

**Sustaining and Enhancing
a Leadership Position
for Massachusetts**
in IT, Communications and Defense

The development of the Mass Insight IT, Communications and Defense report was a community effort that brought together leaders in industry, academia and government. In addition to the generous contribution of McKinsey & Company in assisting with the preparation of the report, Mass Insight would like to thank the following:

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Mass Insight Corporation

18 Tremont Street, Suite 930

Boston, MA 02108

Phone (617) 778-1500

Fax (617) 778-1505

www.massinsight.com

Global Massachusetts 2015 is a two-year initiative organized by Mass Insight that brings together major business groups, industry, and higher education leaders to develop and advance a comprehensive economic agenda that will position Massachusetts to win the competition for talent – the key to securing future prosperity for all our citizens. Other reports in the series include Financial Services and Life Sciences. Together these three sectors comprise the traditional business innovation core of the Massachusetts economy. Mass Insight is a research and consulting firm that seeks to keep Massachusetts and its businesses and institutions globally competitive. The firm focuses on talent and innovation-based economic development and builds strategic alliances between higher education, industry and government.

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EXECUTIVE SUMMARY: Sustaining and Enhancing IT, Communications, and Defense Leadership

Massachusetts has been an industrial and research leader in technology and defense since the early part of the 20th century. Innovations such as radar, the mainframe computer, microwave technology, the Internet and nanotechnology all have roots in the Commonwealth's universities, companies, research labs, or military installations.

The Massachusetts information technology, communications and defense (ITCD) sector employs 331,000 people – 10 percent of overall state employment and roughly four times the number employed in the state's life sciences industry, which gets more attention from the media and state lawmakers. ITCD also accounts for 15 percent of annual economic output. In the period since the 2001 recession, the ITCD sector had stronger growth and employment than the overall state economy.

Despite the success of the technology sector, there are troubling trends that need to be addressed for Massachusetts to maintain and enhance its leadership position in high-tech and defense. First is growth, which fell to 4.3 percent annually between 2001 and 2006, only one-third the rate of the previous 5 years. Moreover, virtually all the growth over the last 10 years was productivity-driven: since 2001, information technology, communications and defense companies in Massachusetts shed a net 64,000 jobs, about a 3.5 percent drop in sector employment and nearly double the rate of job loss across the overall U.S. ITCD sector. The largest losses have been among high-value-added workers, including engineers and managers, suggesting an erosion of the Commonwealth's tech leadership.

Indeed, more alarming than slowed growth is the state's declining influence in the global high-tech

sector. The time when Route 128 held an equivalent position to Silicon Valley in public perception is fading from memory. Through mergers, acquisitions and attrition, the roster of Fortune 1000 tech companies headquartered in Massachusetts has fallen from nine to six since 2002. In the same period, California saw a net gain of three, bringing its total to forty-two. Massachusetts has also fallen behind in the creation of new tech companies, with the relative number of company births declining from 11.4 percent of all ITCD establishments in 2002 to 9.9 percent in 2004. While California, New York and Washington have seen increases in high-tech venture investments since 2002, VC investment in Massachusetts has continued its drop from the dot-com bubble, particularly in early-stage companies.

Without robust new-firm creation and strategies to retain existing firms, the Commonwealth is in danger of becoming a high-tech outpost and a start-up boutique, with diminishing influence over investment and hiring within its borders.

These developments have negative implications for the Massachusetts economy, which has already felt the effects of the tech slowdown. Since 2001, the Commonwealth has lagged the U.S. in GDP growth every year except 2003 and has trailed in household income growth, a metric on which it used to beat national averages. Other leading sectors of the Massachusetts economy, financial services (11 percent of GDP) and health care (9 percent), cannot be counted on to pick up the slack.

In short, the vitality of the Massachusetts high-tech sector is critical to the state's economic future. To address these challenges, Mass Insight Corporation recommends public/private initiatives on three fronts to ensure the ongoing success of the high-tech sector. Taken together, these measures can encourage new company formation and attract new tech investments.

