Firm

Source	All	1-19	20-100	101+
Commercial Banks	83.3%	76.5%	93.3%	86.8%
Personal Funds	77.8%	84.6%	74.6%	48.5%
Leasing Companies to obtain equipment	49.5%	42.4%	58.3%	56.7%
Small Business Loan (SBA)	37.1%	34.7%	39.2%	41.2%
Private Investment/Equity	26.6%	22.6%	26.4%	42.4%
Issuers of Mezzanine/Subordinated Debt	15.3%	9.5%	17.2%	34.8%

Source: Dukakis Center Manufacturing Survey, 2012

As **Table 3.7** demonstrates, there is a substantial difference in the form of capital used by firms of varying size. Nearly 85 percent of the smallest firms have relied on personal funds to finance at least a share of their operations. Less than half (48.5%) of the largest firms with more than 100 employees have relied on such financing. These large firms are much more likely to rely on private investment or private equity funds. According to the survey results, more than 42 percent of large firms have used this form of capital to finance their operations while only about one in four (23%) smaller firms have been able to or have tried to avail themselves of such equity investment.

The largest firms are nearly four times as likely to have used mezzanine capital as firms with fewer than 20 employees and twice as likely as firms with 20-100 employees. What might be surprising is that the larger the firm, the *more* likely they will have used one or more loans from the U.S. Small Business Administration. Larger firms may have greater capacity to ap-

ply for and process such loan applications or it may be the case that larger firms were able to grow to their present size by reason of having the business acumen to better take advantage of these loan opportunities when they were smaller enterprises.

When we surveyed firms as to what they considered to be the most important sources of capital for their operations, we found that regardless of size, commercial banks remain the single most critical source (see **Table 3.8**). On a scale that ranged from “not important” to “extremely important”, 60 percent of all firms named commercial banks as a “very important” or “extremely important” form of capital finance. However, only half (50.7%) of the smallest firms rely on commercial banks as the most important source of their capital. A slightly larger share of these firms noted personal funds served this purpose. Middle-sized and larger firms reported that commercial banks were their most important source of capital,

Table 3.8 “Very Important” or “Extremely Important” Sources of Capital

Source	All	1-19	20-100	101+
Commercial Banks	59.7%	50.7%	73.1%	63.3%
Personal Funds	46.6%	55.2%	42.0%	15.9%
Leasing Companies to obtain equipment	17.7%	19.2%	18.6%	10.5%
Small Business Loan (SBA)	12.3%	14.7%	13.0%	0.0%
Private Investment/Equity	10.1%	7.7%	9.6%	18.2%
Issuers of Mezzanine/Subordinated Debt	3.6%	2.7%	3.0%	7.5%

Source: Dukakis Center Manufacturing Survey, 2012

with only 16 percent of the largest firms and 42 percent of the firms with 20-100 employees noting personal finance as a very important source of capital, if not extremely important.

Note that while the largest firms were most likely to have availed themselves of SBA loans at some point, none of them reported these funds to have been an important source of their overall financing. In contrast, nearly 15 percent of the smallest firms and 13 percent of middle-sized firms considered government-sponsored small business loans to be very important or extremely important to their operations.

When asked about financing their *current operations*, one-third (33%) of manufacturing firms reported that they rely exclusively on internal funds and currently are not borrowing from any source. It turns out that this is not only true for the smallest firms, but for larger ones as well. More than three out of ten (31%) firms with 20-100 employees report no use of external funds. The same is true of 28 percent of firms with more than 100 employees.

That leaves two-thirds (66%) of all firms that are borrowing funds from external sources to finance their current operations. Table 3.9 provides information on how they are using these funds.

By far the largest numbers of firms are using borrowed funds to purchase or lease new man-

ufacturing equipment or software and for working capital to meet week-to-week expenses. More than two-thirds of all firms use their current external funding for these purposes and there is little variance by firm size.

With interest rates at nearly the lowest level in history, a quarter of all firms are borrowing in order to retire past debt, presumably much of which carried a higher interest rate. A nearly equal percentage are using these funds to buy or expand their manufacturing real estate while one in six have borrowed to conduct research and development operations. Between 13 and 14 percent are using borrowed funds to acquire another company or to expand their global sales capacity.

These latter uses vary significantly by size of firm. Nearly 47 percent of the largest firms are using borrowed funds to buy manufacturing real estate, about double the proportion of smaller firms (24%). About 30 percent of the largest firms are using these investment dollars to carry out R&D, again about double the rate of the smallest firms (17%). Similar differences are found when it comes to using borrowed funds for company acquisition and foreign expansion.

Clearly, external funding has been critical to the successful operations of Massachusetts manufacturers and will almost inevitably continue to be so.

Table 3.9 Uses of Borrowed Funds

Use	All	1-19	20-100	101+
Purchase or lease new manufacturing equipment or software	70.2%	64.7%	80.6%	69.4%
Working Capital	66.5%	63.9%	67.6%	72.3%
Retire past debt	25.4%	24.9%	17.6%	40.1%
Expand manufacturing real estate	24.1%	15.8%	29.3%	46.8%
Conduct research and development	16.8%	13.8%	16.8%	30.4%
Acquire another company	13.9%	9.6%	14.8%	31.9%
Expand global sales capacity	12.7%	6.4%	16.6%	28.9%

Source: Dukakis Center Manufacturing Survey, 2012

What our Interviews told us about the Sources and Uses of Capital

As a small chemical and coatings company told us in one of the fifty-six interviews we carried out in the course of this research, "All of our recent investments were funded internally. We have access to a credit line and the last time it was used was in 2004." The same was true for a mid-sized food manufacturer in Lowell who explained, "We are pretty much self-financed and we lease the equipment when we need to grow."

Other interviews provided a glimpse at how small businesses in particular have forged strong ties with local banks to secure funds beyond what they could muster from internal sources. A small metal forging company on the north shore explained, "We have excellent credit. We do business with a very conservative local bank and they don't make it easy, but we get the capital we need." A mid-sized medical device testing company in metro west had a similar story, telling us that they were a thirty-five year old company with a reliable bank that was willing to work with them to fill a number of financial needs. Still another small wholesale food manufacturer in western Massachusetts reported, "We have established a credit line with our bank over the past five years and this has helped us a lot. The credit line helps our cash flow and has made it possible for us to make some capital improvements."

While our survey documents the value of commercial banks to manufacturers, our interviews discovered an additional significant insight. Local and regional commercial banks are perceived to be more responsive and, therefore, more valuable to several of our interviewees. In particular, a large aerospace and automotive industries supplier in the South Coast described, with considerable passion, his frustrations with being stymied by a very large national bank to continue receiving working capital to maintain operations. When the national bank finally refused additional lending, this manufacturer faced shut-down until the SBA connected them with a regional commercial bank willing to lend operating funds. The CEO of this company said that receiving these funds meant "everything" for its continued operations.

Refinancing debt has not posed a problem for a number of firms we interviewed. A small plastics manufacturer in central Massachusetts noted, "We have no issues financially. We have been able to refinance our debt with our bank which has also extended us a line of credit." This same firm managers anticipated that they would need capital for a new, larger facility in the future.

For this, they hoped to obtain an SBA loan. Other firms have already taken advantage of such financing. As one small plastics assembly plant told us, "We are now working with a small local bank here in Worcester. We have an excellent working relationship with them, although many years ago we did get a loan through the Small Business Administration. We have had no other government support in gaining access to capital since then."

Larger firms have sometimes been able to obtain financing from their parent companies. This was true of a large industrial products manufacturer in Springfield who noted, "Our investments are funded by our parent company. We do not have a problem getting access to capital".

The state has played a role as well. As one mid-sized plastics and rubber company in Western Massachusetts put it, "Because our business was growing in 2008 we put on a huge addition to the building. The state helped with the financing. We were able to use industrial revenue bonds for the expansion as well as for new equipment. Today we have no problem securing the capital that we need and in fact we have just bought a lot of new equipment. This financing and investment has allowed us to grow our business recently. We anticipate needing more capital in the future."

Other companies have been able to tap venture capital funds. According to a mid-sized electronics firm in metro west founded some eight years ago, "Most of our funding including our funding for innovation has come from the VCs. We have also gotten low interest loans from the state through MassDevelopment and we have taken advantage of the state's research and development tax credit. Our problem now is getting sufficient capital to scale the products we have already developed. Our specialty in manufacturing is rapid prototyping of inventions and innovations. But we lack the funding to take our prototypes to the next level." To help them deal with this problem, the management of this company told us, "It would be helpful if the state could somehow make capital easier and cheaper to get. It might be better if the state made lots of smaller bets on small companies like ours rather than place the large bets that often don't play out."

The Growing Geographic Dispersion of Suppliers, Customers, and Competitors

In our 2007 survey, we asked manufacturers to tell us about where their suppliers, customers, and competitors were located.

Suppliers - Back in 2007, 43 percent of all surveyed firms reported that their primary suppliers were located in Massachusetts with 49 percent reporting other U.S. states. Only 9 percent reported that their primary suppliers were foreign firms. This varied somewhat by size of firm, with larger firms somewhat more likely to source from other states and foreign firms.

Customers -In 2007, 45 percent of all firms reported that their primary customers were either located in their own region within Massachusetts or somewhere else in the state. An equal proportion (45%) reported their primary customers were located outside of Massachusetts, but within the U.S. The remaining 10 percent noted their primary customers were in foreign countries. Once again, this varied by size of firm, with two-thirds of the largest companies reporting their primary customers to be somewhere else in the U.S., and 21 percent reporting

foreign buyers as their major customers.

Among the smallest companies, only a little more than third (36%) sold to primary customers out of state and only 7 percent to foreign buyers.

Competitors - A reasonably similar picture was found when it came to primary competitors across all firms. Thirty-nine percent reported their major competitors were in-state with another third (33%) noting their key competitors were in other U.S. states. Only 15 percent reported that their primary competition came from abroad. Larger firms were much more likely to be competing in national and international markets. Fifty-six percent of these firms were competing with firms located in other states; 27 percent were competing with foreign enterprises.

As it turns out, the economic environment for manufacturing is expected to change over the next five years, in some ways dramatically. In 2012, we asked "How likely is it that the market for your company's products will change over the next five years?" What we found is reported in **Table 3.10**.

Table 3.10 Likelihood of Changes in Primary Suppliers, Customers, and Competitors

	Field	Not Likely	Somewhat Likely	Fairly Likely	Very Likely	Extremely Likely	Very + Extremely Likely
Suppliers	More MA Suppliers	39.7%	30.4%	18.4%	8.2%	3.3%	11.5%
	More US Suppliers	20.8%	29.4%	26.3%	18.2%	5.3%	23.5%
	More Global Suppliers	46.3%	20.9%	15.9%	10.5%	6.4%	16.9%
Customers	More MA Customers	30.0%	27.9%	19.8%	14.1%	8.2%	22.3%
	More US Customers	15.0%	22.9%	25.7%	23.3%	13.1%	36.4%
	More Global Customers	42.1%	16.3%	13.8%	14.4%	13.4%	27.8%
Competitors	More MA Competitors	50.0%	24.0%	16.8%	5.8%	3.4%	9.2%
	More US Competitors	23.2%	28.3%	27.8%	14.1%	6.6%	20.7%
	More Global Competitors	28.5%	15.6%	18.8%	18.8%	18.4%	37.2%

Source: Dukakis Center Manufacturing Survey, 2012

Suppliers - Nearly 40 percent of firms reported that they did *not* expect to increase the number of Massachusetts suppliers they use to purchase inputs. About 21 percent expected no increase in U.S. suppliers. Nearly half (46%) said they do not expect to increase the number of their global suppliers. However, a not insignificant number reported just the opposite. Nearly one in eight (12%) believe that it is very likely or extremely likely that they will add to the number of Massachusetts suppliers they use; nearly a quarter (24%) expect a very high likelihood of using more suppliers from other U.S. states; and more than one in six (17%) fully expect to be using more foreign suppliers within the next five years.

The expected geographic dispersion of the supplier chain does vary somewhat with size of firm as shown in **Table 3.11**. Nearly 37 percent of the largest firms expect to use more foreign suppliers over the next five years compared with 20% of medium-sized firms, and only 11% of the smallest firms. Similarly, larger firms are more likely to expect to use more national sourcing in the years to come.

Customers - Massachusetts manufacturers have even greater expectations about the ability to

sell in national and international markets. While 22 percent believe it is very likely or extremely likely that they will increase their number of Massachusetts customers, more than 36 percent report they have such expectations regarding their ability to attract nationwide clients and 28 percent have high expectations of selling more abroad.

While expectations about Massachusetts sales do not vary significantly by firm size, expectations about increasing their number of national and international customers are extremely strong among the largest firms and fairly strong among medium-sized firms. More than *half* of those firms with more than 100 employees believe it is very likely or extremely likely that they will have both more U.S. customers (53%) and more global customers (52%). Among medium-sized firms, the respective proportions are 48 percent and 35 percent. Even a quarter (25%) of the smallest firms expect to increase their national customer base and a sixth (17%) expect it will be very likely or extremely likely that they will expand their foreign customer base.

Table 3.11 Expectations of “Very Likely” and “Extremely Likely” Changes in Suppliers, Customers, and Competitors by Size of Firm

	Very + Extremely Likely	All	1-19	20-100	101+
Suppliers	More MA Suppliers	11.5%	11.1%	11.5%	11.6%
	More US Suppliers	23.5%	20.1%	25.8%	28.2%
	More Global Suppliers	16.9%	10.6%	20.2%	36.9%
Customers	More MA Customers	22.3%	21.3%	24.0%	24.3%
	More US Customers	36.4%	25.0%	48.1%	53.3%
	More Global Customers	27.8%	16.8%	35.3%	52.0%
Competitors	More MA Competitors	9.2%	10.6%	5.7%	8.9%
	More US Competitors	20.7%	19.8%	19.5%	24.4%
	More Global Competitors	37.2%	29.3%	39.5%	61.1%

Source: Dukakis Center Manufacturing Survey, 2012

Competitors - At the same time that manufacturers expect to have a more diverse supplier chain and customer base, they also fully expect to have to meet greater national and international competition. While only 9 percent of all firms have very high or extremely high expectations about more in-state competition, more than one-fifth (21%) expect to face stiffer national competition and 37 percent expect a very high likelihood of having to contend with greater foreign competition. More than 61 percent of the largest firms have high expectations of having to compete with global firms in their industry. The same is true of 40 percent of medium-size firms and even close to 30 percent of the smallest firms.

Expectations about additional national competition are not anywhere near as much of a concern as international competition. Only 24 percent of the largest firms expect an increase in this domain and only 20 percent of medium and small-sized firms. The world is indeed becoming “flat” in the words of Thomas Friedman and Massachusetts manufacturers are fully aware of this.³⁸

Expectations about Customer Demands and the Use of Technology and Labor

Finally, we asked about other changes manufacturers expect over the next five years in terms of customer demands, the technologies they employ, and in the deployment of their workforce. **Table 3.12** provides a summary of their responses.

The #1 change expected by Massachusetts manufacturing firms over the next five years is an increased demand by customers for lower prices. Across all firms, nearly 46 percent responded that to a “large extent” or a “great extent” their customers would be coming back to them asking for lower prices in order to retain their business. Only about 10 percent did not see this as likely.

Firms also believe that customers will not only demand lower prices, but improved service delivery and better product quality. Only one in eight did *not* expect greater pressure on service and quality, while 40 percent of firms felt that there would be a substantially increased demand for better service, and 36 percent suggested a very strong demand for quality.

About a quarter of all firms (27%) expected even greater pressure to increase the use of new

technology and 24 percent expected this would lead to increases in productivity.

On the other hand, there is little expectation of major changes in the use of labor, offshoring, and outsourcing:

- Fewer than 6 percent of all firms expected a major substitution of less skilled labor for skilled labor. There seems to be little expectation of job “de-skilling”.
- Likewise, there is little expectation (6%) of the reverse – the “up-skilling” of jobs from less skilled to more skilled.
- Presumably because of the ability of new technology to increase product demand as it increases productivity, fewer than 5 percent of manufacturing firms in the Commonwealth believe strongly that new technology will de-

stroy jobs. More than 85 percent believe there will be no net adverse employment consequences at all from new technology or, at worst, only a small one.

- Some firms (10%) are worried about possible shortages of critical materials in the years ahead as the demand for these goods increases around the world.
- Very few firms (3.5%) believe there will be a major thrust to increase the offshoring of their production to foreign countries. More than 90 percent see little or no additional offshoring in the foreseeable future.
- Even fewer firms (2.9%) see much outsourcing of their internal operations to other Massachusetts firms or firms in other states. More than 90 percent believe this will not occur at all or, if it does, its extent will be quite limited.

Table 3.12 Expectations about Customer Demands, Technology, and Workforce Deployment

Expectation	Not at All	To Some Extent	To a Fair Extent	To a Large Extent	To a Great Extent	Large or Great Extent
Increased customer demand for lower prices	10.7%	21.6%	22.1%	23.6%	22.1%	45.7%
Increased customer demand for improved service delivery	12.7%	21.5%	25.5%	25.2%	15.2%	40.4%
Increased customer demand for better product quality	12.5%	25.3%	26.8%	22.9%	12.6%	35.5%
Substantial increase in the use of new technology	11.7%	32.6%	29.0%	18.2%	8.6%	26.8%
Substantial increase in productivity due to improved technology	13.9%	33.9%	28.0%	17.6%	6.6%	24.2%
Shortage of critical materials	38.2%	34.6%	17.2%	6.7%	3.1%	9.8%
Substitution of less skilled labor for skilled labor	58.4%	21.1%	11.6%	4.7%	1.2%	5.9%
Substitution of skilled labor for less skilled labor	60.9%	24.0%	9.4%	4.3%	1.4%	5.7%

Expectation	Not at All	To Some Extent	To a Fair Extent	To a Large Extent	To a Great Extent	Large or Great Extent
Reduction of employment due to improved technology	58.4%	27.3%	9.6%	2.7%	2.0%	4.7%
Increased off-shoring of internal operations	84.1%	8.5%	3.9%	2.4%	1.1%	3.5%
Increased outsourcing of previous internal operations to other MA firms	68.5%	22.8%	5.9%	2.7%	0.2%	2.9%
Increased outsourcing of previous internal operations to firms in other states	70.8%	20.1%	6.9%	1.6%	0.6%	2.2%

Source: Dukakis Center Manufacturing Survey, 2012

While there is general agreement in terms of expectations about the future, there are some important differences related to firm size as **Table 3.13** demonstrates. Increased customer demand for lower prices dominates all other expected changes, but the larger the firm, the more this is seen as a likely event. More than 70 percent of Massachusetts largest manufacturers expect lower prices to be a key demand to a large or great extent. In contrast, only

about 38 percent of smaller manufacturers viewed the demand for lower prices in the same way. Similar results were found for expectations about the future demand for service delivery and for better product quality. Larger firms were nearly twice as likely as the smallest firms to see the demand for improved service delivery as highly likely and nearly three times more likely to expect an increased demand for better product quality.

Table 3.13 “Large Extent” or “Great Extent” Expectations about Customer Demands, Technology, and Workforce Deployment by Firm Size

Large or Great Extent	1-19	20-100	101+
Increased customer demand for lower prices	38.3%	48.3%	70.5%
Increased customer demand for improved service delivery	34.2%	44.0%	59.0%
Increased customer demand for better product quality	26.2%	40.6%	61.5%
Substantial increase in the use of new technology	21.1%	26.0%	51.3%
Substantial increase in productivity due to improved technology	19.1%	26.3%	42.3%
Shift from local markets to national markets	15.5%	23.8%	28.2%
Shift from national markets to global markets	14.8%	25.7%	42.3%
Shortage of critical materials	8.6%	9.7%	12.9%
Substitution of skilled labor for less skilled labor	5.6%	5.6%	3.8%
Substitution of less skilled labor for skilled labor	4.2%	6.1%	12.8%
Reduction of employment due to improved technology	2.9%	6.6%	6.4%
Increased off-shoring of internal operations	2.6%	4.2%	5.2%
Increased outsourcing of previous internal operations to other MA firms	2.3%	3.3%	1.3%
Increased outsourcing of previous internal operations to firms in other states	1.9%	1.8%	3.9%

Source: Dukakis Center Manufacturing Survey, 2012

This may reflect the fact that larger firms are substantially more likely to be in national and global markets and may therefore face stiffer competition when it comes to their products.

Larger firms also appear to be more cognizant of expected changes in the use of new technology and its impact on productivity, on an expected shift from local markets to national markets, and from national markets to global ones.

On other factors, the differences are small. Regardless of firm size, few expect a reduction in employment due to improved technology, increased off-shoring of internal operations, or increased outsourcing of previous internal operations.

Conclusion

For the most part, then, these results point to an industry that is poised to expand its customer base, broaden its supply chain, and increasingly compete in national and global markets. It will have to pay even more attention to price, quali-

ty, and service delivery, and will have to boost the use of advanced technologies in order to maintain rapid productivity growth in order to remain competitive. However, the overwhelming majority of firms do not expect to meet these challenges through major changes in their employment patterns, by off-shoring more of their operations, or by outsourcing more of their internal production to other companies in Massachusetts or elsewhere.

If these expectations are met, there will be a great deal of employment opportunity in Massachusetts manufacturing for years to come despite what appears to be an inevitable growth in national and global competition for the products they produce. By using advanced technology and employing a highly skilled workforce, the vast majority of the Commonwealth's manufacturers appear ready to compete successfully for their share of regional, national, and international business.

CHAPTER 4

MANUFACTURING'S SURVIVAL IN MASSACHUSETTS

As we have seen, manufacturers in Massachusetts are generally optimistic about their future. But as we first found in our 2008 report, and now in the surveys and interviews carried out in 2012, manufacturers have major concerns about the cost of doing business in the state. As we will see in Chapter 6, the Commonwealth has begun to attend to a number of these concerns, but many are difficult to rectify and progress will take time.

In our 2012 survey, we asked firms to rank a series of factors that can inhibit or aid overall production and operations and then to indicate whether that specific factor might be a reason to “stay” or “leave” the Commonwealth. From these questions, we were able to discern which factors are most important in keeping manufacturing operations in the state and which could ultimately induce manufacturers to move their operations elsewhere.

What Keeps Manufacturers in Massachusetts?

Table 4.1 provides the rankings for what manufacturers report are the most important reasons for maintaining their operations in the Commonwealth. The results are extraordinarily similar to the responses back in 2007. At the very top of the list is the **strong work ethic** of the Massachusetts workforce. More than half (55%) of all firms indicated this was a “very important” or “extremely important” reason they were keeping their production facilities in state. (In 2007, this factor ranked #1 as well, with 52 percent responding very important or extremely important.)

The next most important factor was simply **inertia**. Forty-four percent of firms reported that

this was a critical reason for staying in Massachusetts. This should not be surprising for a company to move, it has to tie up many loose ends. It has to find property in another state with the capacity to continue the same level of production and it must obtain various permits and licenses needed to manufacture in that jurisdiction. Most important, it has to relocate its current employees to the new location or lay them off and hire and train a new workforce. This laundry list of obstacles can be too much for many firms, particularly smaller ones, and so they opt to remain where they are and try to improve their operations in other ways.

The **current availability of appropriately skilled labor** turns out to be nearly as important as inertia in keeping manufacturing enterprises in the Commonwealth. Not only do firms generally praise the work ethic of their current workers, but extol their skills as well. Encouragingly, nearly the same fraction (43%) of firms believe that they will be able to maintain their enterprises in Massachusetts in the years to come because they will be able to find appropriately skilled workers here in the Commonwealth when they need to replace their current ones. To produce new, innovative products in the future with a high degree of efficiency, manufacturers need to know that they will have continued access to a supply of highly skilled workers.

There may be concern over the ability of vocational/ technical schools and community colleges to churn out enough such workers, but apparently firms believe it will be even harder to find such good workers in other locations.

Table 4.1 Reasons for “Staying” in Massachusetts

Reason	Not Relevant	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very or Extremely Important
Work Ethic of workforce	5.3%	2.4%	12.4%	25.0%	33.2%	21.8%	55.0%
Inertia (too hard to relocate)	11.1%	5.9%	19.4%	19.7%	22.4%	21.6%	44.0%
Future availability of appropriately skilled labor	4.8%	5.4%	23.8%	22.9%	30.7%	12.5%	43.2%
Current availability of appropriately skilled labor	4.7%	7.2%	23.8%	21.9%	29.4%	13.0%	42.4%
Current proximity to customers	11.4%	13.7%	17.3%	15.6%	22.8%	19.2%	42.0%
Future proximity to customers	14.5%	15.6%	19.1%	13.4%	20.2%	17.2%	37.4%
Quality of life (e.g. public schools, recreation, and cultural institutions)	10.9%	6.5%	20.1%	29.2%	24.2%	9.1%	33.3%
Access to transportation for shipping/commuting	10.9%	11.8%	19.9%	25.5%	19.9%	11.8%	31.7%
Monetary or in-kind incentives from state or local governments	11.7%	7.9%	22.1%	27.5%	16.7%	14.2%	30.9%
Opportunity for physical expansion	11.7%	16.4%	27.8%	16.0%	19.9%	8.2%	28.1%
Availability of reasonably priced land for expansion	24.8%	11.7%	17.0%	18.7%	18.3%	9.6%	27.9%
Current proximity to key suppliers	9.4%	10.8%	26.3%	28.6%	15.8%	9.1%	24.9%
Future proximity to key suppliers	10.7%	11.5%	26.7%	27.0%	14.8%	9.3%	24.1%
Strategic partnerships with community colleges and vocational education programs	18.3%	17.6%	26.2%	21.1%	8.6%	8.2%	16.8%
Proximity to universities and colleges	21.5%	23.2%	27.2%	15.6%	8.3%	4.3%	12.6%
Massachusetts weather and climate	17.1%	28.0%	21.1%	22.0%	8.1%	3.7%	11.8%
Critical mass of similar firms in region	29.0%	21.0%	22.6%	16.1%	6.9%	4.4%	11.3%
Proximity to European markets	39.2%	25.3%	19.8%	13.1%	1.3%	1.3%	2.6%

Source: Dukakis Center Manufacturing Survey, 2012

A similar story holds for customers. A company's **current proximity to its customers** makes it possible for the company to provide high quality, prompt service delivery. More than four out of ten (42%) firms count this as a very important or extremely important reason for keeping their production facilities in Massachusetts, since proximity is critical to retaining the customers they now have. Staying close to their customers in the future will be important to maintaining demand for their products.

In order to ensure a stable workforce, a firm needs to be established in an area where its employees can live in a community that offers a **high quality of life, abundant cultural and recreational activities, and good schools**. Massachusetts is known for all three and a full third (33%) of manufacturers in our survey acknowledged that this was one of the most important reasons to keep their facilities in the Commonwealth.

Massachusetts' convenient location on the east coast, well-served by seaports, airports, and interstate continues to make the Commonwealth a good location for manufacturers. Maintaining and improving this infrastructure will be important to the future viability of many of the state's manufacturing firms. As such, it was also reassuring that access to **transportation and shipping**, as well as commuting, was mentioned by more than three out of ten firms (32%) as being a critically important reason for remaining in the Commonwealth.

There are a range of additional factors that at least some firms count as very important or extremely important reasons for staying in Massachusetts. These include the opportunity for physical expansion of their manufacturing activities (28%), the availability of reasonably priced land for expansion (28%), and current and future proximity to suppliers (25% and

24%, respectively). In addition, one in six (17%) firms counted strategic partnerships with community colleges and vocational schools as critical to their Massachusetts location decision.

Interestingly, at the bottom of the list were proximity to universities and 4-year colleges, the region's climate, the existence of a critical mass or cluster of similar firms in the region, and proximity to European markets. These factors may be important for other Massachusetts industries (e.g. life sciences, tourism, and software design), but they are decidedly less important to most of the state's manufacturing firms. Close to 45 percent of the firms surveyed reported that proximity to universities and 4-year colleges was either irrelevant or not important at all when it came to their location decision. Despite all of the discussion of "industrial clusters", half (50%) of all firms found these no more relevant or important to their siting decision than proximity to universities and 4-year colleges.

For most manufacturers, workforce ethic, inertia, the availability of appropriately skilled labor, and close proximity to customers trump all of these other factors by far.

There is some variance in the most critical "staying" factors related to firm size as shown in **Table 4.2**. The work ethic of the Massachusetts workforce is at or near the top of the list for *all firms* regardless of size. Inertia, on the other hand is ranked # 3 for the smallest firms, # 4 for the largest, and #5 for medium-sized firms. Proximity to customers is ranked #2 for the smallest firms, but does not rank among the top six factors for medium-sized firms and ranked only #5 for the largest. This is consistent with earlier results that indicated that smaller firms were much more likely to be active in the local market than involved in national or international trade.

Table 4.2 Ranking of Reasons for “Staying” in Massachusetts by Firm Size

Reason	1-19	20-100	101+
Work Ethic	1	1	2
Current Proximity to Customers	2		5
Inertia	3	5	4
Future Proximity to Customers	4		6
Future Availability of Appropriately Skilled Labor	5	3	1
Current Availability of Appropriately Skilled Labor	6	2	3
Availability of Reasonably priced land		4	
Access to Transportation		6	

Source: Dukakis Center Manufacturing Survey, 2012

What Might Prompt Massachusetts Manufacturers to Leave?

All of these factors play a role in keeping manufacturers in Massachusetts. But in the course of our interviews in 2007 (and again in 2012), many manufacturers complained that they face a good deal of resistance from local municipal governments and the federal government when trying to operate their enterprises, and they often mentioned a litany of reasons why doing business in the Commonwealth continues to be an expensive proposition. As such, we probed in this year’s survey for the most important reasons manufacturers might consider moving from Massachusetts to other locations. **Table 4.3** provides these results.

At the very top of the list is the cost of health insurance. More than five out of six firms (84%) responded that paying for this employee benefit was a “very important” or “extremely important” reason why they might at some time consider leaving Massachusetts. Fewer than 2 percent reported this was an irrelevant consideration or not important.

Right behind health care costs are the **cost of workers’ compensation, taxes and fees**, the **cost of unemployment insurance**, and **energy costs**. For each of these, more than 70 percent

of the surveyed firms responded that these were highly important factors that adversely affected their ability to operate in the Commonwealth, and could lead them to possibly relocate their facilities to other regions.

Environmental regulations, labor costs, and the **need to deal with trade unions** follow as factors that might lead to relocation. Two out of three firms ranked these as very important or extremely important reasons to consider relocation.

Three out of five (61%) complained about the **time it takes to obtain permits and licenses** to operate in the state or in a particular community. About the same number worry about whether there will be a sufficient **supply of appropriately skilled labor** to replace their current workforce when it reaches retirement age.

Approximately half of all firms ranked the **cost of living** in the Commonwealth, the **cost of construction**, and the **availability of reasonably priced land** for expansion as highly important factors that could be problematic to their continued operations in the state.

On the other hand, only about a quarter (28%) were very concerned about weather conditions in the state.

Table 4.3 Reasons for Possibly “Leaving” Massachusetts

Reason	Not Relevant	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very or Extremely Important
Health care costs	0.8%	0.4%	3.5%	11.2%	26.5%	57.7%	84.2%
Cost of worker's compensation	0.4%	1.3%	6.2%	16.9%	28.8%	46.7%	75.5%
Taxes and Fees	0.3%	0.0%	6.8%	18.2%	27.0%	47.6%	74.6%
Cost of unemployment insurance	0.0%	1.3%	8.5%	17.1%	26.9%	46.2%	73.1%
Future energy costs	0.0%	1.0%	9.8%	17.1%	29.5%	42.5%	72.0%
Environmental regulations	0.0%	3.0%	13.3%	14.8%	31.0%	37.9%	68.9%
Current energy costs	0.0%	1.6%	10.1%	19.6%	30.2%	38.6%	68.8%
Labor costs	0.5%	0.5%	11.0%	20.0%	42.4%	25.7%	68.1%
Trade Unions	5.6%	8.9%	7.9%	10.5%	24.2%	43.5%	67.7%
Time to obtain permits and licenses	2.7%	4.5%	12.7%	19.1%	27.3%	33.6%	60.9%
Future availability of appropriately skilled labor	2.4%	6.0%	7.2%	26.5%	34.9%	22.9%	57.8%
Current availability of appropriately skilled labor	3.6%	7.2%	14.5%	20.5%	37.3%	16.9%	54.2%
Cost-of-living	0.0%	0.0%	16.8%	29.0%	34.6%	19.6%	54.2%
Cost of construction	1.7%	5.8%	18.2%	27.3%	23.1%	24.0%	47.1%
Availability of reasonably priced land for expansion	6.3%	5.5%	12.5%	29.7%	26.6%	19.5%	46.1%
Opportunity for physical expansion	5.3%	6.2%	15.0%	30.1%	24.8%	18.6%	43.4%
Future proximity to key suppliers	3.2%	12.9%	21.0%	24.2%	24.2%	14.5%	38.7%
Future proximity to customers	2.5%	21.3%	17.5%	21.3%	22.5%	15.0%	37.5%
Current proximity to key suppliers	2.1%	12.5%	27.1%	25.0%	25.0%	8.3%	33.3%
Massachusetts weather and climate	5.9%	11.8%	27.9%	26.5%	16.2%	11.8%	28.0%

Source: Dukakis Center Manufacturing Survey, 2012

As was the case for reasons for staying, the reasons for possibly leaving Massachusetts varied to some extent by firm size (see **Table 4.4**). Regardless of how large a company is, health care costs are ranked #1 or #2 as very important or extremely important factors. The cost of unemployment insurance weighs heavily on small firms, but is ranked only #6 for medium-sized firms and does not make the top six at all for the largest firms. The cost of workers' compensation is ranked #3 for small firms and #2 for medium-sized firms, but again is not highly ranked as a problem for large firms. The largest firms, in contrast, were more concerned about energy costs. Worries about future energy costs ranked #1 among the largest firms while current energy costs ranked #4. Medium-sized firms are more concerned about working with trade unions while labor costs in general ranked in the top six for both small and large firms.

The message here is fairly clear. Health care costs are a problem for all manufacturers regardless of size. The costs of state unemployment insurance and workers' compensation weigh particularly heavy on small companies while the largest manufacturers worry much less about these costs and much more about energy and labor costs.

Innovation in the Massachusetts Manufacturing Sector

Historically, continuous innovation in products and services and in the technology used to produce them has been the key to national prosperity and to the survival of individual firms. Innovation creates new products and services, enhancing our standard of living. Innovation provides the edge that firms need to remain competitive and to increase their market share. In a global economy, innovation permits firms in the U.S. to compete successfully with foreign enterprises even when American workers are better paid. In some cases, innovation even permits U.S. firms to in-source operations that once were sent abroad to take advantage of lower costs.

Because innovation is so critical to the survival and prosperity of Massachusetts manufacturing, the 2012 Dukakis manufacturing survey probed extensively about the types of innovations firms in the Commonwealth have adopted over the past five years. From a long list of innovations, we have created an "innovation index" that combines individual innovation scores into a measure of the extent of innovation in each firm. **Table 4.5** provides a list of the innovations we tracked and the individual scores we attached to each one of them.

Table 4.4 Ranking of Reasons for Possibly "Leaving" Massachusetts by Firm Size

Reason	1-19	20-100	101+
Health Care Costs	1	1	2
Cost of Unemployment Insurance	2	6	
Cost of Workers' Compensation	3	2	
Taxes and Fees	4	3	5
Future Energy Costs	5		1
Labor Costs	6		3
Environmental Regulations		4	
Trade Unions		5	
Current Energy Costs			4
Current Availability of Appropriately Skilled Labor			6

Source: Dukakis Center Manufacturing Survey, 2012

Table 4.5 Innovative Activity of Massachusetts Manufacturer and “Innovation Score”

Initiative	Innovation Points
Invested in new manufacturing equipment	10
Expanded total workforce	5
Invested more in product research and development	10
Expanded sales and marketing workforce	5
Opened sales office abroad	5
Invested in education and training	10
Secured at least one new patent	10
Entered into a formal partnership	10
Hired consultant	5
Implemented performance improvement program	5

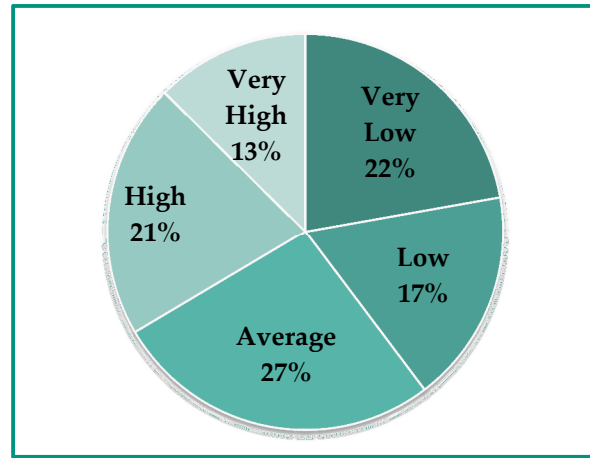
Source: Dukakis Manufacturing Study Staff

Ten points each were assigned to innovations based on investments in new manufacturing equipment, research and development, and education and training of the firm’s workforce as well as to patents received and the consummation of new partnerships. Five points were assigned when a firm reported it expanded the size of its overall workforce, expanded its sales and marketing operations, or opened sales offices overseas.

Each firm’s innovation points were summed into a composite innovation score. The firms were then grouped into five categories based on their innovation scores:

Innovation Score	Innovation Level
0-10	Very Low
11-20	Low
21-35	Average
36-50	High
51+	Very High

Figure 4.1 Distribution of Innovation Scores Across Massachusetts Manufacturing Firms



Source: Dukakis Center Manufacturing Survey, 2012

Table 4.6 Distribution of Innovation Scores Across Massachusetts Manufacturing Firms by Share of Firms

Level	# of Firms	% of Firms
Very Low	141	22.2%
Low	111	17.5%
Average	170	26.8%
High	133	20.9%
Very High	80	12.6%

Source: Dukakis Center Manufacturing Survey, 2012

The score varied from zero to a maximum of 75 points. With the mean “Innovation Score” of 30, the “average” innovators were judged to be within 5 points of the mean (21-35). About a quarter of the respondents scored in the Average category, with approximately forty percent scoring in the Low and Very Low categories and the remaining thirty percent scoring in the High and Very High categories. The distribution of respondents within the innovation levels is shown in **Figure 4.1** and **Table 4.6**.

Who's Innovating in Massachusetts Manufacturing?

One might suspect that the firms with the highest innovation scores would be those in the most modern and most technologically sophisticated industries. But, based on our index, innovation appears to be occurring in a broad range of industries, including some of the oldest – and some would say “old-fashioned” – in the state (see **Table 4.7**). In fact, the industries with the two highest innovation scores are beverage and tobacco product manufacturing and apparel manufacturing. How can this be?

The answer is that these industries need to constantly innovate or must leave the state to survive or they simply die. Those firms that survive in Massachusetts are the ones that are nimble, inventing new products and new sales strategies, and investing in new equipment that keeps them highly efficient and competitive.

Other industries high on the innovation index include nonmetallic mineral product manufacturing, chemicals, electronic equipment, and computer and electronic product manufacturing. Again, these are highly competitive industries world-wide and require constant innovation to remain in business.

Table 4.7 Percentage of Firms in an Industry Scoring 36+ on the Innovation Index

Industry	High or Very High Innovation Score
Beverage and Tobacco Product Manufacturing	83.3%
Apparel Manufacturing	80.0%
Nonmetallic Mineral Product Manufacturing	75.0%
Chemical Manufacturing	66.7%
Electronic Equipment, Appliance, and Component Manufacturing	53.0%
Computer and Electronic Product Manufacturing	50.0%
Petroleum and Coal Products manufacturing	50.0%
Food Manufacturing	44.5%
Paper Manufacturing	41.7%
Plastic and Rubber Plastics Manufacturing	41.7%
Textile Product Mills	37.5%
Machinery Manufacturing	36.1%
Textile Mills	33.4%
Misc. Manufacturing Services	33.4%
Wood Product Manufacturing	33.2%
Misc. Manufacturing	25.9%
Fabricated Metal Product Manufacturing	25.2%
Furniture and Related Product Manufacturing	14.3%
Printing and Related Support Activities	12.7%
Primary Metal Manufacturing	10.0%
Leather and Allied Products Manufacturing	0.0%
Transportation Equipment Manufacturing	0.0%

Source: Dukakis Center Manufacturing Survey, 2012

In the middle of the pack on the innovation index are industries like plastic and rubber plastic manufacturing, machinery manufacturing, and fabricated metal manufacturing. At the bottom, perhaps most remarkably, are two very different industries: leather and allied products manufacturing, and transportation equipment manufacturing. The former is an old industry for which there may not be much new technology to draw upon. As for transportation equipment, this is a surprising result that will require more investigation.

But what this suggests is that almost any industry is capable of innovating regardless of product or how long it has been in operation.

While every industry is capable of innovation, there is no doubt that innovation is much more likely to occur in larger firms, as demonstrated in **Table 4.8** and **Figure 4.2**. Of all the firms in the manufacturing survey with fewer than 20 employees, only 6 percent had very high innovation scores. Over one-third (35%) of these firms were in the very low category and more than half (56%) scored either very low or low on our index.

Medium-sized firms with 20 to 100 employees scored much better than the small firms, with less than one-quarter of these enterprises scoring very low or low on the innovation index and more than 44 percent scoring high or very high.

Continuing this trend by firm size, only 7 percent of our large firms had little innovation activity while nearly three out of four (73%) had an innovation index in the high to very high range.

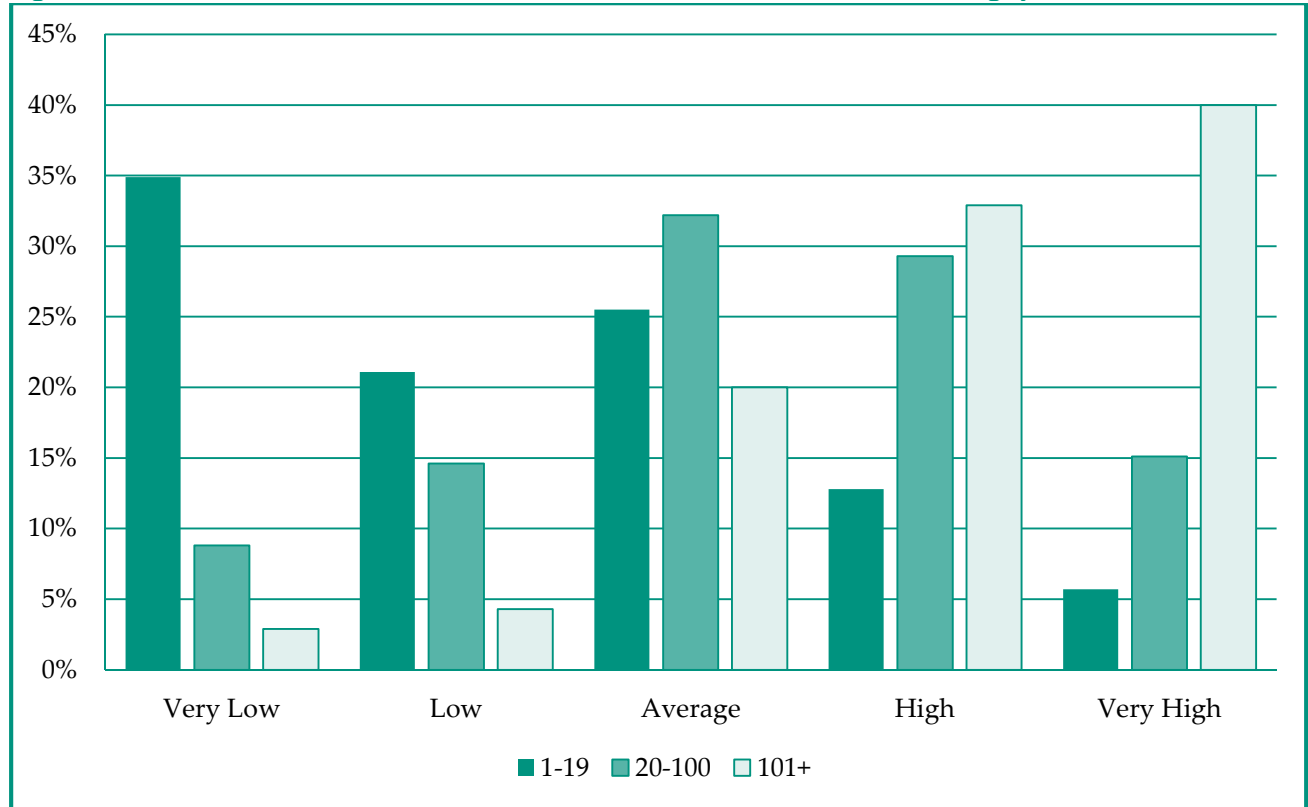
Finding ways to help smaller firms innovate could help many of them to remain competitive and expand their operations.

Table 4.8 Level of Innovation Activity of Massachusetts Manufacturing Firms by Firm Size

Level	1-19	20-100	101+
Very Low	34.9%	8.8%	2.9%
Low	21.1%	14.6%	4.3%
Average	25.5%	32.2%	20.0%
High	12.8%	29.3%	32.9%
Very High	5.7%	15.1%	40.0%

Source: Dukakis Center Manufacturing Survey, 2012

Figure 4.2 Distribution of Innovation Scores across Massachusetts Manufacturing by Firm Size



Source: Dukakis Center Manufacturing Survey, 2012

What Drives Innovation and What Does Innovation Drive?

There turn out to be a number of factors that are highly correlated with the degree to which firms innovate. One of the most important is the presence of global competitors in a firm’s industry. As **Table 4.9** reveals, among those firms that reported that it was “extremely likely” that they would face increasing global competition over the next five years, more than half (56%) scored high or very high on the innovation index. Less than 10 percent scored very low. As such, a very large proportion of those Massachusetts firms that recognize the competitive threat they face have been investing heavily in new products and new technology in an attempt to remain on the innovation forefront.