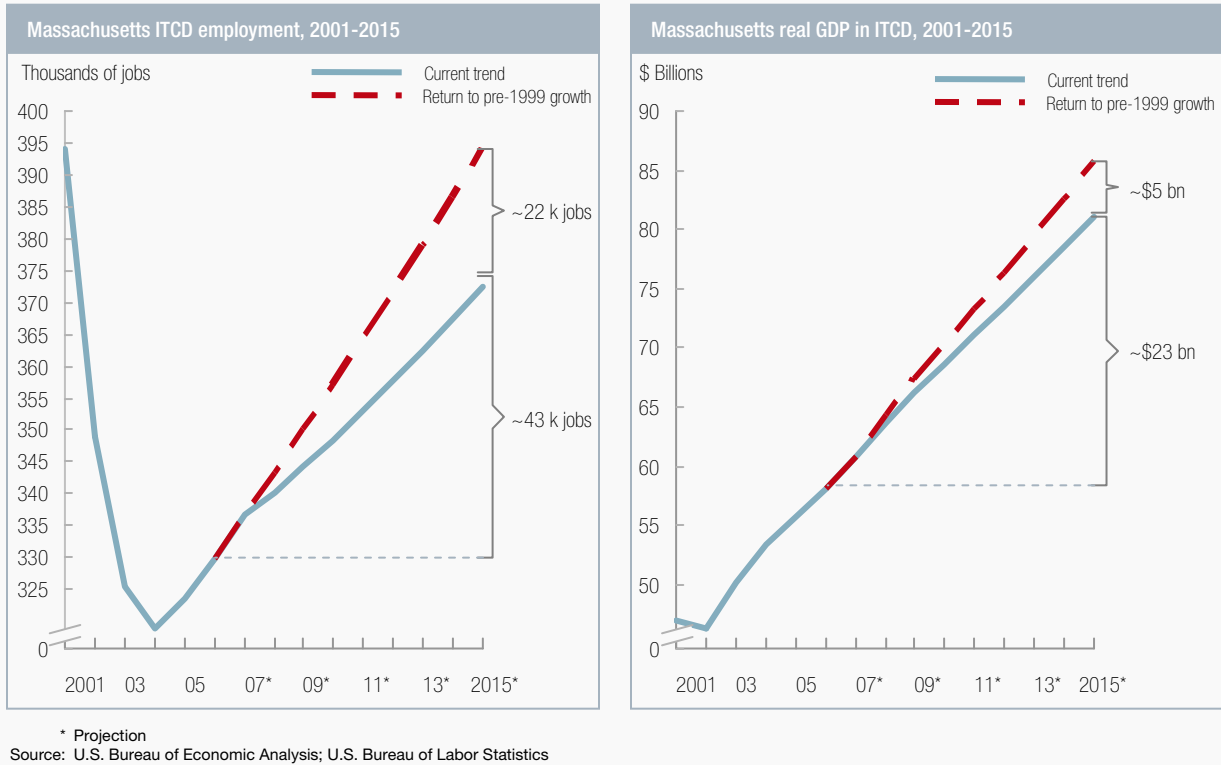
If Massachusetts can stem the projected trend and return to its pre-1999 job growth rates in ITCD (3 percent annually from 1994 to 1999), 21,800 new jobs would be incrementally added – over 2,700 jobs annually, and almost \$5 billion to state GDP by

2015 (Exhibit 1). Alternatively, without a strategy, these sectors could see job losses over the next decade as alternative local and global locations become more attractive. The three initiatives are described in the following paragraphs.

- 1. Talent Initiative. Develop and retain a highly skilled talent base focused on technology-based clusters.** A highly educated – and experienced – workforce is key to maintaining the state's high-productivity, high-income knowledge economy. As a leader in educating young workers in technical disciplines, Massachusetts produces abundant human capital to fuel its high-tech industries, including IT, communications, defense and emerging areas like clean energy. The state has tended to lose graduates in their twenties as their careers progress. In particular, the state has not focused effectively on recruiting out-of-state students attending Massachusetts colleges and universities who might become permanent residents to pursue tech careers. Focused initiatives in these areas will yield significant rewards for the state.
- 2. Innovation Initiative. Reignite the Massachusetts innovation engine through expanded university-industry collaboration.** The state has best-of-class technical prowess in its companies, universities and research centers. But technologies developed here are not commercialized as efficiently as in Silicon Valley. Public/private programs can provide better opportunities for academic researchers in Massachusetts to connect with one another and work with industry and investors to create new companies and attract R&D investments.
- 3. Massachusetts ITCD Attractiveness Initiative. Make Massachusetts the premier state for launching and growing a high-tech business.** State and local government traditionally place significant structural obstacles in the path of new and expanding businesses, ranging from high taxes to slow permitting. Public officials should build on existing initiatives

EXHIBIT 1

Substantial Benefits Resulting from Increased ITCD Job Growth



and specifically consider how these factors affect the growth of high-tech businesses, since they form the state’s largest industry sector. Additionally, the state should invest in economic development and marketing efforts as well as undertaking a rebranding initiative to raise its global profile as a place for tech investments, as it has done in biotechnology.

Fortunately, Massachusetts can draw on ample resources to reignite its tech sector. These include world-class institutions in research and technology education, a well-established technology investing community, and a highly skilled work force.

Mass Insight recommends the following steps towards realizing these initiatives and reinvigorating the ITCD sector:

TALENT INITIATIVE

A. Align curriculum with industry needs

There is a disconnect between available jobs and the skills and ambitions of graduates. High-tech employers say that with a few notable exceptions universities in the state are not aligning curricula with their hiring needs. This creates a lack of understanding about local high-tech career opportunities among college students and recent graduates, but it also generates significant retraining costs for employers. A 2007 Mass Insight focus group of area technology human resource executives showed that nearly three of every four new engineer or technology hires needed employer-provided substantial supplemental training to make them job-ready.

A first step toward solving this problem is a comprehensive effort to identify the future needs

of high-tech employers. The Commonwealth should work with the state's leading science and engineering schools and high-tech employers to create a curriculum feedback loop. Every year, industry and academic leaders should share their plans and requirements to identify curriculum gaps. Beyond revising current curricula, this effort may lead to new concentrations and degree programs. Recently, for example, Worcester Polytechnic Institute established the nation's first undergraduate program in Robotics Engineering, integrating feedback from the state's leading robotics companies. The Defense Technology Initiative's (DTI) Defense Workforce Project, which provides a forum for industry input for university curriculum planning, serves as a model that can be extended across tech sectors.

B. Make Massachusetts the place for future high-tech workers to train and remain

Academia, government, and industry should work together to market Massachusetts as a place for out-of-state students to relocate permanently. Philadelphia, despite offering fewer economic opportunities than Boston, has succeeded in attracting college students and converting them to permanent residents through the Campus Philly marketing effort, coupled with the Career Philly Web sites and events. The Campus Philly program, which is sponsored by both city and state agencies and local universities, has created more than 5,000 internships since 2003, many of which have led to permanent employment. Nearly two out of three students who interned locally in Philadelphia chose to stay in the region. For Massachusetts, we recommend a multi-pronged approach to improving talent retention and attraction efforts across the student life cycle:

- Discover Massachusetts, an information packet and Web site for high-school seniors and college freshmen, including information on culture, entertainment and local events, as well as discount coupons and information on internship programs
- Jumpstart Your Career in Massachusetts, a Web site targeting college juniors with more detailed

career-focused information as they begin their permanent job searches

- Massachusetts Tech Tour, providing greater accessibility for local science and technology students and graduates to ITCD companies in Boston and along the Route 128 and I-495 corridors
- Internship Clearinghouse, to better connect Massachusetts students with employers in the state for internship opportunities and engage them earlier in the state's business community

Many of these initiatives have been proposed before but have lacked the systematic approach or appropriate home necessary to ensure success.

C. Attack addressable cost-of-living issues

Boston is recognized as a highly desirable location for young people, offering a vibrant urban experience and vast cultural, recreational and entertainment options. But when it comes to choosing permanent residence, many graduates find that the high cost of living outweighs those benefits. The state's high cost of living is felt largely in the areas of housing and transportation. Although the real estate market correction has ended the upward price spiral of the boom, there is little to be done in the near term to create significantly more affordable housing options for young professionals in metro Boston. A targeted approach to transportation, however, can help make the Boston region more attractive to recent graduates and high-tech employees. Many tech companies are clustered along the Route 128 and I-495 corridors – beyond the reach of public transportation from the urban neighborhoods where young professionals prefer to live. A potential hire in Boston must consider the cost of buying a car when weighing competing job offers, and car ownership could consume up to 16 percent of the sector's average starting salary. In Silicon Valley, Google has used its free employee-transport network as a recruiting tool, and other tech employers have begun to replicate the program. In a similar vein, we recommend a private/public initiative to provide more extensive shuttle bus service to connect the numerous outlying tech campuses to the commuter lines north and west

of Boston. Furthermore, an analysis of the cost of living and economic surplus of Boston versus other tech cities indicates that Massachusetts should do a better job of educating prospective residents on the economic advantages of Boston.