These companies also appear to be optimistic about their ability to increase their production levels over the next five years, as **Table 4.10** re-

veals. Only 29 percent of firms who score very low on the innovation index expect to increase their production levels over the next five years.

Table 4.9 Relationship between Global Competition and Innovation

Level	Extremely Likely to Face More Global Competitors
Very Low	9.4%
Low	14.0%
Average	18.8%
High	24.2%
Very High	32.0%

Source: Dukakis Center Manufacturing Survey, 2012

In sharp contrast, between 85 and 88 percent of firms scoring in the high and very high range on the innovation index expect to increase their production over the next five years, and less than 5 percent believe they will see their business decline or cease production altogether.

Greater production also often means more employment, and **Table 4.11** provides some evi-

dence to corroborate this. Firms that score high on the innovation index also expect to generate more new jobs over the next five years. Nearly nine out of ten (88%) firms that score very high on the innovation index expect to add jobs even as their innovation efforts increase productivity. Added sales, they believe, will outweigh the adverse impact of productivity on employment. Three out of ten firms that score very high on the index expect to be so successful as to need to expand their employment base by 25 percent or more.

In contrast, only 2 percent of those firms that score lowest on the innovation index expect to increase employment this much, and 63 percent expect to do no better than maintain their cur-

rent employment levels. Close inspection of **Table 4.11** reveals that the correlation between the innovation score and expected employment growth is extraordinarily high. Innovators are also expecting to compete in national and international markets much more so than those firms that score low on the innovation index (see **Table 4.12**). Only 19 percent of those firms with the lowest innovation scores expect to increase their sales nationally over the next five years, and only 4 percent of them expect to expand in the export market. The most innovative firms are more than twice as likely (46%) as these low index innovators to see growth in their national market over the next five years, and almost fourteen times (54%) more likely to expect an expansion in their exports.

Table 4.10 Innovation and Expected Future Production Levels

Innovation Level	Production at increased levels	Production at current levels	Production at reduced levels	Cessation of production in MA
Very Low	29.1%	48.9%	17.0%	5.0%
Low	65.1%	28.4%	5.5%	0.9%
Average	69.8%	21.3%	7.1%	1.8%
High	88.0%	6.8%	3.8%	1.5%
Very High	85.0%	10.0%	2.5%	2.5%

Source: Dukakis Center Manufacturing Survey, 2012

Table 4.11 Expected Massachusetts Employment Growth by Innovation Score

Innovation Level	Expansion of Massachusetts Employment by			No Change	Reduction of Massachusetts Employment by		
	>25%	11-25%	1-10%		1-10%	11-25%	>25%
Very Low	2.2%	8.6%	25.9%	51.8%	5.8%	0.7%	5.0%
Low	8.3%	15.6%	44.0%	26.6%	3.7%	0.0%	1.8%
Average	11.8%	26.0%	37.9%	15.4%	4.1%	3.6%	1.2%
High	18.8%	33.1%	36.8%	4.5%	4.5%	0.0%	2.3%
Very High	30.0%	31.3%	26.3%	11.3%	1.3%	0.0%	0.0%

Source: Dukakis Center Manufacturing Survey, 2012

Table 4.12 Expected National and International Sales by Innovation Score

Innovation Level	Other states in the U.S.	Outside the U.S.
Very Low	19.0%	4.0%
Low	15.7%	4.1%
Average	29.1%	12.7%
High	44.8%	18.3%
Very High	46.3%	53.6%

Source: Dukakis Center Manufacturing Survey, 2012

Finally, we note that there is a strong correlation between how innovative firms have been and the education level they will expect of future employees five years hence. As **Table 4.13** indicates, the higher the innovation score, the more a firm will be seeking workers who have a bachelor’s degree or more. But even the innovation “stars” still expect that by 2017 fully

half of their employees will not require college experience.

The Use of State Programs and Incentives

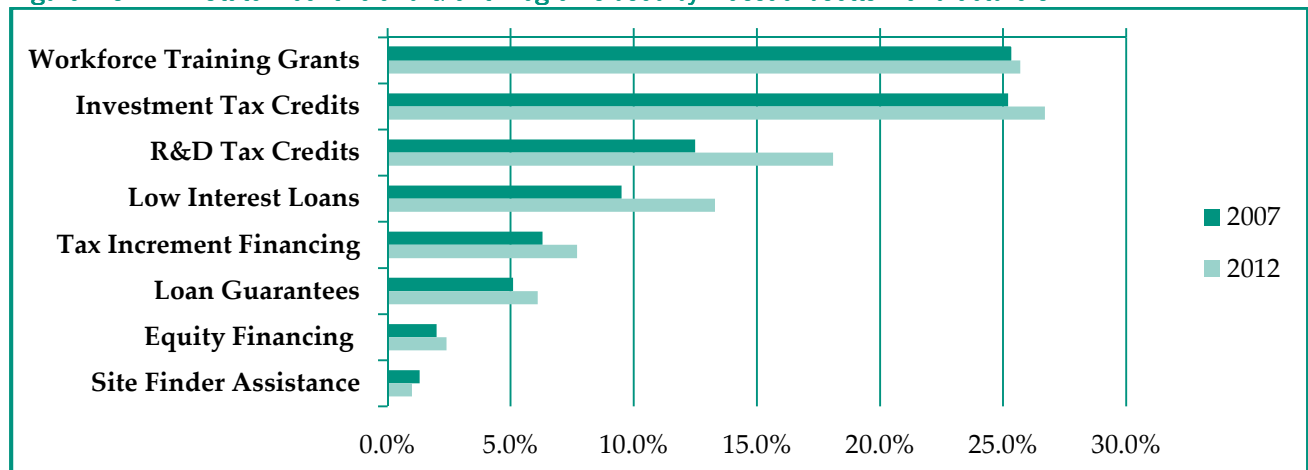
While Massachusetts manufacturers complain about the costs of doing business in the Commonwealth, many have been able to offset some of these costs by taking advantage of a plethora of state programs that provide them with reductions in their tax burdens, reduce their costs of capital, or help them train their workers. As **Figure 4.3** shows, one out of four (25%) manufacturers in the state has taken advantage of **workforce training grants** offered by the Commonwealth, while nearly the same number (27%) has availed themselves of **investment tax credits**.³⁹ In both cases, the proportion of firms reporting the use of these programs in 2012 is nearly identical to the number reporting their use in our 2007 survey.

Table 4.13 Expected Education Requirements for the 2017 Workforce

Innovation Level	Less than a high school degree	High school diploma/GED	Some college	Bachelor's Degree or more
Very Low	21.3%	55.9%	12.8%	11.6%
Low	20.4%	51.9%	19.6%	16.3%
Average	13.4%	54.4%	15.5%	19.4%
High	13.9%	42.4%	19.6%	29.9%
Very High	11.9%	40.7%	17.5%	38.4%

Source: Dukakis Center Manufacturing Survey, 2012

Figure 4.3 State Incentive and Grant Programs used by Massachusetts Manufacturers



Source: Dukakis Center Manufacturing Survey, 2007, 2012

Consistent with the move toward more advanced manufacturing technology, the use of **research and development (R&D) tax credits** has increased since 2007 from one in eight companies (12.5%) to more than one in six (18%).⁴⁰ Similarly, there has been a modest increase in the number of firms using **low interest loans** available from a number of the state's quasi-public agencies, taking advantage of **tax increment financing**, and **loan guarantees**.⁴¹ Very few firms have been able to take advantage of equity financing.

Utilization of these programs, however, differs substantially by firm size, with smaller firms likely failing to take advantage of many of these programs because of the cumbersome application process many of these programs entail (see **Table 4.14**). Large firms have staff who can work the application process while smaller firms often do not have the time or expertise to do so.

Two out of three (67%) large firms have taken advantage of workforce training grants, nearly *seven times* the rate of small firms (10%) and nearly twice the rate of medium-sized firms (38%). An even larger disparity occurs in the use of R&D tax credits. More than half of large firms (52%) have used them compared with only 7 percent of small firms and 27% of medium-sized firms. As such, firms with more than 100

employees are nearly 7.5 times as likely as small firms with fewer than 20 workers to take advantage of this method of lowering a firm's tax burden. Similarly, large firms are nearly four times more likely to utilize investment tax credits than small firms, and forty percent more likely than medium-sized firms.

Where small firms appear to be at least disadvantaged is in the use of low interest loans and loan guarantees from state agencies. Moreover, medium-sized firms have a greater propensity to use these two forms of state assistance than either small firms or large ones.

Finding ways to make it easier for small and medium-sized firms to take advantage of state-sponsored programs could help these firms survive and prosper.

Access to Capital

One concern that has often been raised regarding manufacturing in Massachusetts is the reputed difficulty firms have in obtaining access to capital for their day-to-day operations and for expansion. To assess this claim, we added a battery of questions to the 2012 survey related to whether firms found access to capital had been an impediment to their growth. We found that while some firms reported difficulty in obtaining capital, most did not.

Table 4.14 State Incentive and Grant Programs used by Massachusetts Manufacturers by Firm Size

Program	1-19	20-100	101+
Workforce Training Grants	10.2%	37.7%	66.7%
Investment Tax Credits	14.6%	36.5%	53.1%
R&D Tax Credits	7.0%	26.9%	51.6%
Low Interest Loans	12.2%	15.8%	11.5%
Tax Increment Financing	3.3%	11.2%	22.2%
Loan Guarantees	3.3%	11.0%	3.3%
Equity Financing	1.3%	4.6%	1.7%
Site Finder Assistance	0.7%	0.5%	1.6%

Source: Dukakis Center Manufacturing Survey, 2012

Table 4.15 presents the responses to the question: “Over the past five years, to what extent has access to capital ever been an impediment to growth?” Half of all firms surveyed reported that they had no access problem whatsoever, and *only one firm in six* (17%) reported that access was to a large extent or to a great extent a problem for them. This suggests that while access is not a general problem, it does affect a minority of firms that might benefit from greater access to debt or equity finance.

Table 4.15 Has Access to Capital Been an Impediment to Growth?

Over the last five years, to what extent has access to capital ever been an impediment to growth?				
Not at All	To Some Extent	To a Fair Extent	To a Large Extent	To a Great Extent
50.1%	20.0%	12.4%	9.4%	8.1%

Source: Dukakis Manufacturing Survey, 2012

What we did find, not surprisingly, is that the smaller the firm, the more likely they were to report a capital access problem, as shown in **Table 4.16**. More than one in five (21%) firms with fewer than 20 employees suggested that access to capital over the past five years has been an impediment to growth to a “large extent” or a “great extent.” Less than one in seven (13%) medium-sized firms reported this much difficulty in obtaining capital while only about one in nine (12%) large firms did.

Table 4.16 Firms Reporting Capital Access has been a Barrier to Growth by Firm Size

Access to Capital has been an Impediment to Growth to a Large or Great Extent			
All Firms	1-19	20-100	101+
17.5%	21.0%	13.5%	11.7%

Source: Dukakis Manufacturing Survey, 2012

One possibility is that access to capital is not uniform throughout the state. To test this, we divided our full sample of firms by region. First we looked at those firms inside and outside of Rte. 495. Our sample contains 347 firms inside this circumferential interstate and 339 outside. It is plausible that manufacturing firms to the east of Interstate 495 had better access to capital and credit because they are located within reasonable driving distance from Boston where there is a rich, diverse set of financial institutions.

But the results shown in **Table 4.17** suggest that there is virtually no difference in access to capital whether a firm is located inside or outside of 495. If anything, obtaining capital *outside* of 495 is a bit easier, according to our survey results.

Table 4.17 Access to Capital – Inside vs. Outside Route 495

Over the last five years, to what extent has access to capital ever been an impediment to growth?		
Extent	Inside 495	Outside 495
Not at All	47.9%	52.3%
To Some Extent	20.1%	19.9%
To a Fair Extent	13.4%	11.5%
To a Large Extent	10.1%	8.7%
To a Great Extent	8.5%	7.5%

Source: Dukakis Manufacturing Survey, 2012

To obtain a more granular perspective on the capital access question, we further divided our survey firms into five regions. Are there parts of the state where obtaining financing is more difficult than others? **Table 4.18** provides results to answer this question.

Table 4.18 Access to Capital by Region within Massachusetts

Over the last five years, to what extent has access to capital ever been an impediment to growth?					
Extent	Inside 495	Central MA	Northeastern MA	Southeastern MA	Western MA
Not at All	46.9%	56.0%	63.0%	51.1%	49.5%
To Some Extent	20.7%	21.0%	18.5%	18.2%	19.6%
To a Fair Extent	13.6%	7.0%	7.4%	14.8%	14.0%
To a Large Extent	10.2%	6.0%	11.1%	10.2%	9.3%
To a Great Extent	8.6%	10.0%	0.0%	5.7%	7.5%

Source: Dukakis Manufacturing Survey, 2012

The answer appears to be that in no region of the state is capital access substantially more difficult than others. About one in six firms inside 495, in Central MA, in Southeastern MA, and in Western MA regions report that they have found access to be an impediment to growth either to a large extent or to great extent. Those in Northeastern MA report that capital access is slightly less of a barrier to growth, but the difference is small.

Concerns about Future Access to Capital

Even though *current* access to capital does not seem to present a large problem for manufacturers, there is some concern about their *future ability to finance growth*. While **Table 4.18** above revealed that fully half (50%) of all firms reported no problem in accessing capital to fuel their growth over the past five years, **Table 4.19** suggests that only one-third (33%) of firms claim no concern about their ability to finance future growth.

Table 4.19 Extent of Concern about Ability to Finance Future Growth

To what extent are you concerned about your company's ability to finance future growth?				
Not Concerned	Some-what Concerned	Fairly Concerned	Very Concerned	Extremely concerned
32.7%	29.2%	15.7%	12.2%	10.2%

Source: Dukakis Manufacturing Survey, 2012

While only a few more than one in six firms (17.5%) reported that prior access to capital posed an impediment to growth to a large or

great extent, more than 22 percent voice great concern about their ability to finance growth in the future.

This apprehension about future access to capital is expressed most often by small firms with fewer than 20 employees. More than three out of ten (31%) small firms are “very concerned” or “extremely concerned” about finding sufficient capital to support future growth while only 14 percent of medium-sized firms and less than 6 percent of large firms expressed a similar concern.

This is the point that the 2012 survey has driven home: smaller firms have to worry about the financial future much more than larger firms. Smaller firms often have a hard time obtaining financing because of their lack of collateral and since many smaller firms are owned and managed by a single proprietor, they are leery of taking out sizable loans that might place their families in financial jeopardy. It is important to remember that these smaller companies with fewer than 20 employees make up more than half (52%) of all manufacturers in Massachusetts and therefore it would seem judicious to address their concerns. With easier access to capital, presumably more of these firms can expand their operations and create more manufacturing employment opportunity in the Commonwealth.

Given these findings, what proportion of firms are likely to seek outside financing for growth, expansion, or acquisitions over the next twelve

to eighteen months? The 2012 survey reveals that 36 percent of small firms anticipate turning to outside funding sometime in the near-term, substantially less than the half (49%) of all large firms and the six out of ten (61%) medium-sized enterprises (see **Table 4.20**).

Table 4.20 **Expected Use of Outside Financing to Fund Company Growth by Firm Size**

Companies anticipating utilizing outside financing to fund growth/expansion/acquisitions in the next 12-18 months		
1-19	20-100	101+
36.2%	61.1%	48.5%

Source: Dukakis Manufacturing Survey, 2012

For these firms with 20 to 100 employees, finding financing is less difficult than for smaller firms, and these funds provide them with the opportunity to expand their operations even more. While larger firms have even less difficulty accessing outside capital, they are more likely to have internal sources of capital available to them and therefore are less likely to apply for large bank loans.

Conclusions

While manufacturers in Massachusetts have a good number of concerns about the cost of doing business in the state with health care insurance, workers' compensation, and unemployment insurance costs near the top of the list, followed by taxes and fees and high energy costs, there are ample reasons why they continue to operate in the Commonwealth. Sheer inertia is one of them, given the often prohibitive expenses of moving to other locations. Yet the leading reasons for manufacturers remaining in Massachusetts are the work ethic of their employees and the current availability of appropriately skilled labor. Trying to hire an equally loyal and skilled workforce elsewhere appears to be a daunting challenge for many manufacturers.

Proximity to their current customers is particularly important to smaller firms and this keeps

them close to home. Access to good transportation was rated highly, particularly by medium-sized firms. For the largest firms, they are counting on being able to replace their current skilled workforce with new Massachusetts recruits and this, they tell us, is the #1 reason for retaining their operations in the Commonwealth.

The state has provided some help to manufacturing firms which may encourage them to remain here. About one fourth of all firms have availed themselves of workforce training grants and investment tax credits, and the use today is slightly higher than in 2007. More than one in six firms is now using R&D tax credits, up from just one in eight five years ago. And more than 13 percent have taken advantage of low interest loans available from one or another state or federal agency.

However, as we found in our 2007 survey, utilization of these programs is still highly correlated with firm size. Two-thirds of the largest firms have taken advantage of workforce training grants while only 10 percent of small firms and 38 percent of medium-sized enterprises have done so. Over half of the large firms in the state are using investment tax credits and R&D tax credits to reduce their state tax burden. For smaller firms, only 15 percent use the former and only 7 percent the latter.

As for access to private capital, the overall picture is rather encouraging. Fully half of all firms report no problem at all in accessing capital to fuel their past growth, with only one in six (17.5%) expressing the position that capital financing presented a major impediment to growth. Not surprisingly, small firms appear to have faced somewhat higher barriers in the capital market, but even here only one in five reported past access was a significant problem for them. Our survey results showed no difference in capital availability across regions of the state.

Concerns about future access to capital are greater. More than two-thirds (67%) of all firms reported at least some concern about their ability to finance their company's future growth and more than one in five (22%) reported that they were very concerned or extremely concerned about it. This was particularly true of smaller firms, with 45 percent expressing great concern about their own ability to finance future expansion.

All in all, the results suggest that manufacturing companies have much stronger reasons to remain in Massachusetts than to relocate. Boosting the ability of smaller firms to take advantage of programs offered by the state to encourage economic growth can only increase the chances that these firms will stay here and expand their operations. Similarly, finding ways to increase access to private financing of small firm growth could further enhance the Commonwealth's manufacturing sector.

CHAPTER 5

A MANUFACTURING WORKFORCE FOR THE FUTURE

As mentioned in Chapter 1, because of expected retirements and labor turnover, it is likely that Massachusetts manufacturers will need to fill nearly 100,000 job openings over the next ten years. How they will fill these vacancies, however, remains a challenge to the industry. As our 2008 study revealed, company officials were finding it “difficult” or “extremely difficult” to recruit the labor they needed. This was particularly true of skilled craftsmen, but also applied to executive managers, scientific and R&D personnel, and even entry level workers. Today, with a much weaker overall job market, higher unemployment, and a bevy of manufacturing closings and layoffs throughout 2008 and early 2009, the short-term recruitment challenge should have eased. The extent to which this has happened and what this means for the future of manufacturing is a vital question.

The Worker Recruitment Challenge Today

Before the Great Recession began at the end of 2007, our original survey indicated that managers were troubled by the prospect of finding replacement workers for those who were retiring or leaving the industry. At the time, unemployment in Massachusetts stood at 4.5 percent, the lowest rate since the fall of 2001. In such a tight labor market, two-thirds (67%) of firms reported that it was “difficult” or “extremely difficult” to find skilled craftsmen. Over half

(53%) reported a similar degree of difficulty in recruiting scientific or R&D professionals, while 39 percent found a similar problem hiring executive managers. More than a quarter (27%) of all firms even found it difficult or extremely difficult to enlist entry level workers to join their firms.⁴²

In the 2012 survey, we asked the same question, the results of which can be found in **Table 5.1**. As expected, in this much looser labor market with many manufacturing workers still not recalled from layoff, the difficulty in attracting workers has, to some degree, subsided. For instance, the difficulty in hiring entry level workers has almost entirely abated. However, the challenge of filling open positions with appropriately trained and skilled workers is far from over. More than two out of five firms (43%) report “difficulty” or “extreme difficulty” in recruiting skilled craftsmen; nearly a quarter (24%) have trouble hiring R&D staff; and nearly one in six (16%) face a challenge in hiring executive managers.

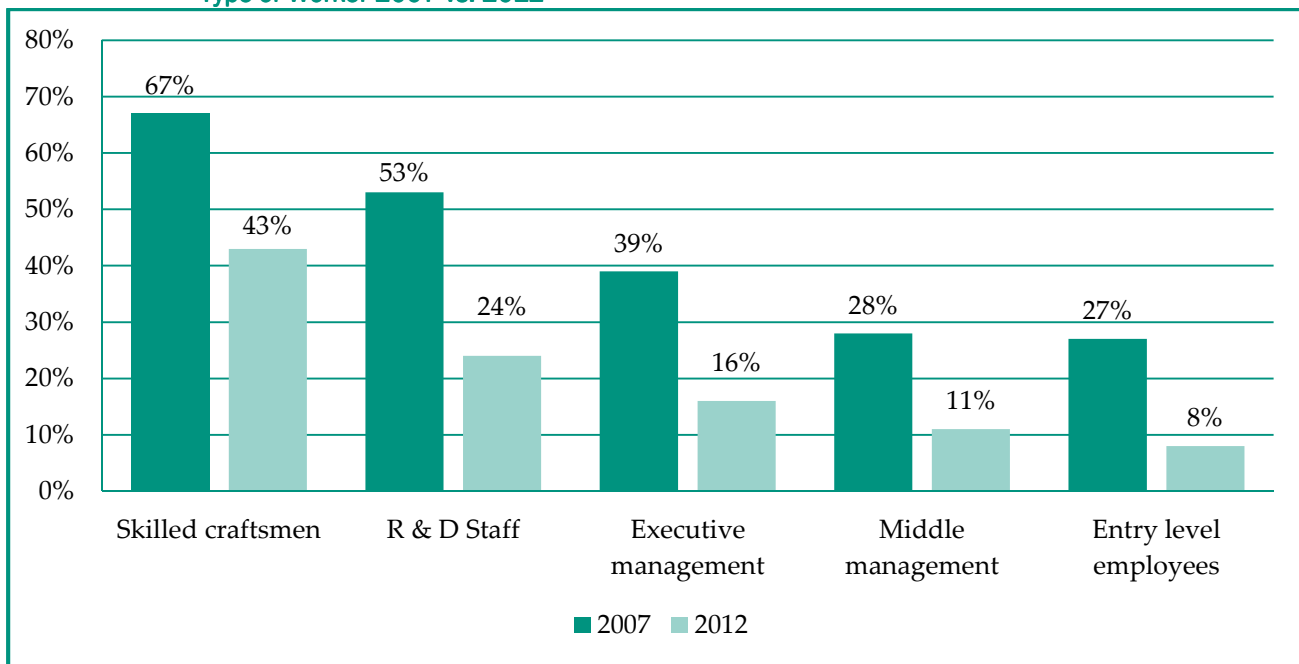
Figure 5.1 provides a graphical representation of the change in the recruiting climate between 2007 and 2012. Clearly, from the point of view of employers, it has improved across the board, but many challenges remain – especially when it comes to hiring skilled craftsmen.

Table 5.1 Difficulty in Recruiting Labor for Massachusetts Manufacturers 2012

Employment Type	Not Difficult	Somewhat Difficult	Fairly Difficult	Very Difficult	Extremely Difficult	Very or Extremely Difficult
Skilled craftsmen	18.4%	16.2%	22.2%	26.7%	16.4%	43.1%
R & D Staff	36.7%	17.3%	21.9%	14.8%	9.3%	24.1%
Executive management	40.9%	22.8%	20.7%	10.2%	5.4%	15.6%
Middle management	40.3%	22.3%	26.5%	7.8%	3.2%	11.0%
Entry level employees	49.9%	25.9%	16.3%	5.5%	2.5%	8.0%

Source: Dukakis Center Manufacturing Survey, 2012

Figure 5.1 Proportion of Firms Finding It "Very Difficult" or "Extremely Difficult" to Recruit New Employees by Type of Worker 2007 vs. 2012



Source: Dukakis Center Manufacturing Survey, 2007; 2012

Sources Used for Recruiting Shop Floor Workers

Given the continuing recruitment challenge, we inquired as to what sources manufacturing managers turned to for recruiting shop floor workers, and which proved most successful. **Table 5.2** provides these results. By far the most used method for recruitment was employee referral with five out of six firms (83%) enlisting their current employees to find candidates for job openings on the shop floor. Nearly six out of ten (59%) still use newspaper advertisements to solicit new workers, while half (50%) have turned to electronic media, placing

internet advertisements to attract new workers. More than half (55%) use temporary agencies to fill these positions while half (50.2%) of all firms tap vocational schools and high schools for new workers. Only a little more than a third (37%) use private employment or recruiting agencies and fewer still use one stop career centers, career and technology fairs, or community colleges.

For the most part, however, manufacturers do not find much success with many of these sources for recruiting new shop floor employees. The most successful method is employee

referral with about one-third (32.6%) of firms reporting that this has proven very successful or even extremely successful. All the other methods of recruitment have proven much less successful. For example, no more than 12 percent of manufacturing employers report a high degree of success in recruiting via vocational

schools, temporary staffing agencies, and all forms of print and electronic advertising. Of those who have turned to one stop career centers, career and technology fairs, and community colleges for recruiting, very few firms have found any of these to be particularly useful in terms of actually finding a candidate to hire.

Table 5.2 Sources Used for Recruiting and Hiring Shop Floor Employees

Source	Used	Not Successful	Somewhat Successful	Fairly Successful	Very Successful	Extremely Successful	Very or Extremely Successful
Employee Referrals	83.2%	2.1%	19.9%	28.4%	21.7%	10.9%	32.6%
Temporary Employment Agencies	55.3%	7.8%	16.8%	18.3%	9.5%	2.9%	12.4%
Vocational High Schools/High Schools	50.2%	11.3%	17.1%	11.6%	7.3%	2.9%	10.2%
Internet Advertisements	49.6%	9.0%	18.9%	12.3%	6.0%	3.1%	9.1%
Internet Job Search Sites (e.g. Monster.com)	46.0%	11.4%	17.1%	10.4%	5.1%	2.0%	7.1%
Newspaper Advertisements	59.2%	11.4%	25.4%	15.2%	6.0%	1.1%	7.1%
Private Employment or Recruiting Agencies	36.8%	7.2%	12.4%	10.3%	5.4%	1.5%	6.9%
Industry Networking Events	24.4%	5.5%	9.5%	6.3%	2.0%	1.2%	3.2%
One Stop Career Centers	15.9%	6.8%	5.0%	2.3%	1.5%	0.3%	1.8%
Career and Technology Fairs	16.6%	5.4%	7.1%	2.8%	1.2%	0.2%	1.4%
Community Colleges	21.1%	7.4%	7.9%	4.6%	1.2%	0.0%	1.2%

Source: Dukakis Center Manufacturing Survey, 2012

Table 5.3 Sources Used for Recruiting and Hiring Shop Floor Employees by Firm Size

Source Used	Firm Size		
	1-19	20-100	101+
Employee Referrals	73.3%	95.9%	100.0%
Newspaper Advertisements	48.4%	72.1%	77.9%
Vocational High Schools/High Schools	48.1%	51.8%	61.8%
Internet Advertisements	36.7%	64.8%	67.6%
Temporary Employment Agencies	35.2%	74.1%	88.2%
Internet Job Search Sites (e.g. Monster.com)	31.1%	62.8%	72.1%
Private Employment or Recruiting Agencies	24.7%	51.3%	52.9%
Industry Networking Events	16.1%	27.2%	46.3%
Community Colleges	11.8%	29.5%	37.9%
One Stop Career Centers	10.5%	18.8%	35.3%
Career and Technology Fairs	8.7%	18.1%	47.7%

Source: Dukakis Center Manufacturing Survey, 2012

As **Table 5.3** shows, the sources used for hiring shop floor employees vary drastically. Virtually all medium and large-sized firms use employee referrals to recruit new employees, whereas this is true for about three-fourths (73%) of smaller firms. Nearly four out of five (78%) large employers still use newspaper advertisements while fewer than half (48%) of the smallest employers do so. Large employers are also much more likely to use internet advertisements, temporary employment agencies, and private employment agencies.

Preparation and Training for Work in Massachusetts Manufacturing Sector

Recruiting is one challenge Massachusetts manufacturers face. A second is the preparation and training of their companies' job floor workforce. As **Table 5.4** reveals, nearly two out of five firms (38%) responded that *vocational and*

technical high schools are "very important" or "extremely important" training grounds for their firms. *Comprehensive high schools* were mentioned as being very or extremely important by about one in five (22%) firms with *four year colleges* and *community colleges* being somewhat less important (18% and 13% respectively). Indeed, nearly half of firms (47%) reported that community colleges were "not important" to training their shop floor workers and more than half (52%) responded that four year colleges and universities were unimportant in this regard. Very few mentioned private training companies, the military or workforce investment boards as very important when it comes to preparing their workers for employment at their companies. There was almost no difference by size of firm on this ranking of institutions used for preparing their workforces.

Table 5.4 Importance of Institutions in Preparing the Manufacturing Job Floor Workforce

Institution	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very or Extremely Important
Vocational/Technical High Schools	24.5%	17.8%	19.6%	20.5%	17.6%	38.1%
Comprehensive High Schools	35.5%	19.7%	23.2%	14.0%	7.7%	21.7%
Four Year Colleges/Universities	52.1%	16.7%	13.7%	10.2%	7.3%	17.5%
Community Colleges	46.5%	20.7%	19.4%	9.0%	4.4%	13.4%
Private Training Companies	70.8%	15.5%	7.9%	3.6%	2.1%	5.7%
The Military	70.2%	15.8%	8.4%	3.5%	2.1%	5.6%
Workforce Investment Board	87.2%	6.5%	3.2%	2.3%	0.8%	3.1%

Source: Dukakis Center Manufacturing Survey, 2012

We asked firms to identify those factors that were most important to them in hiring entry-level and experienced workers. It turns out there is little difference in terms of what managers are looking for in their new recruits, regardless of the level of experience they are seeking. **Table 5.5** provides these results for entry level workers and **Table 5.6** provides the same for experienced shop floor employees.

By far, the most important characteristics that manufacturing managers are looking for in their new entry level shop floor workers are a positive attitude and motivation, and an inter-

est in learning and self-improvement. Eighty-six percent of firms ranked “attitude and motivation” as very important or extremely important for their new entry-level hires. More than three out of four (76%) ranked “interest in learning and self-improvement” as equally important. Such “soft skills” are rated as critical when it comes to the hiring criteria of most manufacturers. Essentially, managers believe they can train entry level workers in the technical skills they need to acquire if they begin with recruits who express the right attitude, motivation, and a strong interest in learning.

Table 5.5 Important Factors in Hiring Entry-Level Shop Floor Workers

Factor	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very or Extremely Important
Interest in Learning and Self-Improvement	2.6%	4.5%	16.5%	39.4%	37.0%	76.4%
Technical Skills and Competencies	9.1%	21.3%	32.2%	22.0%	15.4%	37.4%
Hours and Flexibility	19.9%	23.5%	25.6%	18.9%	12.1%	31.0%
Related Experience in Manufacturing	13.7%	30.9%	30.1%	13.5%	11.7%	25.2%
Potential for Career Mobility Within Company	27.7%	25.8%	24.3%	14.8%	7.3%	22.1%
Education Beyond High School	39.1%	30.0%	18.3%	7.9%	4.7%	12.6%

Source: Dukakis Center Manufacturing Survey, 2012

Table 5.6 Important Factors in Hiring Experienced Shop Floor Workers

Factor	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very or Extremely Important
Attitude and Motivation	2.6%	1.1%	8.1%	37.1%	51.1%	88.2%
Interest in Learning and Self-Improvement	3.1%	4.2%	16.9%	41.1%	34.7%	75.8%
Technical Skills and Competencies	6.0%	8.5%	16.8%	34.7%	34.0%	68.7%
Related Experience in Manufacturing	7.4%	15.0%	27.2%	31.9%	18.5%	50.4%
Hours and Flexibility	18.0%	23.4%	25.2%	21.3%	12.2%	33.5%
Potential for Career Mobility Within Company	24.9%	23.4%	29.2%	14.9%	7.6%	22.5%
Education Beyond High School	29.0%	32.2%	22.0%	12.1%	4.7%	16.8%

Source: Dukakis Center Manufacturing Survey, 2012

Indeed, only 37 percent of firms ranked “technical skills and competencies” as very or extremely important in their recruitment criteria. Related experience in manufacturing was ranked as very or extremely important by only 25 percent of all firms. Education beyond high school was also rarely sought, with nearly 40 percent of manufacturing managers reporting that it was not important at all in their hiring decisions for entry level workers.

The ranking of factors related to the hiring of experienced shop floor workers varied little from that of entry-level workers. The “soft skills” of attitude and motivation and an interest in learning and self-improvement ranked #1 and #2 in importance, the same as for entry-level workers. The big difference, however, be-

tween experienced and entry level workers, was the need for demonstrated technical skills and competencies and solid manufacturing experience. More than two-thirds (69%) of managers ranked technical skills as very or extremely important and a full half (50%) ranked related experience in manufacturing as highly important.

Again, there was very little difference by size of firm in these rankings for either entry level workers or experienced workers.

We probed further in our survey about what specific competencies firms were looking for or expected their entry-level workers to master in order to meet the needs of the company. **Table 5.7** presents these results.

Table 5.7 Important Competencies/Attributes for Entry Level Shop Floor Workers

Attribute	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very or Extremely Important
Basic Employability/Job Readiness Skills	2.4%	7.3%	20.2%	38.7%	31.4%	70.1%
Reading/Writing/Verbal Communication	2.9%	9.4%	27.0%	36.3%	24.4%	60.7%
Mechanical Aptitude	6.0%	10.6%	25.9%	33.3%	24.2%	57.5%
Mathematics Skills	5.7%	16.6%	29.3%	30.1%	18.4%	48.5%
Hours and Flexibility	17.7%	24.2%	21.2%	23.4%	13.4%	36.8%
Hands-On Machining Skills	19.3%	19.2%	25.5%	21.6%	14.4%	36.0%
Read and Interpret Blueprints	34.9%	15.0%	18.7%	17.0%	14.4%	31.4%

Source: Dukakis Center Manufacturing Survey, 2012

Consistent with the responses regarding attitude and motivation and ability to learn, managers ranked “basic employability” and “job readiness” as the most important factors in hiring entry level workers with seven in ten firms (70%) ranking these as very or extremely important. Reading, writing, and verbal communication skills along with mechanical aptitude were found to be very important or extremely important for six out of ten firms (61% and 58%, respectively). About half (48.5%) of the surveyed managers mentioned math skills as highly important in entry-level recruits. Hands-on machining skills and the ability to read and interpret blueprints were ranked much lower than other factors in hiring new entry-level workers.

The overall conclusion is that for entry level workers, more focus needs to be placed on providing potential recruits with the soft skills noted above. When it comes to technical skills, more emphasis needs to be placed on honing mechanical and math skills. Science, Technology, Engineering, and Math (STEM) training is therefore an important complement to ensuring the desired workplace attitudes and motivation.

Types of Training Used by Massachusetts Manufacturers

Massachusetts manufacturers resort to a variety of methods to provide training for their new shop floor employees. These range from on-the-job training (OJT) and in-firm classroom training to a reliance on technical and vocational schools, community colleges, and even, to some extent, universities. In addition, some firms have begun to use web-based training or external consultants to train their employees, along with a variety of trade association partnerships.

By far, the most heavily used means of training is OJT (see **Table 5.8**). More than four out of five (81%) firms report that they use this method to provide their new shop floor employees with the technical skills they need to perform required operations. Of those firms that use OJT, nearly 70 percent rate this form of training as “very successful” or “extremely successful”, ranking this form of training as much more essential than others. This suggests that the specialized technical skills needed by each firm are actually best supplied by the firms themselves.

Half of all firms (50%) supplement the OJT with in-house classroom training by their

own staff or skilled employees. However, only 42 percent of firms using this method find it to be highly successful.

About the same proportion (48%) of firms rely on regional, technical or vocational schools for training their shop floor workers. However, only about a third (32%) of these firms consider this training highly successful.

External consultant/trainers are used by 42 percent of all Massachusetts manufacturing firms, but these are, on the whole, rated as only “somewhat” or “fairly successful.”

About a third (31%) of firms are now experimenting with web-based training but so far this has proven to be the least successful method for imparting the required skills to shop floor workers. Less than 16 percent of adopters of web-based training report high-level success with this method.

Three in ten firms (30%) have turned to community colleges to offer some training to their production workers while another 26 percent say they have used college or university centers for the same purpose. Unfortunately, nearly 70 percent of those using community colleges report only modest success on the part of the institutions in training their workers.

Finally, about one in four firms (18%) report they have used the Massachusetts Manufacturing Extension Partnership (Mass MEP) or the Greater Boston Manufacturing Partnership (GBMP) for training purposes. The firms that have turned to MEP and GBMP have found a somewhat higher success rate in training quality than that provided by community colleges, universities, or external consultants/trainers.

Table 5.8 Types of Training Used for Shop Floor Workers and Degree of Success

Training Type	Used	Not Successful	Somewhat Successful	Fairly Successful	Very Successful	Extremely Successful	Very or Extremely Successful
On-the-job Training	81.4%	0.9%	6.5%	22.9%	44.2%	25.4%	69.7%
Internal Classroom Training by Staff or Skilled Employees	50.3%	4.2%	22.3%	31.4%	31.4%	10.5%	41.9%
Technical/Vocational Schools	48.2%	7.5%	32.2%	28.2%	18.5%	13.7%	32.2%
Use of External Consultants/Trainers	42.3%	11.8%	33.8%	28.4%	20.3%	5.9%	26.2%
Web-based Training	31.0%	16.1%	49.4%	19.0%	9.0%	6.5%	15.5%
Community Colleges	30.2%	13.6%	39.1%	29.5%	15.2%	2.3%	17.5%
Universities	25.8%	16.3%	23.6%	34.1%	14.0%	12.0%	26.0%
MassMEP/ GBMP*	18.0%	18.9%	18.3%	33.3%	18.3%	11.1%	29.4%

Source: Dukakis Center Manufacturing Survey, 2012

*Massachusetts Manufacturing Extension Partnership/Greater Boston Manufacturing Partnership

As **Table 5.9** reveals, there are some differences in the training methods used by different-sized firms. All firms, regardless of size, rely to a great extent on OJT and about half use technical and vocational schools.

However, there are large differences in training modalities other than OJT and technical/vocational schools. Nearly 90 percent of those firms with more than 100 employees supplement OJT with internal classroom training using their own staff and highly skilled employees as instructors. Only about 63 percent of medium-sized firms and a third (33%) of the smallest firms use this method. Similarly, two-thirds of the largest firms use external consultants for training purposes, whereas only a quarter (26%) of firms with fewer than 20 employees do so. The largest firms are also the most likely to have used web-based training or turned to community colleges and universities for at least some of their training purposes and are also much more likely to have turned to MEP or GBMP for training.

Regardless of size, vocational high schools and other high schools represent the one kind of

institution that a large share of all firms use when trying to hire new shop floor workers. Nearly half (48%) of the smallest firms rely on vocational schools as one of their chief means of recruitment, about the same proportion (52%) as medium-sized firms.

The larger employers are also the chief users of industry networking events, one stop career centers, and career and technology fairs. Indeed, nearly half (48%) of all the largest employers report they have used career fairs to attract new workers – more than five times the rate of the smallest firms (8.7%) and nearly three times the rate of firms with 20-100 employees (18.8%). Presumably, larger firms have the staff and resources to attend such fairs while smaller and medium-sized firms do not. For the same reason, larger firms may also be more likely to be in contact with community colleges when it comes to recruitment. Nearly four out of ten (38%) of these firms report that they have included community colleges in their hiring efforts – more than three times the rate of the smallest firms.

Table 5.9 Types of Training Used for Shop Floor Workers by Size of Firm

Training Source	1-19	20-100	101+
On-the-job Training	74.4%	88.7%	89.9%
Technical/Vocational Schools	45.8%	50.5%	52.3%
Internal Classroom Training by Staff or Skilled Employees	32.9%	62.5%	89.7%
Use of External Consultants/Trainers	26.1%	57.7%	66.2%
Web-based Training	19.7%	41.0%	50.0%
Community Colleges	19.4%	38.2%	53.7%
Universities	18.2%	30.3%	45.6%
MassMEP/ GBMP*	9.0%	25.4%	35.3%

Source: Dukakis Center Manufacturing Survey, 2012

*Massachusetts Manufacturing Extension Partnership/Greater Boston Manufacturing Partnership

Conclusions

Despite the fact that employers now find it easier to recruit workers in an economy that is generally much weaker than in 2007 when we fielded our first manufacturing survey, we continue to find that hiring appropriately skilled and talented new employees poses a serious challenge for manufacturing firms in the Commonwealth. To meet their needs, employers have turned to the state's vocational schools and, to a lesser extent, four-year colleges and community colleges to find replacements for the older employees who end up retiring or leaving the industry for other reasons. Yet, of all the methods they use to recruit, a referral from their own employees is the most common and, according to our survey, the most successful.

While manufacturing firms look to schools and training centers to provide some of the technical skills their entry level shop floor employees will need, they are even more attentive to the social skills they wish to see their workers exhibit. Manufacturers want to see high motivation and an interest in learning and self-improvement, job readiness skills, a mechanical aptitude, and some math ability in their candidates. They are slightly less concerned with specific technical training because those skills will be learned on-the-job in the shop, but they still hold those skills to be very valuable. As for hiring already experienced shop floor workers, employers are not only looking for employees with the right motivation, but with a high

level of technical skill and related manufacturing experience.

Despite the fact that manufacturers rely on vocational schools and community colleges for some of their recruitment efforts, they are not completely satisfied with the training these institutions currently provide these potential recruits. A clear majority of firms that have turned to technical and vocational schools for training their shop floor employees rate them as less than highly successful training institutions. Even fewer firms rate the current training offered by community colleges as very successful or extremely successful, with only one in six firms that have used community colleges reporting high success with the training these schools provide.

What is clear from all of this is that manufacturers in the Commonwealth will continue to rely on a partnership with the public sector – with local and regional schools and with community and four-year colleges – to help prepare the manufacturing workforce for the future. These institutions, however, appear to need some improvement if they are to offer the kinds of training most useful to Massachusetts manufacturers.

If the schools can provide the appropriate social and technical skills, many firms are prepared to offer specific training to their employees in order to maintain a high level of productivity, quality, and service delivery required to remain competitive in the marketplace and expand their operations in the state.

CHAPTER 6

THE FUTURE OF MANUFACTURING IN MASSACHUSETTS

With the Great Recession taking its toll on demand for their products and forcing manufacturers to reduce the numbers of workers they employ, it would have been easy for Massachusetts manufacturers to hunker down and tread water, waiting for a stronger sign of economic recovery. Instead, it appears that the vast majority of them spent the past five years investing heavily as they position themselves to compete aggressively in the future. As our survey results indicate, they have invested in new manufacturing equipment, invested in the education and training of their employees, expanded their sales and marketing efforts, invested in more product research, secured new patents for new products and, in a few cases, opened sales offices abroad.

Table 6.1 provides a summary of the activities that Massachusetts manufacturers have engaged in since 2007. The question we asked was “Over the past five years, which of the following initiatives have you pursued to grow your manufacturing operations in Massachusetts?” Survey respondents could answer “Yes” or “No” to whether they undertook each type of initiative.

As the table indicates, nearly five out of six firms (83%) invested in new manufacturing equipment during this period. When broken out by size of firm, the results ranged from three out of four (74%) small firms investing in new equipment to over 90 percent of medium-sized enterprises to virtually all of the largest

firms we surveyed. Such investments point to at least a modicum of confidence that these firms plan to be around in the future and are taking steps to make sure they remain competitive.

The investments these firms are making in their equipment are only part of the story. Half of all firms (50%) invested in the education and training of their employees in order to keep their skills current with new technology. This ranged from about a third (35%) of the smallest firms to 87 percent for the largest.

Just about half of all firms (47%) expanded their manufacturing sales efforts or increased their marketing workforce. Large firms were more than twice as likely (70% vs. 32%) as small firms to have done this, but even then, nearly a third of small firms were aggressively marketing their products to both current and prospective customers.

Almost the same proportions invested in product research and development, including more than one-third (34%) of small companies and nearly three quarters of larger firms (72.9%).

Working with their employees, a quarter (26%) of small companies, nearly three out of five (58%) of medium-sized companies, and 70 percent of large manufacturers implemented new programs or strengthened existing ones aimed at improving performance in their plants.

Table 6.1 Initiatives Pursued over Past 5 Years to Grow Manufacturing Operations in Massachusetts

Initiative	All Firms	1-19	20-100	101+
Invested in new manufacturing equipment and/or manufacturing process software	82.6%	73.7%	91.2%	98.6%
Invested in education and training for manufacturing workforce	49.5%	34.5%	60.5%	87.1%
Expanded manufacturing sales and marketing workforce	47.2%	31.5%	65.0%	70.0%
Invested more in product research and development than in the previous five years	45.1%	34.0%	55.1%	72.9%
Implemented or strengthened a performance improvement program	41.6%	25.7%	57.6%	69.6%
Expand overall square footage of existing manufacturing floor space	36.7%	27.3%	43.3%	59.4%
Developed a succession plan for ownership	29.4%	22.0%	43.2%	21.7%
Developed a succession plan for senior executives	25.4%	14.6%	36.4%	52.2%
Hired consultants to help grow business	24.8%	17.6%	29.6%	38.6%
Entered into a formal partnership and/or joint venture with another manufacturing firm	17.8%	13.2%	21.8%	30.0%
Secured at least one new patent for a new product	16.6%	10.8%	16.6%	47.1%
Opened a new manufacturing location in Massachusetts	8.8%	6.7%	9.5%	20.0%
Opened a sales office abroad	8.6%	2.7%	10.9%	31.4%

Source: Dukakis Center Manufacturing Survey, 2012

A smaller number of firms initiated other methods for growing their Massachusetts manufacturing operations. More than one out of six (18%) firms entered into a formal partnership or joint venture with another manufacturing company including 13 percent of small firms, 22 percent of medium-sized firms, and three out of ten (30%) of the largest firms. About one out of six firms secured at least one new patent for a new product since 2007. Such activity was dominated by large firms where nearly half (47%) did so. One in five of the largest firms opened a new manufacturing location within the state and even more of these larger firms (31%) reported opening a sales office abroad.