INNOVATION INITIATIVE

A. Create new centers of innovation and collaboration

Massachusetts has an excellent model for an approach to speeding up the commercialization of new technologies and increasing the number of start-ups. The Deshpande Center, a business incubator at MIT, has had a profound impact on the commercialization process for new technologies and could be replicated at other institutions in the state. Deshpande, which was funded by MIT-trained telecom entrepreneur Desh Deshpande, has a range of programs to help faculty and students turn promising innovation projects into business ventures. Volunteers from industry lend their expertise in financing, marketing and other business disciplines. Since the program began in 2002, the number of start-ups launched annually at MIT has grown by 40 percent, rebounding to the level of activity in the 1990s. Research shows that companies emerging from incubators are twice as likely to survive to Year 3 as independent start-ups. The state, universities and industry should work together to create similar centers at other institutions, including expanding the Massachusetts Technology Transfer Center at the University of Massachusetts.

The state can further improve the connection between academic research and industry needs by creating a research clearinghouse. By pooling information about research activities, entrepreneurs and investors can focus on the most fruitful avenues of development – and stretch precious R&D funds.

B. Create an “early warning system” to guide increased state investment in collaborative R&D opportunities

Through the creation of the peer-reviewed matching grant fund at the John Adams Innovation Institute in 2003, Massachusetts supports collaborative federal

grant applications that could deliver significant R&D awards to the state’s universities in collaboration with industry partners. However, compared to such states as California and Florida, the \$30 million Massachusetts originally committed to compete for federal research funds remains modest. Massachusetts should increase its technology R&D investment using a peer-reviewed system that insulates that investment from political influence.

Massachusetts also needs to embrace a systematic effort that identifies, tracks and organizes resources to pursue federal grant opportunities, by bringing together area universities and providing planning resources. This system would help ensure that taxpayer money is well spent and the state does not miss out on opportunities. An example of this type of coordination can be found in the Defense Technology Initiative’s effort to galvanize leaders in industry, university and government to bring the Air Force’s Cyber Command Center to Hanscom Air Force Base.

The early warning system would also offer increased opportunity to identify “Global Challenge Centers” – large-scale university-industry R&D collaborations – in appropriate Massachusetts sectors. These centers would be built around disciplines where Massachusetts companies and researchers have established expertise and distinctive advantages and would serve to concentrate research efforts in those areas.

C. Explore opportunities to enhance local networking fabric

Industry sources have consistently noted that networking in the tech community is less open and extensive than in other regions, particularly Silicon Valley. For example, an informal review of the LinkedIn professional networking site shows that Massachusetts computer software workers have over 35 percent fewer connections than their counterparts in Silicon Valley. Massachusetts public and private sector leaders must make deepening and widening the local networking fabric an explicit public policy goal. Such networks are essential to the spontaneous creation of new enterprises.

In California, five times as many start-ups emerge from existing companies as arise from academia. Yet in Massachusetts, corporate spin-offs occur at only one and one-half times the rate of academic start-ups. One often cited driver of new business creation is the mobility of ideas and people in a networked community. Industry sources suggest one reason Massachusetts lags California in corporate spin-offs is the strict enforcement of non-compete agreements in employment contracts, which can discourage tech professionals from even casually sharing knowledge and ideas with peers at other companies. In California, where non-compete agreements are not enforced, networking is a full-time activity and is directly linked to company formation. Recognizing this, some industry participants have already volunteered to ease their demands for non-competes – Boston venture firm Spark Capital, for example, has dropped all non-compete requirements for its portfolio companies. We recommend that the Commonwealth establish a taskforce to further investigate how legal and social regulations impact the local networking fabric and evaluate reforms adopted by other states.