Future Expected Production Levels and Job Creation

With all of this activity, we asked firms about their expectations about the possible future growth of their enterprises and about prospects

for adding additional workers to their Massachusetts operations.

Back in 2007, we were somewhat surprised by the level of optimism expressed in our survey results and in our personal interviews with CEOs, owner-managers, and other manufacturing executives in Massachusetts.⁴³ The decline in manufacturing's share of Gross State Product (GSP) between 2000 and 2006 and the large reductions in employment during this period suggested to us that firms would be cautious about predicting better times ahead. As it turned out, despite these discouraging trends, Massachusetts manufacturers were optimistic about the future. More than half (55%) of all the firms answering our 2007 survey expected to expand production over the next five years. Another 28 percent expressed the opinion that they would be able to sustain production at current levels. Only about one in ten firms

(11%) expected reduced production and one in twenty thought they would cease production by 2012.

Small firms were somewhat less optimistic about increasing production. Only about one in two small firms (47%) expected to increase production levels in-state, whereas two-thirds of medium-sized and large firms (67% and 65%, respectively) projected such an outcome. Seven percent of small firms expected to cease production within five years, while this was true of only 3 percent of medium-sized firms and none of the large firms. Nonetheless, even for small firms, an expectation of a 93 percent survival rate demonstrated a great deal of self-confidence in their ability to remain in business.

When it came to employment, Massachusetts manufacturers in 2007 were even more bullish. More than 60 percent of all firms projected at least some expanded employment by 2012, with nearly 9 percent believing they would be in a position to boost their workforce in the state by 25 percent or more. Another one in five (21%) responded that they expected to increase employment by anywhere from 11 to 24 percent. Fewer than one in eight (12%) reported that reductions in employment from 2007 levels were likely. Again, there was little difference in employment projections by size of firm. Indeed, the survey results suggested that a smaller percentage of small firms expected to reduce employment than either medium-sized or larger firms.

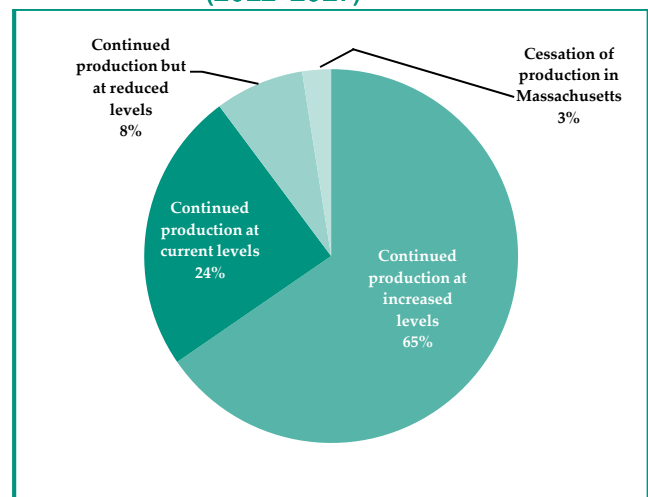
Of course, none of the manufacturers in Massachusetts – nor anyone else for that matter – could have foreseen in 2007 what was just around the corner in terms of the depth and duration of the recession that began that December. As such, most of the firms that made upbeat projections probably found their expectations crushed by the economic downturn.

In 2012, we asked identical questions about expected production levels and projected employment. What

we found is that after enduring more than four years of recession and slow economic recovery, Massachusetts manufacturers entertain expectations about the future that express, if anything, more confidence than in 2007.

Figure 6.1 reveals the proportion of all manufacturers in the state by their expectations about production levels five years out in 2012. Now nearly two-thirds of all firms (65%) expect production levels to be higher in 2017 than today. Another one in four project that their production levels will be sustained at current levels. Only 8 percent predict reduced production and now only 3 percent expect to cease production in the Commonwealth altogether.

Figure 6.1 Expected Production Levels of Massachusetts Manufacturing Firms over the Next Five Years (2012-2017)



Source: Dukakis Center Manufacturing Survey, 2012

Part of the more optimistic projections we find in the 2012 survey stems from the fact that some, or perhaps many, of these firms are starting up from a deep hole in their production levels caused by the recession. Nonetheless, given the current uncertainty about the national economy as well as the precarious position of much of the global economy, such optimism suggests that the investments those firms have made in the past five years may hold them in good stead unless the entire economy sinks.

As **Table 6.2** reveals, results by firm size do not diverge very much from the *relative* rankings we found in 2007. Yet, regardless of size, firms are more optimistic about their futures today than back then. Nearly 54 percent of small firms today expect to be producing at increased levels five years from now, compared with 47 percent in 2007. For medium-sized firms, this statistic jumps from 67 percent to 79 percent. The largest firms express the greatest increase in optimism with the expectation of increased production leaping from 65 percent to 83 percent.

Table 6.2 **Expected Production Levels of Massachusetts Manufacturing Firms over the Next Five Years (2012 – 2017) by Size of Firm**

Expected Level	1-19	20-100	101+
Continued production at increased levels	53.8%	78.5%	82.9%
Continued production at current levels	32.8%	14.6%	11.4%
Continued production but at reduced levels	9.0%	5.9%	5.7%
Cessation of production in Massachusetts	4.3%	1.0%	0.0%

Source: Dukakis Center Manufacturing Survey, 2012

Similarly, a smaller proportion of firms are expecting a drop off in production levels. For firms with fewer than 20 employees, only 9 percent expect to be producing less five years from now compared with 13 percent of small firms back in 2007. For medium-sized firms the difference over time is smaller (6% in 2012 vs. 8% in 2007), but for larger firms, the number expecting to shrink production has decreased from 15 percent in 2007 to only 6 percent in the 2012 survey. Moreover, fewer than one in twenty small firms (4.3%) expect to close down their Massachusetts operations by 2017, something which virtually no larger firms with 20 or more employees expects to do.

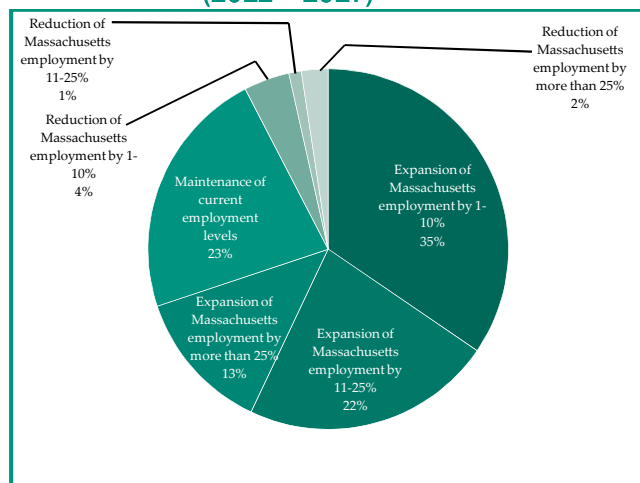
All of this suggests a new-found stability in the Massachusetts manufacturing environment. The ability of this sector to hold its own in terms of employment since 2009 and its growing share of state output suggests that the optimism reported in the 2012 survey may not be misplaced.

Even with expected increases in the use of new technology and the increased productivity that usually accompanies it, manufacturing firms in the Commonwealth are so confident of increasing their production levels that many expect they will need to increase employment to meet the higher demand for output. This is clear in **Figure 6.2**.

Of all the surveyed firms, only 7 percent project employing fewer workers in 2017 than they employ today. Furthermore, only half of these firms expect to cut employment by more than 10 percent. About a quarter of all firms (23%) project that their employment levels will remain at near current levels. *That leaves 70 percent expecting to expand their workforce – five percentage points higher than expected in 2007.* More than a third (35%) are so confident in their ability to increase their sales that they project increasing their employment by more than 10 percent, and a third of these by more than 25 percent.

Medium-sized and larger firms are more optimistic about increasing employment, but even 59 percent of smaller firms expect at least some increase in their employment levels. For those firms currently with 20 or more employees, more than four out of five expect to boost employment by 2012 (see **Table 6.3**). Fewer than 10 percent of the smallest firms expect to cut jobs and this number falls to practically zero for medium-sized and larger firms.

Figure 6.2 5 Year Employment Projections of Massachusetts Manufacturing Firms (2012 – 2017)



Source: Dukakis Center Manufacturing Survey, 2012

Table 6.3 5-Year Employment Projections of Massachusetts Manufacturing Firms by Firm Size (2012 – 2017)

Employment Projection	1-19	20-100	101+
Expansion of Massachusetts employment by 1-10%	29.4%	37.6%	43.5%
Expansion of Massachusetts employment by 11-25%	17.2%	31.2%	27.5%
Expansion of Massachusetts employment by more than 25%	12.5%	13.2%	10.1%
Maintenance of current employment levels	31.4%	13.7%	10.1%
Reduction of Massachusetts employment by 1-10%	3.7%	3.9%	5.8%
Reduction of Massachusetts employment by 11-25%	1.7%	0.5%	1.4%
Reduction of Massachusetts employment by more than 25%	4.1%	0.0%	1.4%

Source: Dukakis Center Manufacturing Survey, 2012

The survey results establish that firms are planning to increase employment, but the question arises: what kinds of firms expect an increase over the next five years? One might suspect these would be the firms operating with the most sophisticated technology. However, the results of our survey do not support this supposition. In fact, as **Table 6.4** reveals, the small number of firms in our survey in the most technologically advanced industries like aerospace, computers, electronics, and pharmaceuticals are, if anything, less optimistic about the chances for increasing employment than other firms. This may reflect concerns about cuts in defense spending, continued competition from China and elsewhere in the computer and electronics industries, and the potential for cheaper generic drugs competing for a share of the medical drug industry, not to mention pressure to reduce health care spending.

Medium High-Tech manufacturing firms and Medium Low-Tech companies are the most confident about their future employment levels. These industries include scientific instruments, motor vehicle parts, electrical machinery, and chemicals as well as rubber and plastic products and fabricated metal products. These appear to be industries which have a chance of bringing production back to Massachusetts because of their ability to use advanced technology to improve their competitiveness.

Even two-thirds (65%) of the Low-Tech manufacturers in the Commonwealth are expecting to produce additional jobs over the next five years. Many of these firms are food and beverage processors, and they seem to be at least partially immune from foreign competition.

Table 6.4 Year Employment Projections of Massachusetts Manufacturing Firms by Level of Technology (2012 - 2017)

Employment Projection	High-Technology	Medium-High-Technology	Medium-Low-Technology	Low-Technology
Expansion of Massachusetts employment by 1-10%	10.0%	37.1%	34.9%	37.7%
Expansion of Massachusetts employment by 11-25%	10.0%	17.1%	23.6%	15.9%
Expansion of Massachusetts employment by more than 25%	10.0%	25.7%	12.6%	11.3%
Maintenance of current employment levels	60.0%	14.3%	21.3%	27.2%
Reduction of Massachusetts employment by 1-10%	0.0%	2.9%	4.6%	4.0%
Reduction of Massachusetts employment by 11-25%	0.0%	2.9%	1.0%	1.3%
Reduction of Massachusetts employment by more than 25%	10.0%	0.0%	2.1%	2.6%
Total Expecting Expanded Employment	30.0%	79.9%	71.1%	64.9%

Source: Dukakis Center Manufacturing Survey, 2012

Projected Merger and Acquisition Activity in Massachusetts Manufacturing

One of the ways that Massachusetts manufacturing firms expect to boost their production and employment is through mergers and acquisitions. According to the 2012 survey, about 40 percent of all firms in the state expect to acquire another firm, merge with another company, or be acquired by one. According to **Table 6.5**, half (50%) of the largest firms are planning such corporate deals. Moreover, the survey reveals that companies with more than 100 employees are four times more likely to expect to merge and expand with companies *outside* the Commonwealth than inside. This presumably helps these firms extend their reach to national and international markets, while keeping their main business focus planted in Massachusetts.

About 13 percent of small firms with fewer than 20 employees believe there is a good possibility of being acquired by another Massachusetts company during the next five years while one in six (17%) expect they could be acquired by a non-Massachusetts firm. Even one in ten (9.5%) of the largest companies expect the possibility of being acquired by a national or international company in the near future. A somewhat

smaller number of firms of all sizes expect to enter into mergers with other companies either inside or outside the state.

Table 6.5 Anticipated Merger and Acquisition Activity by Massachusetts Manufacturing Firms by Firm Size (2012 - 2017)

Anticipation	All	1-19	20-100	101+
Acquisition of additional MA-based companies	11.1%	9.4%	13.1%	13.6%
Acquisition of additional companies based outside of MA	16.7%	8.7%	18.5%	50.8%
Being acquired by another MA company	11.1%	12.7%	9.0%	3.1%
Being acquired by a non-MA based company	16.7%	17.0%	18.5%	9.5%
Merging with another MA company	8.9%	9.9%	7.4%	4.6%
Merging with another non-MA company	10.8%	9.9%	10.6%	9.2%
No current plans for merger/acquisition	60.2%	63.4%	59.6%	50.0%

Source: Dukakis Center Manufacturing Survey, 2012

This suggests that many of these companies believe they remain viable partners, which reflects the value of their assets, their technological know-how, and their customer base.

Geographic Expansion

Another indication of the projected viability of Massachusetts manufacturers is their expected plans to expand their businesses into communities other than those where they are based now. As **Table 6.6** demonstrates, a little more than half (52%) of all the firms in the survey suggest they have expansion plans for the next five years. Of those who do, about two-thirds (67%) expect to build or acquire facilities in other Massachusetts cities and towns. A quarter (27%) project expanding into other New England states while nearly a third (31%) believe that they will add to their business by expanding in the U.S., but outside of New England. Overall, about one in six firms (17%) say they will be considering opening up operations outside the country.

Table 6.6 Business Expansion Plans of Massachusetts Manufacturers by Firm Size (2012 - 2017)

Expansion Location	All	1-19	20-100	101+
Massachusetts	66.7%	67.7%	67.6%	55.6%
New England (Excluding MA)	26.5%	23.6%	28.6%	23.4%
Other states in the U.S.	31.3%	22.5%	38.2%	51.0%
Outside the U.S.	17.3%	5.7%	20.2%	49.0%
No expansion plans	47.9%	55.4%	38.5%	35.6%

Source: Dukakis Center Manufacturing Survey, 2012

With the exception of national and international destinations, this expansion activity varies less by firm size than one might imagine. While nearly half (49%) of all large firms are contemplating global expansion, only about one in twenty (6%) small firms have such aspirations. Likewise, where about half (51%) of large firms

see some potential in expanding outside of New England, only 23 percent of small firms and 38 percent of medium-sized enterprises expect to do the same. On the other hand, two-thirds (68%) of these small firms can see themselves expanding their Massachusetts operations – a proportion somewhat larger than reported by large firms. Regardless of size, about a quarter of all firms see expansion potential in other New England states.

Once again, these expansion plans paint a picture of a viable sector poised to grow and expand both inside the Commonwealth and beyond.

Exports and Export Potential

Finally, we asked firms whether they currently export any of their products or services to other countries and whether they have plans to do so sometime over the next five years.

Currently, more than half (55%) of the manufacturing firms in Massachusetts export at least some of their goods or services globally. As **Figure 6.3** depicts, of this 55 percent, about 5 percent export half or more of their product. Another 7 percent export between a quarter and half of their output, while the remaining 43 percent sell up to a quarter of that produced in Massachusetts in foreign markets. This suggests reasonably strong export performance for the Commonwealth’s manufacturers.

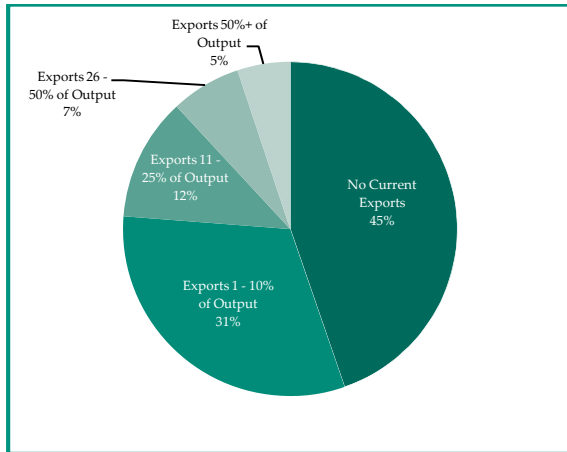
Large firms, of course, have the edge in the export market. According to **Table 6.7A**, more than five out of six (84%) of large firms are active in the export market with two-thirds (66%) of medium-sized firms doing the same, and about 43 percent of small firms exporting at least some of their products or services.

While one in seven (15%) large firms export more than half of what they produce, less than 3 percent of small firms and only 6 percent of medium-sized firms are this globally oriented. It can be concluded that, while many firms have

dipped their toes in the export trade, international trade is still dominated by the largest firms in the Commonwealth.

This discrepancy in firm participation is no doubt due to the intricacies of dealing with customs unions, exchange rates, and foreign languages. Large firms have the wherewithal to handle such complexity while many smaller firms have neither the knowledge nor the staff support to enter big time into global markets.

Figure 6.3 Export Proportion of Massachusetts Manufacturers



Source: Dukakis Center Manufacturing Survey, 2012

Despite these hurdles, a small number of small and medium-sized companies are contemplating entering export markets for the first time over the next five years. About 11 percent of all firms that do not currently export anything are making at least tentative plans to join the global marketplace. This ranges from 9 percent of non-exporting small firms to 18 percent of non-exporting medium-sized firms, to more than a quarter (27%) of the large non-exporting firms (Table 6.7B).

With greater technical support for exporting, it is conceivable that a substantially larger number of these firms could become global competitors.

Table 6.7A Massachusetts Manufacturers in the Export Market by Firm Size

Export Level	All	1-19	20-100	101+
No Current Exports	45%	57%	34%	16%
Exports 1 - 10% of Output	32%	26.6%	37.4%	36.2%
Exports 11 - 25% of Output	12%	9.4%	13.8%	21.7%
Exports 26 - 50% of Output	7%	4.7%	8.9%	11.6%
Exports 50%+ of Output	5%	2.7%	5.9%	14.5%

Source: Dukakis Center Manufacturing Survey, 2012

Table 6.7B Massachusetts Manufacturers Exporting vs. Planning to Export

Export Level	All	1-19	20-100	101+
Percent of Firms Exporting to Global Markets	55%	43%	66%	84%
Percent of Non-Exporting Firms planning to export sometime over next 5 years	11%	9%	18%	27%

Source: Dukakis Center Manufacturing Survey, 2012

Praise and Scorn from Massachusetts Manufacturers

During the interview phase of our research, we inquired at length about the role of state government vis-a-vis the manufacturing sector. The predominant attitude can be summed up thusly: manufacturers in the Commonwealth sink or swim, succeed or fail, on the basis of their own talent and tenacity and most do not see state government as a meaningful factor in determining the outcome either way. The more conservative attitude within this broad perceptual framework is one of mild hostility toward state government while at the other end of the spectrum are those firms that have taken advantage of some state programs and report reasonable to respectable results.

While the majority of our interviewees reported little to no utilization of state incentive or support programs, a minority of firms interviewed have utilized state programs including: MassDevelopment Funds, SBA loans, investment tax credits, consulting and training services from the Mass Manufacturing Extension Partnership (MEP), and workforce development funds from the Workforce Training Fund. Of the companies reporting some utilization of state programs, the program most often cited as a strong positive contributor to firm performance is MassMEP. Smaller firms in particular, those perhaps lacking the resources to do essential training in lean manufacturing practices and/or quality standards and certification training/preparation, have generally found MassMEP to be an invaluable partner. In contrast to MassMEP, an organization that works closely and directly with individual companies, the Workforce Training Fund (WTF) is often criticized for its “cumbersome”, “bureaucratic” and “expensive” application and compliance process. Several firms interviewed reported utilization of WTF resources but these acknowledgements were usually followed by a comment suggesting the firm would not seek WTF resources a second time.

One exception to this general refrain came from an executive in one of the state’s largest manufacturers. This manager praised the work it received through the state’s Workforce Training Grant program and suggested that it would have relocated thousands of Massachusetts’ manufacturing jobs if it and, equally important, its union had not successfully adopted the lean manufacturing principles it acquired through the grant program. This employer was convinced that this program was a success for both itself and the state.

Some smaller firms also praised the Workforce Training Grant program. One bakery in the Western part of the state employing 45 staff lauded MassMEP for its lean manufacturing training and found the Workforce Training Fund’s Express Grants Program to be well-run and beneficial to the company along with the local career center.

A small plastics fabrication company in central Massachusetts received both an SBA loan and a Workforce Training Fund grant in 2009. Along with taking advantage of the work share program, this company was able to survive the darkest days of the recession while maintaining continuity of its entire workforce.

In 2008 and 2009, a medium-sized electronics company on the North Shore also used the work share program to avoid layoffs when the industry was hit by the Great Recession. However, the company found that the paperwork needed to successfully apply for investment tax credits and R&D credits was burdensome as was the “dissertation” needed in order to apply for workforce training grants.

Others who praised state programs once they utilized them were still critical of the fact that they found it difficult to find out about these programs in the first place. They would like the Commonwealth to better market these programs so that all firms with the potential to benefit from them will know about them. In the case of a small lighting company in Western Massachusetts, the owners found out about state-sponsored workforce training assistance because of a chance meeting with a UMass Amherst business school faculty member. We heard a smattering of other complaints, almost all of them related to what some firms see as the cumbersome and time-consuming bureaucratic hoops that they need to negotiate to avail themselves of training funds and other state assistance. Some complained that new firms coming into the Commonwealth receive better treatment from the state than do those that have been here for decades.

The common element contributing the most toward a positive view of government is the presence of a strong relationship between the business owner or senior executive and a knowledgeable and trustworthy individual working in government. Business owners build relationships with individuals and not with agencies or organizations. Often when an owner commented favorably about support from MassMEP, they named a specific staff person/consultant. Similarly, in Hampden County, where one is more likely to hear positive comments about the role of state government, there is usually mention of a specific individual who is often viewed as a business partner.

What Massachusetts Manufacturers Want from Government

The 2007 survey included a battery of questions regarding how Massachusetts manufacturers viewed the “business climate” for their sector in the Commonwealth and what they hoped government might do in order to help them compete more successfully in the future.⁴⁴ In general, their responses fell into three primary areas:

- Changing government’s attitude toward manufacturing and manufacturers
- Reducing some of the direct costs of doing business in the Commonwealth
- Improving and expanding workforce training

For the first of these, we noted a broad consensus about what we called the “Rodney Dangerfield” syndrome. Manufacturers in 2007 felt they had been largely ignored by state and local government and given very little respect despite the size of this sector and the important contributions it makes to the Commonwealth’s prosperity. We noted that:

Too often, they feel, state and local officials act as though the era of manufacturing is over in the Commonwealth and therefore this sector can be the recipient of “benign neglect” rather than affirmative action. So much attention is given to the “new sectors of the state’s economy – the life sciences, biotech, nanotech, and financial services – that seldom does anyone stop for a second to consider just how many workers “old” traditional manufacturing still employs and how much the sector adds to gross state product (GSP).⁴⁵

We can now report that since 2007, the Commonwealth has taken a number of important measures to eliminate the Rodney Dangerfield syndrome. This began with sweeping economic development legislation proposed by the Governor and passed by the Massachusetts legislature in August 2010.⁴⁶ Among its many provisions, Chapter 240 of the General Laws of Massachusetts reorganized economic development in the Commonwealth and introduced a num-

ber of programs that will assist manufacturers in the state. Among these measures were:

- Creation of the Massachusetts Growth Capital Corporation (MGCC) with a \$20 million initial allocation for providing low interest loans and free technical assistance to Massachusetts companies including manufacturing enterprises. The MGCC specifically is charged with assisting “firms in specific mature industries for the purpose of technological investment or upgrading management operations in order for the business to maintain future economic stability.”⁴⁷
- The recapitalization of the Massachusetts Technology Development Corporation (MTDC) to assist companies with incorporating technological advances in their business operations.
- Creation of a statewide Economic Development Planning Council with the purpose of developing and implementing “a written comprehensive economic development policy for the Commonwealth and a strategic plan for implementing that policy.”⁴⁸

The Planning Council released its first major report, *Choosing to Compete in the 21st Century* in December 2011. Among its 55 action steps which should be of assistance to the state’s manufacturing industries are:

- Creation of a system to coordinate the expansion of “middle skills” education and workforce training programs working with community colleges, vocational-technical schools, and workforce investment boards.
- Expand the Workforce Training Fund
- Develop “best practice” workforce development programs specifically for the advanced manufacturing sector
- Increase the number of Science, Technology, Engineering, and Math (STEM) programs in the state to encourage more

workers to consider jobs in manufacturing

- Increased funding for the making and testing of product prototypes
- Raise the “profile of advanced manufacturing as an integral part of our innovation economy by encouraging young people to enter the sector”
- Creation of a regulatory “ombudsman” to address regulatory matters of interest to businesses including manufacturers
- Simplify or eliminate state regulations that are particularly onerous for small businesses
- Expand the state’s national and international marketing of Massachusetts produced products
- Reduce the corporation income tax from 9.5% in 2009 to 8.0% by 2012

While most of these provisions apply to all Massachusetts firms, a companion report was prepared simultaneously that dealt specifically with manufacturing. *Building Bridges to Growth* developed by the Massachusetts Technology Collaborative for the Commonwealth’s Executive Office of Housing and Economic Development provided a roadmap for advanced manufacturing in Massachusetts.⁴⁹ It focused on five major issues, all of which had been highlighted in the 2007 *Staying Power* report.

- Promoting Manufacturing
- Workforce and Education
- Technical Assistance and Innovation
- Cost of Doing Business in the Commonwealth
- Company Access to Capital

The *Building Bridges* report identified “small and medium sized enterprises (SMEs) as a particularly important target for a state role to enhance the competitiveness of manufacturing in Massachusetts.”⁵⁰ The report called for the creation of a Massachusetts Advanced Manufacturing Collaborative (AMC) which would recommend specific steps the Commonwealth

could take to enhance the manufacturing sector in the state. On November 28, 2011 with the release of the report, the AMC was formally launched by Massachusetts Governor Deval Patrick. The Collaborative has been charged with working closely with leaders of the manufacturing sector to address virtually all of the concerns expressed in the 2007 *Staying Power* survey.

Specific Actions taken by the State Government to Address Manufacturers' Concerns

There is now ample evidence that the Commonwealth has recognized the importance of its manufacturing sector both as a source of employment and also innovation. Over the past five years it has taken steps to address many of the most important concerns of manufacturers.

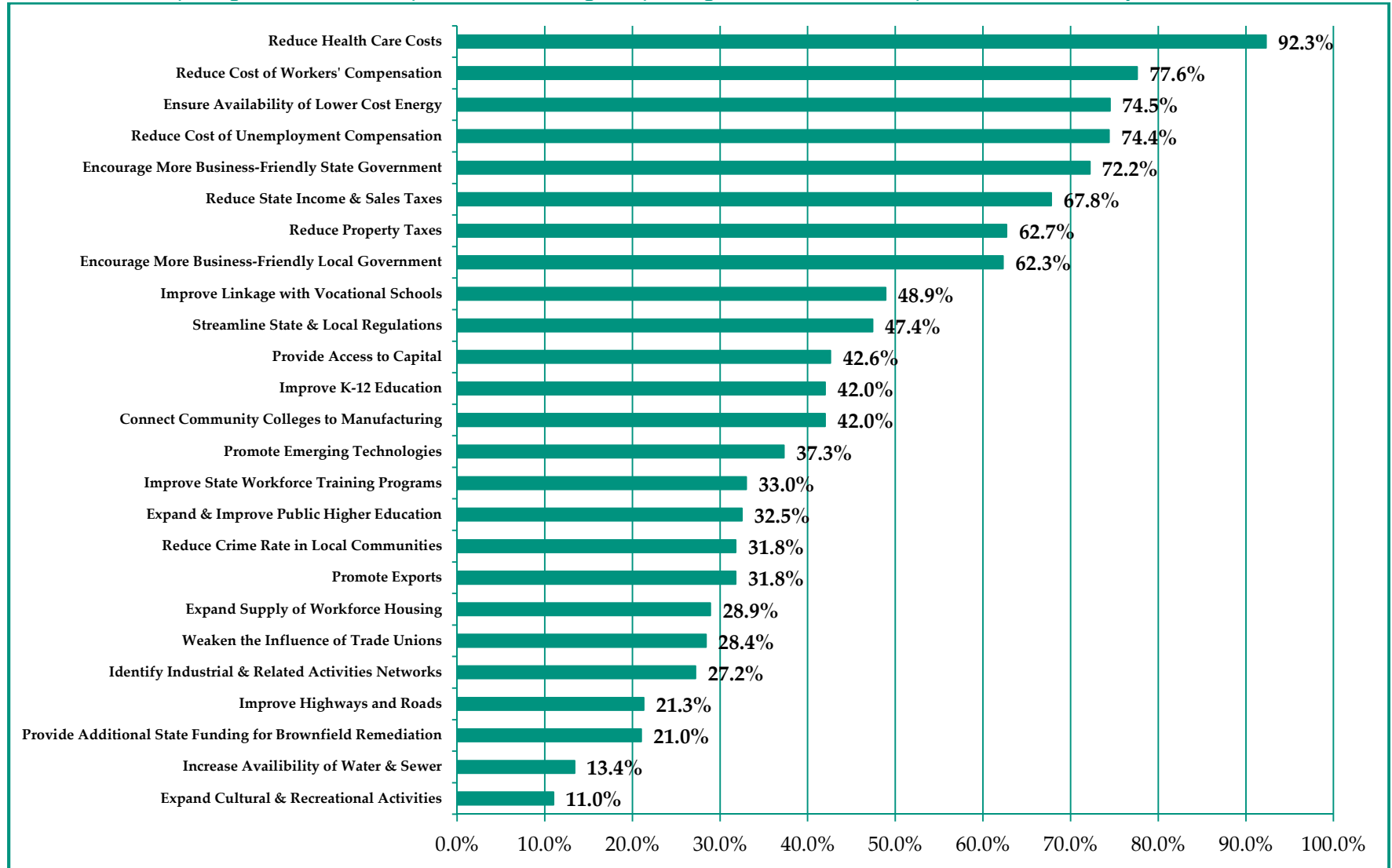
The 2007 Dukakis Center survey was able to capture and rank the actions that manufacturers most wanted to have the state government address. This ranking is reproduced in **Figure 6.4**.⁵¹ Highest on the list was a reduction in the cost of health insurance with over 90 percent of respondents claiming this issue as critical to their operations. Ranked #2 was action to reduce workers compensation costs with more than three out of four firms naming this as a priority. Reducing energy costs was #3 followed by reducing unemployment insurance costs, encouraging a more business-friendly state government (particularly related to regulatory reform), and reducing state income and sales taxes. Also on the list, and garnering support from at least 30 percent of the firms, was improving the linkage to vocational schools, providing access to capital, connecting the community colleges to manufacturing, and the promotion of exports.

Perhaps most important because of its #1 ranking among manufacturers' calls for action has been Massachusetts' first-in-the-nation attempt to aggressively control the growth of health care costs through legislation passed in the summer of 2012. The law contains provisions that are aimed at holding the annual increase in total health care spending to the rate of growth of the state's Gross State Product (GSP) for the first five years, through 2017, and then even lower for the next five years, to half a percentage point below the economy's growth rate, and then back to GSP.⁵²

In order to try to meet these targets, the law requires government agencies including MassHealth, the Group Insurance Commission (GIC), and the Connector to use global and other alternative health care payment systems and to encourage more cost-efficient forms of health care delivery. To monitor and address the market power and price disparities that can lead to higher costs, the law allows a Health Policy Commission to conduct a cost and market impact review of any provider organization to ensure that they can justify price variations.

This new approach to containing health care costs is estimated to save \$40,000 per family in health care premiums over the next 15 years. Since nothing like this legislation has been tried before, only time will tell if the targets are reasonable and the estimated savings actually ensue without reducing the quality of health care delivery. Nonetheless, this appears to be a serious effort to address the highest priority state issue identified in the 2008 *Staying Power* report and, if successful, could slow the rise in employer-paid health insurance premiums, reducing the overall cost of labor for Massachusetts manufacturers as well as other firms.

Figure 6.4 Actions State and Local Government Can Take to Help Manufacturers Sustain or Expand their Operations in Massachusetts – Percent reporting action would be important to sustaining or expanding their Massachusetts operations – 2007 Survey Results



Source: Dukakis Center Manufacturing Survey, 2007

As for the #2 call for lowering workers' compensation costs, in 2008 the Workers' Compensation Rating and Inspection Bureau (WCRIB), a private, non-profit association of insurers, requested a 2.3 percent hike in workers' comp rates in Massachusetts. After investigating this request, the state's Division of Insurance not only refused to permit this increase in rates, but ordered a reduction averaging 1.0 percent. This marked the ninth reduction in Workers' Comp insurance rates in the Commonwealth since 1994. This reduction alone was estimated to save Massachusetts businesses \$11 million.⁵³

In subsequent years, rates continued to be cut – by 2.4 percent in 2010 and in 2012 rates were fixed at 2011 levels. This should save businesses \$65 million over what they may have paid if the WCRIB's request for a 6.6 percent increase had been granted.⁵⁴

It is not surprising that three-quarters (75%) of manufacturers listed lowering energy costs in Massachusetts as one of the most important things that could be done to help the industry remain price competitive. Between 1999 and 2007, the average price per kilowatt of electricity delivered to industrial customers in the Commonwealth soared by 73 percent to 13.03 cents. Back in 1999, industrial electric rates in Massachusetts were already 70 percent higher than the U.S. average. By 2007, they were double the national rate.⁵⁵

Electric rates continued to rise in Massachusetts and the nation as a whole through 2008 when the average price for the state's industrial customers peaked at 14.85 cents per kilowatt. Since then, however, in part because of the recession and lower demand, prices have fallen steeply. By May 2012, the average price was 12.94 cents per kilowatt, down nearly 13 percent from its peak. One presumes with the expansion of natural gas production, much of it in northeastern and midwestern states, the cost of electric generation in Massachusetts will con-

tinue to decline and this should be reflected in the prices charged industrial consumers.

There is not a great deal the state can do to directly reduce the price of energy paid by manufacturers, but it can try to encourage energy conservation and reduce the state's own demand for power – thus reducing overall demand for electricity and easing upward price pressure. Toward this end, the Massachusetts Department of Energy Resources awarded over \$70 million in federal American Recovery and Reinvestment Act (ARRA) funds for various energy efficiency and renewable energy projects in the state.⁵⁶

With the help of the Commonwealth, 103 cities and towns in Massachusetts have been designated as "Green Communities" for their actions to reduce energy consumption. Many of these municipalities benefited from nearly \$15 million in ARRA dollars to fund energy efficiency and renewable energy projects. While it is hard to estimate the impact of these efforts on overall industrial electric rates, it should be noted that while per kilowatt electric prices have declined by 13 percent since 2008 in Massachusetts as noted above, prices nationwide have declined by just 4 percent. That contrasts with the period 1999 to 2007 when industrial electric rates soared by 73 percent in Massachusetts compared with just 44 percent nationally.

As for making Massachusetts more "business-friendly" – something called for by more than 70 percent of manufacturers in the 2007 survey – the state has moved aggressively on a number of fronts. It has created the Office of Permitting Ombudsman in the Executive Office of Housing and Economic Development to help expedite the permitting system in the state. It has streamlined the Chapter 43D permitting approval process to do the same. It created the Massachusetts Growth Capital Corporation with \$35 million in start-up funds to provide additional low interest loans and technical assistance to Massachusetts businesses with a fo-

cus on manufacturing. And it has required all state agencies to undertake small business impact statements in order to streamline or in some cases even eliminate state regulation.⁵⁷

Finally, as for corporate taxes, Massachusetts has reduced its corporate income tax rate from 9.5 percent in 2008 to 8.0 percent in 2012.⁵⁸

All of these efforts represent a first step in improving the economic environment for manufacturers in Massachusetts and may help these firms meet the high expectations they have expressed in the 2012 survey for expanded production and job creation in the state.

Promoting Manufacturing in Massachusetts

As we noted in the original *Staying Power* report, a major problem facing the industry – at least back in 2007 - was that its reputation was so compromised that it received little respect from public officials, from the mass media, from school counselors, and from the general public. While recent attention by Massachusetts government officials, by President Obama in his 2012 State of the Union Address, and by the media has begun to resurrect the industry's status, there appears to be much that could still be done to encourage support for the sector and especially to encourage young workers to consider a career in manufacturing.

To assess what might be the best ways to promote manufacturing in the Commonwealth, the final set of questions on the 2012 survey asked firms for their recommendations for what they thought were the most important initiatives that might be taken by the industry itself, by their own firms, and by the state. We asked respondents to consider the importance of:

- Working with school or community college instructors to incorporate industry standards into their curricula
- Creating a certificate in manufacturing technology

- Serving as mentors/advisors at selected vocational schools or community colleges
- Speaking to parent organizations and student groups about careers in manufacturing
- Contributing machinery, tools, or other materials to schools
- Exhibiting at education, career, and technology fairs
- Instituting company-sponsored educational scholarships
- Hiring vocational/community college teacher to train company employees

Table 6.8 provides the results from this inquiry. At least a third of all firms were fairly cynical about every one of these initiatives, suggesting that none of these were important for the well-being of the industry. Nevertheless, four of the listed possible initiatives received strong support from at least a quarter of the firms in the survey. The one ranked highest in terms of being “very important” or “extremely important” was working with high school and community college instructors to incorporate industry standards into their courses. More than 30 percent of respondents ranked this effort as highly important.

Right behind this was support for the idea of creating a certificate in manufacturing technology with 28 percent of respondents marking this very or extremely important. Ranked equally important with the certificate notion is to have company managers and employees serve as mentors and advisors in vocational/technical schools and community colleges.

One in four (25%) respondents thought it was important that company managers be invited into schools to address parent organizations and student groups about the current and future state of manufacturing and how to prepare for the good jobs that will be available in the industry.

About one in five (21%) supported the idea of companies contributing some of their surplus machinery and tools to schools to assist these schools in offering practical skills to their students.

There was even a little support for companies providing educational scholarships so that their own employees could attend college and a little support for hiring vocational school teachers and community college instructors to train their own employees.

We believe these ideas have some merit and should be explored further in order to promote

Table 6.8 Recommendations for Promoting Manufacturing in Massachusetts

Recommendation	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very Important or Extremely Important
Working with School or Community College Instructors to Incorporate Industry Standards into Curriculum	32.3%	15.9%	21.4%	18.4%	11.9%	30.3%
Creating a certificate in manufacturing technology	35.2%	16.8%	20.4%	18.4%	9.1%	27.5%
Serving as mentors/advisors at selected vocational schools or community colleges	30.4%	20.1%	22.0%	18.6%	8.8%	27.4%
Speaking to Parent Organizations/Student Groups About Careers in Manufacturing	35.3%	21.0%	19.0%	15.1%	9.6%	24.7%
Contributing Machinery, Tools, or Other Materials to Schools	36.8%	21.3%	21.0%	12.9%	8.1%	21.0%
Exhibiting at Education, Career, and Technology Fairs	35.3%	21.2%	23.8%	12.9%	6.8%	19.7%
Instituting company-sponsored educational scholarships	43.9%	23.6%	18.2%	9.3%	4.9%	14.2%
Hiring vocational/community college teachers to train your employees	57.6%	19.6%	11.2%	7.9%	3.7%	11.6%

Source: Dukakis Center Manufacturing Survey, 2012

manufacturing in the state.

We probed further about the actual willingness of companies to participate in a variety of manufacturing promotion programs. These ranged from providing unpaid school-year internships to vocational and community college students, providing paid summer employment to students, and creating school-year co-op positions in their firms to having students work alongside experienced employees and providing part-time after-school or Saturday employment for students. **Table 6.9** provides a summary of their responses.

At least a third of respondents are not willing to become involved in any of these programs, either because they believe they are not useful or because they do not have the resources or time to participate. Yet 44 percent of respondents are at least “fairly willing” to consider providing unpaid school-year internships and the

Not surprisingly, we found some differences by size of firm as shown in **Table 6.10**. For the most part, the larger the firm, the more willing it is to participate. Nearly two-thirds (66%) of large firms are at least fairly willing to consider offering paid summer employment, twice as

same percentage are fairly willing to provide paid summer employment to vocational high school and community college students. Close to 40 percent of firms share the same willingness to consider hiring co-op students and having them work with their own employees to learn on-the-job skills.

many as small firms. More than half of the large firms are at least fairly willing to consider providing paid 3-6 month employment to vocational and community college students or at least offer unpaid school-year internships. Only a third of small firms feel the same way.

Table 6.9 Company Willingness to Participate in Manufacturing Promotion Programs

Promotion Program	Not Willing	Somewhat Willing	Fairly Willing	Very Willing	Extremely Willing	At Least Fairly Willing
Providing unpaid school-year internships to vocational and community college students	33.2%	22.7%	19.9%	16.7%	7.6%	44.2%
Providing paid summer employment to vocational and community college students	30.5%	25.4%	23.9%	14.8%	5.4%	44.1%
Providing paid 3-6 month employment to vocational or community college students (cooperative education)	35.9%	25.0%	21.5%	12.7%	4.9%	39.1%
Students working with experienced employees (job shadowing)	35.9%	26.5%	18.5%	15.2%	3.8%	37.5%
Providing part-time after-school/Saturday employment to vocational and community college students	55.0%	18.8%	14.7%	8.4%	3.1%	26.2%

Source: Dukakis Center Manufacturing Survey, 2012

Table 6.10 Company Willingness to Participate in Manufacturing Promotion Programs by Firm Size (Percent Fairly Willing – Extremely Willing)

Promotion Program	1-19	20-100	101+
Students working with experienced employees (job shadowing)	32.0%	44.7%	42.2%
Providing paid 3-6 month employment to vocational or community college students (cooperative education)	31.4%	45.7%	50.8%
Providing unpaid school-year internships to vocational and community college students	37.4%	48.7%	55.3%
Providing paid summer employment to vocational and community college students	34.1%	50.5%	65.7%
Providing part-time after-school/Saturday employment to vocational and community college students	22.0%	28.8%	29.2%

Source: Dukakis Center Manufacturing Survey, 2012

Beyond these programs aimed at encouraging students to enter manufacturing occupations, we asked firms to consider how important other initiatives might be to strengthening manufacturing in the Commonwealth. We asked respondents to consider the following list of possible options:

- Continued alignment of the vocational and community college curricula with industry needs
- Programs to increase school, student, and parent awareness of careers in manufacturing
- State-wide marketing campaign to promote manufacturing industry
- Expand professional development/continuous improvement programs for existing employees
- Create an employee applicant referral system
- Instituting company-sponsored educational scholarships

More than two out of five firms (43%) regard continued alignment of industry needs with vocational school and community college curricula as “very important” or “extremely important.” About the same proportion (41%) consider manufacturing awareness programs to be equally important, with about a third of firms (34%) giving a strong nod to state-wide marketing campaigns to promote manufacturing, and 30 percent encouraging strongly the expansion of professional development and continuous improvement programs for existing employees. A smaller, but not insignificant (23%), number of firms support creating an employee applicant referral system.

While there are differences of opinion of how useful some of these programs might be, there is a clear message emanating from manufacturers throughout the state: we need to do more to promote manufacturing in the Commonwealth and we need to get more young people interested in entering the industry.

Table 6.11 Company Assessment of Broad-Based Initiatives to Strengthen Manufacturing in Massachusetts

Initiative	Not Important	Somewhat Important	Fairly Important	Very Important	Extremely Important	Very or Extremely Important
Continued alignment of the vocational and community college curricula with industry needs	15.1%	16.3%	25.8%	25.0%	17.8%	42.8%
Programs to increase school, student, and parent awareness of careers in manufacturing	17.6%	17.4%	24.5%	24.7%	15.8%	40.5%
State-wide marketing campaign to promote manufacturing industry	24.7%	22.7%	18.7%	18.7%	15.2%	33.9%
Expand professional development/continuous improvement programs for existing employees	21.4%	21.8%	27.2%	21.1%	8.5%	29.6%
Create an employee applicant referral system	27.2%	27.7%	22.7%	15.5%	7.0%	22.5%

Source: Dukakis Center Manufacturing Survey, 2012

Conclusions

Taking into account all that we have learned from our analysis of recent employment and output data on the Massachusetts manufacturing sector, the responses we received from the nearly 700 firms we surveyed in the course of this research, the 56 interviews with CEOs and owner-managers, and our review of actions taken by the Commonwealth to reassert the importance of this sector in the overall state economy and to provide a more supportive business climate for it, we conclude that there is every reason to believe that manufacturing has a vibrant future in Massachusetts. Specifically, we project a future in which manufacturing:

- Continues to invest aggressively in advanced technology thereby improving its productivity
- Continues to develop new products and improve both service delivery and quality contributing to its competitive position in national and international markets
- Boosts its sales efforts beyond the state's borders and increases its foreign export share; and
- Receives increased respect and tangible support from the Commonwealth to lower the cost of doing business in the state
- As a result, we project that Massachusetts manufacturers will:
- Continue to be responsible for approximately 12 percent of total state output for the foreseeable future
- Maintain employment for more than 235,000 workers over the next ten years

- Continue to provide the state's second highest total payroll given its relatively high wages and salaries
- Play a key role in the continued revival of the state's older industrial cities outside of Greater Boston; and
- Provide up to 100,000 new job opportunities over the next ten years as a large share of the sector's current workforce retires or moves on to other industries.

These outcomes are not guaranteed, of course. If the U.S. economy continues to grow slowly or experiences another major economic downturn, or if international market demand for Massachusetts' manufactured products shrinks sharply as a result of continued recession conditions, particularly in Europe, these projections could turn out to be too rosy. If our vocational and technical high schools and community colleges do not increase their output of well-trained workers specifically targeted for manufacturing jobs, the job vacancies we project may not be filled, slowing the growth of our manufacturing sector or forcing firms to move to other locations where an ample supply of such workers can be found. If the Commonwealth's assurances of more attention to the manufacturing sector begin to flag, this may also undermine the forecasts we make here.

But clearly the economic and political environment for manufacturing in Massachusetts is improving based on the entrepreneurial activities of both the private and public sector, leading us to imagine a bright future for this once-neglected sector of our economy.

APPENDIX 1A

MASSACHUSETTS MANUFACTURING INDUSTRIES BY SIZE OF EMPLOYMENT (2010)

NAICS Code	Industry	Employment		
		2002	2007	2010
31-33	Manufacturing mfg	347,430	295,264	254,283
3345	Navigational, measuring, medical and control instruments mfg	30,816	28,472	26,139
3344	Semiconductor and other electronic component mfg	20,823	19,030	17,022
3231	Printing and related support activities	17,586	15,783	12,532
3341	Computer and peripheral equipment mfg	18,213	13,847	12,253
3364	Aerospace product and parts mfg	13,158	11,899	11,978
3261	Plastics product mfg	15,817	12,904	11,309
3391	Medical equipment and supplies mfg	14,879	11,281	10,759
3327	Machine shops, turned product and screw, nut and bolt mfg	10,508	10,701	9,957
3118	Bakeries and tortilla mfg	8,930	8,327	9,356
3254	Pharmaceutical and medicine mfg	8,294	9,180	9,136
3399	Miscellaneous mfg	14,672	11,167	8,886
3222	Converted paper product mfg	12,579	9,258	7,622
3323	Architectural and structural metals mfg	6,630	6,364	4,892
3329	Other fabricated metal product mfg	5,139	4,359	4,183
3332	Industrial machinery mfg	5,725	6,005	4,011
3328	Coating, engraving, heat treating, and allied activities	4,046	4,222	3,945
3339	Other general purpose machinery mfg	5,702	4,536	3,923
3322	Cutlery and hand tool mfg	6,155	4,846	3,767
3353	Electrical equipment mfg	6,563	4,299	3,545
3359	Other electrical equipment and component mfg	4,066	4,384	3,241
3335	Metalworking machinery mfg	4,874	3,559	3,216
3119	Other food mfg	2,028	2,782	3,138
3342	Communications equipment mfg	9,913	5,373	3,090
3117	Seafood product preparation and packaging	2,314	2,543	2,744
3333	Commercial and service industry machinery mfg	5,248	3,272	2,687
3121	Beverage mfg	2,988	2,587	2,578
3252	Resin, synthetic rubber, and artificial synthetic fibers and filaments mfg	1,958	3,155	2,403

NAICS Code	Industry	Employment		
		2002	2007	2010
3351	Electric lighting equipment mfg	2,529	2,555	2,327
3152	Cut and sew apparel mfg	4,421	2,706	2,129
3116	Animal slaughtering and processing	2,132	2,068	2,019
3221	Pulp, paper and paperboard mills	3,564	3,030	1,875
3321	Forging and stamping	3,188	2,356	1,857
3273	Cement and concrete product mfg	2,195	2,284	1,840
3133	Textile and fabric finishing and fabric coating mills	4,189	2,490	1,822
3371	Household and institutional furniture and kitchen cabinet mfg	3,907	2,749	1,808
3336	Engine, turbine, and power transmission equipment mfg	1,407	1,855	1,807
3219	Other wood product mfg	2,463	2,509	1,789
3255	Paint, coating and adhesive mfg	2,423	1,977	1,765
3372	Office furniture (including fixtures) mfg	1,472	2,157	1,695
3314	Nonferrous metal (except aluminum) production and processing	3,294	2,623	1,664
3259	Other chemical product and preparation mfg	2,734	1,657	1,545
3132	Fabric mills	5,390	2,478	1,538
3149	Other textile product mills	1,529	2,011	1,474
3279	Other nonmetallic mineral product mfg	2,258	1,753	1,390
3251	Basic Chemical mfg	1,085	1,168	1,126
3334	Ventilation, heating, AC and commercial refrigeration equip mfg	2,019	1,171	1,045
3315	Foundries	1,652	1,103	904
3256	Soap, cleaning compound and toilet preparation mfg	1,517	1,051	897
3363	Motor vehicle parts mfg	1,532	1,216	746
3141	Textile furnishings mills	1,660	1,223	672
3169	Other leather and allied product mfg	723	410	612

Source: Massachusetts Department of Labor and Workforce Development, ES-202 Employment and Wage Statistics

APPENDIX 1B

AVERAGE WEEKLY WAGE – ALL MASSACHUSETTS MANUFACTURING INDUSTRIES – 3RD QUARTER 2011

NAICS	Description	Average Weekly Wages
31-33	Manufacturing	\$1,418
3341	Computers and Peripheral Equipment	\$2,782
334	Computer and Electronic Product Manufacturing	\$2,026
3254	Pharmaceutical & Medicine Manufacturing	\$1,998
3345	Electronic Instrument Manufacturing	\$1,939
3342	Communications Equipment Manufacturing	\$1,851
3364	Aerospace Product & Parts Manufacturing	\$1,812
3353	Electrical Equipment Manufacturing	\$1,769
3332	Industrial Machinery Manufacturing	\$1,743
325	Chemical Manufacturing	\$1,738
3252	Resin, Rubber, and Synthetic Fibers	\$1,734
3322	Cutlery and Handtool Manufacturing	\$1,733
336	Transportation Equipment Manufacturing	\$1,710
3344	Semiconductor and Electronic Components	\$1,648
3336	Turbine and Power Transmission Equipment	\$1,606
3312	Purchased Steel Product Manufacturing	\$1,578
324	Petroleum & Coal Products Manufacturing	\$1,529
3241	Petroleum & Coal Products Manufacturing	\$1,529
3351	Electric Lighting Equipment Manufacturing	\$1,489
3251	Basic Chemical Manufacturing	\$1,454
333	Machinery Manufacturing	\$1,437
3255	Paint, Coating, & Adhesive Manufacturing	\$1,436
335	Electrical Equipment and Appliances	\$1,418
3333	Commercial & Service Industry Machinery	\$1,417
3391	Medical Equipment and Supplies Manufacturing	\$1,417
3346	Magnetic Media Manufacture & Reproducing	\$1,384
3329	Other Fabricated Metal Product Manufacturing	\$1,382
3339	Other General Purpose Machinery Manufacturing	\$1,356
3221	Pulp, Paper, and Paperboard Mills	\$1,329
3114	Fruit, Vegetable, & Specialty Foods Manufacturing	\$1,306
3321	Forging and Stamping	\$1,288
3112	Grain and Oilseed Milling	\$1,261
339	Miscellaneous Manufacturing	\$1,260
3115	Dairy Product Manufacturing	\$1,253
3331	Ag., Construction, and Mining Machinery	\$1,232

NAICS	Description	Average Weekly Wages
3359	Other Electrical Equipment & Components	\$1,227
3259	Other Chemical Preparation Manufacturing	\$1,217
3256	Cleaning Compound and Toiletry Manufacturing	\$1,207
3253	Agricultural Chemical Manufacturing	\$1,204
3314	Other Nonferrous Metal Production	\$1,191
332	Fabricated Metal Product Manufacturing	\$1,185
331	Primary Metal Manufacturing	\$1,178
3324	Boilers, Tanks, and Shipping Containers	\$1,173
3261	Plastics Product Manufacturing	\$1,160
3162	Footwear Manufacturing	\$1,154
3334	HVAC and Commercial Refrigeration Equip	\$1,152
326	Plastics & Rubber Products Manufacturing	\$1,140
312	Beverage & Tobacco Product Manufacturing	\$1,136
3121	Beverage Manufacturing	\$1,136
323	Printing and Related Support Activities	\$1,132
3231	Printing and Related Support Activities	\$1,132
3335	Metalworking Machinery Manufacturing	\$1,130
322	Paper Manufacturing	\$1,122
3273	Cement & Concrete Product Manufacturing	\$1,113
3366	Ship and Boat Building	\$1,107
3327	Machine Shops and Threaded Products	\$1,101
3271	Clay Product & Refractory Manufacturing	\$1,084
3279	Other Nonmetallic Mineral Products	\$1,084
327	Nonmetallic Mineral Product Manufacturing	\$1,074
3222	Converted Paper Product Manufacturing	\$1,072
3133	Textile and Fabric Finishing and Fabric	\$1,066
3399	Other Miscellaneous Manufacturing	\$1,064
3372	Office Furniture and Fixtures Manufacturing	\$1,060
3313	Alumina and Aluminum Production	\$1,047
3323	Architectural and Structural Metals	\$1,034
3362	Motor Vehicle Body and Trailer Manufacturing	\$1,019
337	Furniture and Related Product Manufacturing	\$1,008
3369	Other Transportation Equipment Manufacturing	\$994
3272	Glass and Glass Product Manufacturing	\$993
3352	Household Appliance Manufacturing	\$976
3379	Other Furniture Related Product Manufacturing	\$974
3371	Household and Institutional Furniture	\$963
313	Textile Mills	\$952
3311	Iron and Steel Mills and Ferroalloys	\$951
3363	Motor Vehicle Parts Manufacturing	\$946
3262	Rubber Product Manufacturing	\$938
3117	Seafood Product Preparation & Packaging	\$927

NAICS	Description	Average Weekly Wages
3219	Other Wood Product Manufacturing	\$908
3149	Other Textile Product Mills	\$907
3212	Veneer and Engineered Wood Products	\$902
3328	Coating, Engraving & Heat Treating Metal	\$895
3326	Spring and Wire Product Manufacturing	\$890
321	Wood Product Manufacturing	\$887
3315	Foundries	\$885
3116	Animal Slaughtering and Processing	\$877
316	Leather and Allied Product Manufacturing	\$859
3132	Fabric Mills	\$844
311	Food Manufacturing	\$841
3119	Other Food Manufacturing	\$836
314	Textile Product Mills	\$825
3325	Hardware Manufacturing	\$785
3159	Accessories and Other Apparel Manufacturing	\$700
3131	Fiber, Yarn, and Thread Mills	\$681
3211	Sawmills and Wood Preservation	\$675
3118	Bakeries and Tortilla Manufacturing	\$644
315	Apparel Manufacturing	\$632
3152	Cut and Sew Apparel Manufacturing	\$622
3113	Sugar/Confectionery Product Manufacture	\$610
3141	Textile Furnishings Mills	\$609
3169	Other Leather Product Manufacturing	\$523
3111	Animal Food Manufacturing	\$447

Source: Massachusetts Executive Office and Labor and Workforce Development

APPENDIX 1C

MANUFACTURING CONCENTRATION BY MUNICIPALITY, MASSACHUSETTS 2007 (GATEWAY CITIES HIGHLIGHTED)

Municipality	Manufacturing Employment per 1,000 Residents (2007)
Andover	340.4
Avon	308.2
Wilmington	290.9
Boxborough	265.8
Ayer	238.7
Hudson	182.8
Franklin	182.6
Marlborough	182.2
Bedford	176.6
East Longmeadow	170.4
Canton	148.7
Billerica	137.9
Danvers	132.9
Attleboro	132.7
Woburn	131.4
Chelmsford	121.6
Newburyport	114.8
Westborough	103.6
Montague	100.6
Clinton	99.6
West Bridgewater	99.6
Gloucester	97.0
Plainville	96.1
Taunton	94.9
North Andover	94.8
Southbridge	90.6
Holliston	90.0
Lee	89.8
Athol	88.4
Littleton	86.4
Orange	86.3
Milford	86.1
Amesbury	85.7
Spencer	84.1
Westfield	82.7

Municipality	Manufacturing Employment per 1,000 Residents (2007)
Chicopee	81.7
Norwood	81.6
New Bedford	79.6
Dudley	79.0
Beverly	78.8
Leominster	78.4
Ipswich	77.7
Oxford	77.4
Sterling	76.5
Agawam	75.4
Gardner	75.1
Easthampton	74.2
Rockland	73.1
Auburn	72.9
Westminster	71.7
Foxborough	71.4
Mansfield	70.4
Waltham	69.8
Ashland	68.2
Burlington	67.6
North Attleborough	67.4
Fall River	66.7
Acton	66.4
Pittsfield	64.9
Lawrence	64.1
Braintree	63.9
Charlton	63.6
Hopkinton	62.6
Westwood	60.8
West Springfield	60.6
Millbury	59.5
Freetown	59.4
Palmer	58.5
Fitchburg	57.0
Holyoke	56.2

Municipality	Manufacturing Employment per 1,000 Residents (2007)
Lynn	56.1
Southwick	55.9
Sutton	55.8
Westford	55.1
Chelsea	55.0
Peabody	54.1
Grafton	53.3
Medway	52.6
Watertown	52.0
Worcester	49.9
Stoughton	49.1
Northampton	48.6
Walpole	48.0
North Adams	45.3
Haverhill	44.4
Lexington	44.1
Wilbraham	42.8
Raynham	42.4
Ludlow	39.5
Needham	38.0
Lowell	37.7
Methuen	37.3
Northbridge	36.7
Greenfield	36.5
Hanover	36.1
Bellingham	36.0
Middleborough	35.1
Wareham	34.7
Easton	33.7
Dartmouth	33.4
Springfield	32.2
Wakefield	31.3
Malden	30.4

Municipality	Manufacturing Employment per 1,000 Residents (2007)
Webster	30.0
Hingham	29.9
Plymouth	29.8
Shrewsbury	29.6
Norton	29.1
Brockton	29.0
Cambridge	28.7
Pembroke	27.9
Bourne	26.9
Everett	23.6
Natick	23.0
Framingham	22.9
Randolph	20.8
Falmouth	20.6
Somerville	20.5
Salem	19.3
Tewksbury	17.2
Boston	16.6
Revere	13.0
Barnstable Town	12.0
Weymouth	11.8
Newton	9.5
Medford	9.1
Quincy	6.7
Dedham	N.A.
Franklin	N.A.
Holden	N.A.
Maynard	N.A.
Northborough	N.A.
Sharon	N.A.
South Hadley	N.A.

APPENDIX 2

2012 MANUFACTURING SURVEY

Please fill out the following questions, or, if you prefer, use the online version of the same survey at <http://www.zoomerang.com/Survey/WEB22ESA3GZB6J>. Please return the survey within seven days of receipt.

Section 1: Company Profile

1. Company Name (As known in Massachusetts) _____

** Identifying information about your company will not be associated with questionnaire responses without your permission.*

2. What year was your company founded? _____

3. Where is your company headquartered?

City _____

State _____

Country _____

4. What is the ownership structure of the firm?

- Private family owner-operated
- Private investor-owned
- Publicly owned stock corporation
- Other (please specify): _____

5. What position do you currently hold in your company?

- CEO/President
- Owner/Manager
- General Manager
- Vice President
- Department Head
- Other (please specify): _____

6. Which of these industry sectors best describes your company's primary operations in Massachusetts?

- Food Manufacturing
- Beverage and Tobacco Product Manufacturing
- Textile Mills
- Textile Product Mills
- Apparel Manufacturing
- Leather and Allied Products Manufacturing
- Wood Product Manufacturing
- Paper Manufacturing
- Printing and Related Support Activities
- Petroleum and Coal Products Manufacturing

- Chemical Manufacturing
- Biotech Manufacturing
- Medical Device Manufacturing
- Plastics and Rubber Plastics Manufacturing
- Nonmetallic Mineral Product Manufacturing
- Primary Metal Manufacturing
- Fabricated Metal Product Manufacturing
- Machinery Manufacturing
- Computer and Electronic Product Manufacturing
- Electronic Equipment, Appliance, and Component Mfg.
- Transportation Equipment Manufacturing
- Furniture and Related Product Manufacturing
- Misc. Manufacturing
- Misc. Manufacturing Services

7. Is your company involved in an additional industry sector?

- No
- Yes (please list): _____

8. What are the primary products or manufacturing services your company produces in Massachusetts?

9. Please list the Massachusetts municipalities in which your company has manufacturing facilities:

10. Please **estimate** your company's total number of employees for the following two years:

	Firm as a whole	MA facilities only	Other US facilities (excluding MA)	Facilities in other countries (excluding US)
2007				
2011				

11. Please **estimate** your company's total annual gross revenue for the following two years:

	Firm as a whole	MA facilities only	Other US facilities (excluding MA)	Facilities in other countries (excluding US)
2007				
2011				

Section 2: Market Dynamics

12. How likely is it that the market for your company's products will change over the **next five years**? (Circle the appropriate response for each factor)

	1 Not likely	2 Somewhat likely	3 Fairly like- ly	4 Very likely	5 Extremely likely
Customers					
More Massachusetts customers	1	2	3	4	5
More U.S. customers	1	2	3	4	5
More global customers	1	2	3	4	5
Suppliers					
More Massachusetts suppliers	1	2	3	4	5
More U.S. suppliers	1	2	3	4	5
More global suppliers	1	2	3	4	5
Competitors					
More Massachusetts competitors	1	2	3	4	5
More U.S. competitors	1	2	3	4	5
More global competitors	1	2	3	4	5

13. To what extent do you expect your Massachusetts facility(ies) will experience each of the following changes over the **next five years**? (Circle the appropriate response for each factor)

	1 Not at all	2 To some extent	3 To a fair extent	4 To a large extent	5 To a great extent
Substantial increase in the use of new technology	1	2	3	4	5
Substantial increase in productivity due to improved technology	1	2	3	4	5
Reduction in employment due to improved technology	1	2	3	4	5
Increased off-shoring of internal operations	1	2	3	4	5
Increased outsourcing of previous internal operations to other Massachusetts firms	1	2	3	4	5
Increased outsourcing of previous internal operations to firms in other states	1	2	3	4	5
Substitution of skilled labor for less skilled labor	1	2	3	4	5
Substitution of less skilled labor for skilled labor	1	2	3	4	5
Increased customer demand for better product quality	1	2	3	4	5
Increased customer demand for improved service delivery	1	2	3	4	5
Increased customer demand for lower prices	1	2	3	4	5
Shift from local markets to national markets	1	2	3	4	5
Shift from national markets to global markets	1	2	3	4	5
Shortage of critical materials	1	2	3	4	5

Section 3: Operational Issues and Access to Capital

14. How important is each of this first set of factors to your decision to continue to operate manufacturing facilities in Massachusetts, or to consider changing location? (If factor is relevant, indicate its importance, and whether it is a reason to stay (“stay”), or a reason to leave (“leave”))

	How Important (if relevant)?						Location Consideration (Check One)
	0 Not Relevant	1 Not important	2 Somewhat important	3 Fairly important	4 Very important	5 Extremely important	
Inertia (too hard to relocate)	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Current availability of appropriately skilled labor	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Future availability of appropriately skilled labor	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Opportunity for physical expansion	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Availability of reasonably priced land for expansion	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Work ethic of workforce	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Current proximity to customers	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Future proximity to customers	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Critical mass of similar firms in region	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Access to transportation for shipping/commuting (e.g. highways, rail)	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Taxes and fees	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Environmental regulations	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Proximity to European markets	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Time to obtain permits and licenses	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Current proximity to key suppliers	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Future proximity to key suppliers	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave

15. How important is each of this second set of factors to your decision to continue to operate manufacturing facilities in Massachusetts, or to consider changing location?

	How Important (if relevant)?						Location Consideration (Check One)
	0 Not Relevant	1 Not important	2 Somewhat important	3 Fairly important	4 Very important	5 Extremely important	
Proximity to universities and colleges	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Quality of life (e.g. public schools, recreation, and cultural institutions)	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Cost-of-living	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Monetary or in-kind incentives from state or local governments	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Labor costs	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Trade unions	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Cost of construction	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Current energy costs	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Future energy costs	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Massachusetts weather and climate	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Health care costs	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Cost of worker's compensation	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Cost of unemployment insurance	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Strategic partnerships with community colleges and vocational education programs	0	1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave
Other (please specify):		1	2	3	4	5	<input type="radio"/> Stay <input type="radio"/> Leave

16. Has your company's Massachusetts facility(ies) made use of any of the following state/local incentive programs?

Incentive Program	Yes	No
Investment Tax Credit		
R & D Tax Credit		
Workforce Training Grant		
Tax Increment Financing (TIF)		
Low Interest Loans		
Loan Guarantees		
Site Finder Assistance		
Equity Financing (from government sources)		

17. Please indicate which of the following sources of capital and credit your company has used, and how important it is to your operations.

	How Important (if used)?					
	0 Not used	1 Not important	2 Somewhat important	3 Fairly important	4 Very important	5 Extremely important
Commercial Banks	0	1	2	3	4	5
Small Business Administration (SBA)	0	1	2	3	4	5
Personal Funds	0	1	2	3	4	5
Private Investment/Equity	0	1	2	3	4	5
Issuers of Mezza-nine/Subordinated Debt	0	1	2	3	4	5
Leasing Companies to obtain equipment	0	1	2	3	4	5
Other (please specify):		1	2	3	4	5

18. If you currently borrow money, what are the funds used for?

Use for Funds	Yes	No
Working capital		
Purchase or lease new manufacturing equipment or software		
Expand manufacturing real estate		
Conduct research and development		
Retire past debt		
Acquire another company		
Expand global sales capacity		
We do not currently borrow funds		
Other (please specify):		

Over the last five years, to what extent has access to capital ever been an impediment to growth?

- Not at all
- To some extent
- To a fair extent
- To a large extent
- To a great extent

19. To what extent are you concerned about your company's ability to finance future growth?

- Not concerned
- Somewhat concerned
- Fairly concerned
- Very concerned
- Extremely concerned

20. Do you anticipate utilizing outside financing to fund growth/expansion/acquisitions in the next 12-18 months?

- Yes
- No

Section 4: Workforce Profile

21. Approximately what percentage of all jobs in your Massachusetts facility(ies) requires each of the following levels of education? (Total percentage should sum to 100)

Level of education	Percent of jobs
Less than a high school degree	%
High school diploma/GED	%
Some college	%
Bachelor's Degree or more	%
	100%

22. **By 2017**, approximately what percentage of all jobs in your Massachusetts facility(ies) do you expect will require the following level of education?

Level of education	Percent of jobs
Less than a high school degree	%
High school diploma/GED	%
Some college	%
Bachelor's Degree or more	%
	100%

23. What is the estimated **average** age of your current Massachusetts workforce?

- Less than 30 yrs
- 30-35 yrs
- 36-40 yrs
- 41-45 yrs
- 46-50 yrs
- 51-55 yrs
- 56-60 yrs
- 61-65 yrs
- More than 65 yrs

24. Approximately what percentage of your current Massachusetts employees are age 55 or over?

____%

25. Over the next five years, approximately how many job openings do you anticipate in your Massachusetts operations? (This could be due to factors such as new jobs, retirement, or turnover of your current workforce.)

26. What is the average hourly wage for your Massachusetts manufacturing workforce?

- Skilled \$ _____
- Semiskilled \$ _____
- Unskilled \$ _____

Section 5: Workforce Recruitment and Training

27. How important have the following institution(s) been in preparing your company's shop floor workforce?

	1 Not im- portant	2 Somewhat important	3 Fairly im- portant	4 Very im- portant	5 Extremely important
Comprehensive High Schools	1	2	3	4	5
Vocational/Technical High Schools	1	2	3	4	5
Community Colleges	1	2	3	4	5
Four Year Colleges/Universities	1	2	3	4	5
Private Training Companies	1	2	3	4	5
The Military	1	2	3	4	5
Workforce Investment Board	1	2	3	4	5
Other (please specify):	1	2	3	4	5

28. Please indicate which of the following organizations/sources your company has used or contracted for the education/training of your shop floor employees. How successful were they?

	How Successful (if used)?					
	0 Not used	1 Not suc- cessful	2 Somewhat successful	3 Fairly suc- cessful	4 Very suc- cessful	5 Extremely successful
On-the-job Training	0	1	2	3	4	5
Internal Classroom Training by Staff or Skilled Employees	0	1	2	3	4	5
Web-based Training	0	1	2	3	4	5
Use of External Consultants/Trainers	0	1	2	3	4	5
Massachusetts Manufacturing Extension Partnership (Mass-MEP)/Greater Boston Manufacturing Partnership (GBMP)	0	1	2	3	4	5
Technical /Vocational Schools	0	1	2	3	4	5
Community Colleges	0	1	2	3	4	5
Universities	0	1	2	3	4	5
Other (please specify):		1	2	3	4	5

29. Please identify the importance of the following factors in hiring **experienced** shop floor employees.

	1 Not im- portant	2 Somewhat important	3 Fairly im- portant	4 Very im- portant	5 Extremely important
Technical Skills and Competencies	1	2	3	4	5
Interest in Learning and Self-Improvement	1	2	3	4	5
Attitude and Motivation	1	2	3	4	5
Related Experience in Manufacturing	1	2	3	4	5
Education Beyond High School	1	2	3	4	5
Hours and Shift Flexibility	1	2	3	4	5
Potential for Career Mobility Within the Company	1	2	3	4	5
Other (please specify):	1	2	3	4	5

30. Please identify the importance of the following factors in hiring **entry-level** shop floor employees.

	1 Not im- portant	2 Somewhat important	3 Fairly im- portant	4 Very im- portant	5 Extremely important
Technical Skills and Competencies	1	2	3	4	5
Interest in Learning and Self-Improvement	1	2	3	4	5
Attitude and Motivation	1	2	3	4	5
Related Experience in Manufacturing	1	2	3	4	5
Education Beyond High School	1	2	3	4	5
Hours and Shift Flexibility	1	2	3	4	5
Potential for Career Mobility Within the Company	1	2	3	4	5
Other (please specify):	1	2	3	4	5

31. How important is it for **entry-level shop floor** employees to possess each of the following competencies/attributes?

	1 Not im- portant	2 Somewhat important	3 Fairly im- portant	4 Very im- portant	5 Extremely important
Basic Employability/Job Readiness Skills	1	2	3	4	5
Mechanical Aptitude	1	2	3	4	5
Hands-On Machining Skills	1	2	3	4	5
Reading/Writing/ Verbal Communication	1	2	3	4	5
Mathematics Skills	1	2	3	4	5
Read and Interpret Blueprints	1	2	3	4	5

32. How difficult is it for your company to recruit talent into your Massachusetts facility(ies) for the following types of positions?

	1 Not difficult	2 Somewhat difficult	3 Fairly difficult	4 Very difficult	5 Extremely difficult
R & D staff	1	2	3	4	5
Skilled craftsmen	1	2	3	4	5
Executive management	1	2	3	4	5
Middle management	1	2	3	4	5
Clerical support staff	1	2	3	4	5
Entry level employees	1	2	3	4	5

33. Have you used the following sources for recruitment/hiring of **shop floor** employees? How successful have these sources been?

	How Successful (if used)?					
	0 Not used	1 Not successful	2 Somewhat successful	3 Fairly successful	4 Very successful	5 Extremely successful
Private Employment or Recruiting Agencies	0	1	2	3	4	5
Temporary Employment Agencies	0	1	2	3	4	5
Vocational High Schools/High Schools	0	1	2	3	4	5
One Stop Career Centers	0	1	2	3	4	5
Internet Advertisements	0	1	2	3	4	5
Internet Job Search Sites (e.g. Monster.com)	0	1	2	3	4	5
Community Colleges	0	1	2	3	4	5
Newspaper Advertisements	0	1	2	3	4	5
Career and Technology Fairs	0	1	2	3	4	5
Employee Referrals	0	1	2	3	4	5
Industry Networking Events	0	1	2	3	4	5
Other (please specify):		1	2	3	4	5

Section 6: Experience and Expectations

34. **Over the past five years**, which of the following initiatives have you pursued to grow your manufacturing operations in Massachusetts?

Initiative	Yes	No
Expanded overall square footage of existing manufacturing floor space		
Invested in new manufacturing equipment and/or manufacturing process software		
Expanded total manufacturing workforce		
Invested more in product research and development than in the previous five years		
Opened a new manufacturing location in Massachusetts		
Expanded manufacturing sales and marketing workforce		
Opened a sales office abroad		
Invested in education and training for manufacturing workforce		
Secured at least one new patent for a new product		
Entered into a formal partnership and/or joint venture with another manufacturing firm		
Hired consultants to help grow business		
Developed a succession plan for senior executives		
Developed a succession plan for ownership		
Implemented or strengthened a performance improvement program		
Other (please specify):		

35. What do you expect production levels to be for your company's Massachusetts facility(ies) over the **next five years**? (Check one)

- Continued production at current levels
- Continued production at increased levels
- Continued production but at reduced levels
- Cessation of production in Massachusetts

36. What do you expect employment levels to be for your company's Massachusetts' facility(ies) over the **next five years**? (Check one)

- Expansion of Massachusetts employment by 1 - 10%
- Expansion of Massachusetts employment by 11 - 25%
- Expansion of Massachusetts employment by more than 25%
- Maintenance of current employment levels
- Reduction of Massachusetts employment by 1 - 10%
- Reduction of Massachusetts employment by 11 - 25%
- Reduction of Massachusetts employment by more than 25%

37. Which, if any, of the following merger and acquisition activities are likely to take place in/affect your company's Massachusetts facility(ies) over the next five years?

Merger and Acquisition Activities	Yes	No
Acquisition of additional Massachusetts-based companies		
Acquisition of additional companies based outside of Massachusetts		
Being acquired by another Massachusetts company		
Being acquired by a non-Massachusetts based company		
Merging with another Massachusetts company		
Merging with another non-Massachusetts based company		
No current plans for merger/acquisition		

38. If you are planning to expand your business, **where** are you likely to expand?

Expansion Location	Yes	No
Massachusetts		
New England (excluding MA)		
Other states in the U.S.		
Outside the U.S.		
We have no current plans to expand our business		

39. Does your company currently export any of the products or services produced here in Massachusetts to foreign countries?

- No, and no future plans for such exports in the next five years
- No, but plan to do so within the next five years
- Yes, and the exports constitute approximately the following proportion of total sales:
 - 1-10%
 - 11-25%
 - 26-50%
 - 50%+

Section 7: Promoting Manufacturing

40. How important are the following workforce development activities to promoting manufacturing in Massachusetts?

	1 Not important	2 Somewhat important	3 Fairly important	4 Very important	5 Extremely important
Speaking to Parent Organizations/Student Groups About Careers in Manufacturing	1	2	3	4	5
Exhibiting at Education, Career, and Technology Fairs	1	2	3	4	5
Contributing Machinery, Tools, or Other Materials to Schools	1	2	3	4	5
Working with School or Community College Instructors to Incorporate Industry Standards into Curriculum	1	2	3	4	5
Creating a certificate in manufacturing technology	1	2	3	4	5
Serving as Mentors/Advisors at Selected Vocational Schools or Community Colleges	1	2	3	4	5
Instituting Company-Sponsored Educational Scholarships	1	2	3	4	5
Hiring Vocational/Community College Teachers to Train your Employees	1	2	3	4	5
Other (please specify):	1	2	3	4	5

41. How willing would your company be to participate in the following types of programs?

	1 Not willing	2 Somewhat willing	3 Fairly willing	4 Very willing	5 Extremely willing
Students working with experienced employees (Job Shadowing)	1	2	3	4	5
Providing paid 3-6 month employment to vocational or community college students (Cooperative Education)	1	2	3	4	5
Providing unpaid school-year internships to vocational and community college students	1	2	3	4	5
Providing paid summer employment to vocational and community college students	1	2	3	4	5
Providing part-time after-school/Saturday employment to vocational and community college students	1	2	3	4	5
Other (please specify):	1	2	3	4	5

42. How important are the following broad-based initiatives in strengthening manufacturing as a critical industry sector in the Commonwealth?

	1 Not im- portant	2 Somewhat important	3 Fairly im- portant	4 Very im- portant	5 Extremely important
State-Wide Marketing Campaign to Pro- mote Manufacturing Industry	1	2	3	4	5
Create an Employee Applicant Referral System	1	2	3	4	5
Continued Alignment of the Vocational and Community College Curricula with In- dustry Needs	1	2	3	4	5
Expanded Professional Develop- ment/Continuous Improvement Programs for Existing Employees	1	2	3	4	5
Programs to Increase School, Student, and Parent Awareness of Careers in Manufac- turing	1	2	3	4	5
Other (please specify):	1	2	3	4	5

Final Questions

43. Is there anything you would like to share about your company and/or industry that is not covered in this survey?

44. May we contact you for further information about any of these questions? If so, please supply the contact information you prefer:

Name: _____

Address: _____

Phone (o): _____

Phone (c): _____

Email address: _____

ENDNOTES

¹ Barry Bluestone, Don Walsh, Lauren Nicoll, and Chase Billingham, *Staying Power: The Future of Manufacturing in Massachusetts* (Boston: The Boston Foundation, July 2008).

² See Deloitte Consulting LLP and The New England Council, "Reexamining Advanced Manufacturing in a Networked World: Prospects for a Resurgence in New England," December 2009 and

³ See Letter of Conveyance from Secretary Greg Bialecki of the report, *Building Bridges to Growth: A Roadmap for Advanced Manufacturing in Massachusetts*, Massachusetts Technology Collaborative, November 28, 2011.

⁴ Massachusetts Technology Collaborative, *Building Bridges to Growth: A Roadmap for Advanced Manufacturing in Massachusetts*, op.cit., p. 8.

⁵ Ibid., p. 9

⁶ Transcript of "President Obama's State of the Union Address," *New York Times*, January 25, 2012, p. 1.

⁷ The White House, *Blueprint for An America Built to Last*, Washington, D.C., January 24, 2012.

⁸ National Institute of Standards and Technology (NIST), "President Proposes National Network for Manufacturing Innovation," March 9, 2012.

⁹ Office of Science and Technology Policy, "Made in America: Helping to Revitalize U.S. Manufacturing," April 30, 2012.

¹⁰ See U.S. Department of Labor, Bureau of Labor Statistics, "Employment, Hours, and Earnings from the Current Employment Statistics survey," July, 2012 (www.bls.gov).

¹¹ Barry Bluestone, Don Walsh, Lauren Nicoll, and Chase Billingham, *Staying Power: The Future of Manufacturing in Massachusetts*, "Executive Summary," (Boston, The Boston Foundation, July 2008), p. 3-4.

¹² Council of Economic Advisors, *Economic Indicators*, (Washington, D.C.: U.S. Government Printing Office, December 2007).

¹³ U.S. Department of Labor, Bureau of Labor Statistics, "Local Area Unemployment Statistics," July 2012. (www.bls.gov).

¹⁴ Bluestone, et.al., *Staying Power: The Future of Manufacturing in Massachusetts*, "Executive Summary," op.cit.

¹⁵ U.S. Bureau of Labor Statistics, "State and Local Employment Data," <http://bls.gov/sae/>.

¹⁶ The manufacturing employment data used here have been adjusted by Mass Benchmarks to account for new information available from the ES-790 data series. As such, the employment levels for 2011 and 2012 are lower than those reported by the U.S. Bureau of Labor Statistics. See Alan Clayton-Matthews, "Revised Estimates of 2011 Payroll Employment," *Mass Benchmarks*, July 6, 2012.

¹⁷ Bluestone, et.al., *Staying Power: The Future of Manufacturing in Massachusetts*, op.cit., p. 24.

¹⁸ US Census Bureau, *Statistics of U.S. Businesses, 2003-2009*, <http://www.census.gov/econ/susb/data/susb2009.html>.

¹⁹ See Massachusetts Department of Labor and Workforce Development, ES-202 Employment and Wage Statistics.

²⁰ U.S. Bureau of Labor Statistics, *State and Local Employment Series* (adjusted for change from SIC to NAICS industry code definitions.)

²¹ Bluestone, et. al., *Staying Power: The Future of Manufacturing in Massachusetts*, op. cit., p. 35.

²² The OECD methodology is detailed in Thomas Hatzichronoglou, "Revision of the High-Technology Sector and Product Classification," STI Working Papers 1997/2 (Paris: Organization for Economic Cooperation and Development, 1997).

²³ Because of known problems in measuring real dollar output, **Figure 1.8** uses current dollar output for both the private sector and for manufacturing.

²⁴ See National Association of Manufacturers, "Massachusetts Manufacturing Facts," <http://nam.org/statedata>.

²⁵ Business Roundtable, "Trade Creates Jobs for Massachusetts," <http://trade.businessroundtable.org>.

²⁶ Estimate from the World Institute for Strategic Economic Research as quoted in Michael B. Farrell, "Europe's Financial Crisis hits Firms in Mass.," *Boston Globe*, June 11, 2012.

²⁷ Calculations based on U.S. Bureau of Economic Analysis, "Real GDP," <http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1&isuri=1&acrdn=1> and U.S. Bureau of Labor Statistics, "State and Local Employment," <http://bls.gov/sae/>.

²⁸ US Bureau of Labor Statistics, *Quarterly Census of Employment and Wages, Employment and Wages, Annual Wages, 2010*, table 8 & 10, <http://www.bls.gov/cew/cewbultn10.htm#Tables>.

²⁹ The Gateway Cities, according to Massachusetts legislation, are those with a population between 35,000 and 250,000, with an average household income below the state average, and an average educational attainment rate (Bachelor's or above) below the state average.

³⁰ Hispanic includes Hispanics that are foreign-born and native. The same with Asians and African-Americans.

³¹ U.S. Bureau of Labor Statistics, "Job Openings and Labor Turnover Survey News Release," March 13, 2012.

³² Bluestone, et.al., *Staying Power: The Future of Manufacturing in Massachusetts*, op.cit, p. 70.

³³ The *InfoUSA* database is assembled from phone books, annual reports, and other business directories, which are then supplemented with public record data and phone calls to each business. For more information, see www.infousa.com

³⁴ Since *InfoUSA* tends to overestimate the number of manufacturers, using other counts of establishments leads to somewhat higher response rate estimates. For example, according to *Employment and Wage* data available from ES-202 forms collected by the state from all employers, there were 7,507 manufacturing establishments in Massachusetts as of the third quarter 2011. The response rate using this denominator is 9 percent. Further, according to the latest available Statistics of U.S. Businesses, there were 7,140 manufacturing establishments in Massachusetts in 2009, representing 6,812 firms. Since our survey was filled out by firms and not establishments (i.e. none of our responses were from multiple establishments within the same firm), the response rate using this denominator is 10 percent.

³⁵ Barry Bluestone, Don Walsh, Lauren Nicoll, and Chase Billingham, *Staying Power: The Future of Manufacturing in Massachusetts* (Boston: The Boston Foundation, July 2008), pp. 94-95.

³⁶ Op.cit. p. 110.

³⁷ U.S. Bureau of Labor Statistics, "Employment, Hours, and Earnings from the Current Employment Statistics Survey" <http://data.bls.gov/cgi-bin/surveymost?ce>. The nominal average hourly wage for the first six months of 2007 and the first six months of 2012 were adjusted for inflation using the Consumer Price Index for All Urban Workers for the same time periods. The CPI increased by 11.25% during this five year period.

³⁸ See Thomas Friedman, *The World is Flat 3.0: A Brief History of the Twenty-First Century* (New York: MacMillan-Picador, 2007).

³⁹ *Workforce Training Grants* are aimed at improving employee education and the skills needed in their respective industries. There are three different workforce training programs that the Commonwealth offers:

The *Express Program* is for companies with 50 or fewer employees, and has a fast turnover time with quick approval of applications by the state. Firms wishing to enroll employees in one of these programs have to contribute at least 50% of the cost of the training which is then reimbursed to them after the training is completed (up to 50% of the total costs). This option is aimed at the smaller companies.

The *General Program* and the *Hiring Incentive Program* are open to any firm of any size, but they have application deadlines and also have stiffer requirements when it comes to the contributions paid by the employer. The General Program requires that the company match the amount of the grant in either cash or an in-kind contribution. The Hiring Incentive Program is an incentive program for new, untrained employees. The requirement on the part of the company is relatively low and only requires them to pay the wages of the employee while they are at the training. The stipulation for this program, however, is that the application has to be filed within 30 days of the start date of the employee.

These programs help employers by offering training at a lower cost than the norm but also help the employee by offering them skills that they can use in their current job but also use in other professions.

⁴⁰ The *R&D Tax Credit* is aimed at promoting research and development efforts in Massachusetts. It acts as a discount on the cost of in-house research and can also be used to pay for a third party to conduct research and development for a firm. Using this credit, a firm can get 10% of the cost of in-house research credited to its state excise tax. If a firm hires a third party, such as a research institute or a university to do the work, it can get 15% of that cost credited. This is put in place so that MA firms are encouraged to hire another company, thus spending money inside the state and creating paid jobs for researchers.

This credit is available to any firm, foreign or domestic, which is subject to Massachusetts state excise taxes.

The R&D credit can be used in conjunction with the Investment Tax Credit which allows companies a cheaper option if they want to expand and grow.

Investment Tax Credits are tax credits of up to 3% off the cost of purchasing, adding to, constructing, or erecting “tangible property” after other tax deductions have been taken into account. These allow businesses to expand with lower long term costs.

⁴¹ According to the Commonwealth of Massachusetts website, *tax-increment financing* (TIF) and *district improvement financing* (DIF) “provide opportunities to redevelop areas in ways which can lead to increased property values, increased tax revenue, improved infrastructure, enhanced transportation services, increased housing supply, new jobs and an overall improvement in quality of life for the inhabitants of the city or town. While TIF focuses on job creation, DIF allows significant flexibility in planning for the district’s housing and commercial needs.”

“TIF provides a direct upfront benefit to a Developer in the form of tax relief. The money saved on taxes helps pay the project’s construction costs. Depending on the size and location of the project, Developers utilizing TIF benefits can also often access other state financial incentives such as Investment Tax Credits, Abandoned Building Tax Deductions and Research and Development Tax Credits.”

See http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-diftif.html.

A manufacturer can be the “developer” when it constructs a new building or improves an existing one. With TIF the manufacturer receives tax relief on the assessed value of the new building or building improvement, reducing the company’s overall local tax burden.

⁴² See Barry Bluestone, Don Walsh, Lauren Nicoll, and Chase Billingham, *Staying Power: The Future of Manufacturing in Massachusetts* (Boston: The Boston Foundation, 2007), Table 5.3, p. 166.

⁴³ Barry Bluestone, Don Walsh, Lauren Nicoll, and Chase Billingham, *Staying Power: The Future of Manufacturing in Massachusetts* (Boston, MA.: The Boston Foundation, July 2008), Figure 4.2, p. 151 and Table 4.7, p. 152.

⁴⁴ Bluestone, et.al., *Staying Power: The Future of Manufacturing in Massachusetts*, op.cit., Chapter 6: “What Manufacturers Want from Government,” pp. 179-196.

⁴⁵ Bluestone, et.al., *Staying Power: The Future of Manufacturing in Massachusetts*, op.cit., p. 180.

⁴⁶ Massachusetts General Court, Chapter 240 “An Act Relative to Economic Development Reorganization,” signed by Governor Deval Patrick on August 10, 2010.

⁴⁷ Massachusetts General Court, Chapter 240, Section 9(a).

⁴⁸ Massachusetts General Court, Chapter 240, Section 6.

⁴⁹ Massachusetts Technology Collaborative, “Building Bridges to Growth: A Roadmap for Advanced Manufacturing in Massachusetts,” November 2011.

⁵⁰ Massachusetts Technology Collaborative, “Building Bridges to Growth: A Roadmap for Advanced Manufacturing in Massachusetts,” op.cit., p. 13.

⁵¹ Bluestone, et.al., *Staying Power: The Future of Manufacturing in Massachusetts*, op.cit., Figure 6.1, p. 184.

⁵² Michael Levenson, "Governor Deval Patrick signs new health care cost measure; bill builds on law passed when GOP candidate Mitt Romney was governor," Boston.com, August 6, 2012.

<http://www.boston.com/metrodesk/2012/08/06/governor-deval-patrick-signs-new-health-care-cost-measure-bill-builds-law-passed-when-gop-candidate-mitt-romney-was-governor/07JmLjWj5cnvuQGBGT4nRN/story.html>.

⁵³ See Commonwealth of Massachusetts, Executive Office of Consumer Affairs and Business Regulation, "Patrick Administration Announces \$11 Million Workers' Compensation Rate Cut,"

<http://www.mass.gov/ocabr/government/oca-agencies/doi-lp/patrick-administration-announces-11-million.html>.

⁵⁴ See Commonwealth of Massachusetts, Executive Office of Consumer Affairs and Business Regulation, "Commissioner of Insurance Approves Workers' Compensation Rate Agreement, Saving \$65 million for Business,"

<http://www.mass.gov/ocabr/saving-65-million-for-businesses.html>.

⁵⁵ See U.S. Energy Information Administration, "Electricity" Annual State Data Tables, "Average Price by State by Provider, Industrial Customers," EI-861 www.eia.gov/electricity/data/state, November 15, 2011 and Annual Report 2012.

⁵⁶Source: Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs,

<http://www.mass.gov/eea/grants-and-tech-assistance/guidance-technical-assistance/agencies-and-divisions/doer/>.

⁵⁷ Source: Commonwealth of Massachusetts, Executive Office of Housing and Economic Development,

<http://www.mass.gov/hed/economic/eohed/pro/about/mission-of-the-office.html>.

⁵⁸ See "Corporate tax rate drops to 8.0 percent effective January 1,"

<http://revenue.blog.state.ma.us/blog/2011/12/corporate-tax-rate-drops-to-80-percent-effective-january-1.html>.