MASSACHUSETTS ITCD ATTRACTIVENESS INITIATIVE

A. Remove barriers to business launch and expansion

While its existing tech industries are healthy, Massachusetts is falling behind in the nationwide competition for new high-tech investment and development. Cost and complexity are twin roadblocks. According to data compiled by the Milken Institute, Massachusetts has risen from No. 5 to No. 4 in the rankings of the most expensive states in which to do business, a dubious distinction. An important factor is the multiple layers of government at work, which makes building new facilities a challenging and lengthy process. *"Permitting is a nightmare and is more time-consuming for small companies,"* says one Massachusetts venture capitalist. North Carolina— which competes directly with Massachusetts for high-tech investment and jobs – has a program to identify certified development sites to speed the process.

Massachusetts, under both the Romney and Patrick Administrations, has shown a strong commitment to improving the state and local permitting systems. Still, Massachusetts is a home-rule state and local government has various means at its disposal to hinder development. Through the permitting reform bill of 2006, the state created an opt-in system for streamlined permitting by cities and towns. As of June 1, 2008, 44 of the Commonwealth's 351 municipalities have adopted this fast-track permitting. Massachusetts employers should work with the Commonwealth and the cities and towns to encourage broader adoption of fast-track permitting. The Mass High Technology Council has started this process through the development of Masstrack.org, an interactive website that ranks the high-tech competitiveness of the state's communities on streamlined permitting and other variables.

B. Put Massachusetts back on the high-tech map

The state has worked successfully with the local life sciences industry to market the Boston area nationally and internationally as an ideal place to locate new facilities and find top talent, but the state's well-established information technology, communications and defense sectors have not received this type of support. As a result, Massachusetts no longer commands share of mind in high-tech and has been far less successful in attracting out-of-state investment. Our interviews indicate that the state is not regarded as adept at reaching out to the high-tech community; high-tech has not appeared to be a top priority for the state government for many years. The recent declarations of February 2008 as "IT Month" and May 2008 as "Defense Month" are steps in the right direction but the administration needs to employ a more long-term commitment, both in practice and in public messaging, to supporting the Commonwealth's pillar industry sectors. Massachusetts should make a more concerted effort to publicize its resources, opportunities, and successes in high-tech and defense and undertake a rebranding effort to reinvigorate public perception of the sector in the wake of the decline of the Route 128 brand.

The state should undertake a focused economic-development effort around the ITCD sector. Massachusetts currently offers financial incentives for workforce training and job creation, as well as development in targeted economic areas, but other states' programs are equally or more competitive. North Carolina, for example, has launched the One North Carolina Fund, offering incentives to vital employers that are considering a move outside the state. Texas created the Texas Leverage Fund, a program that encourages localities to levy an economic development sales tax for use in new company attraction.

* * *

Massachusetts has been a leader in information technology, communications and defense electronics for decades – the foundations of those industries were laid here. The Commonwealth has remained an important source of new ideas and talent, but it is falling behind in turning cutting-edge concepts and inventions into new businesses and jobs within its borders. All the ingredients are in place for the industry and for policymakers to change this picture. With sufficient will and focus, Massachusetts can regain its standing as a leader and ensure that its high-tech industries continue to generate economic growth.



1. TECHNOLOGY INDUSTRIES IN MASSACHUSETTS – Maintaining Vitality in a Critical Economic Sector

Technology industries – computers, software, communications, defense – continue to play an essential role in the Massachusetts economy. But their ability to sustain historic growth rates is now challenged, posing significant policy questions for ITCD leaders and state officials.

Growing to more than 15 percent¹ of gross state product, the largest economic sector in the state (Exhibit 2), ITCD represented the successful transformation of the Commonwealth into a knowledge economy in the closing decades of the 20th century. In the past decade, as these industries have matured, they have made their own shift up the value chain: Massachusetts companies now invent and design high-tech products that are often manufactured elsewhere. Until very recently, the climb up the functional value chain has enabled the industry to sustain healthy growth rates and create high-paying high-skills jobs, which have more than made up for the loss of manufacturing and assembly jobs that went to low-cost states and overseas.

Now, however, Massachusetts companies in the information technology and communications sectors are at a crossroads: for all their success, they remain more concentrated in enterprise computing hardware and other business-to-business (B2B) markets, and less focused on software & services

and the business-to-consumer (B2C) market – areas that have exhibited significant growth and innovation in recent years.

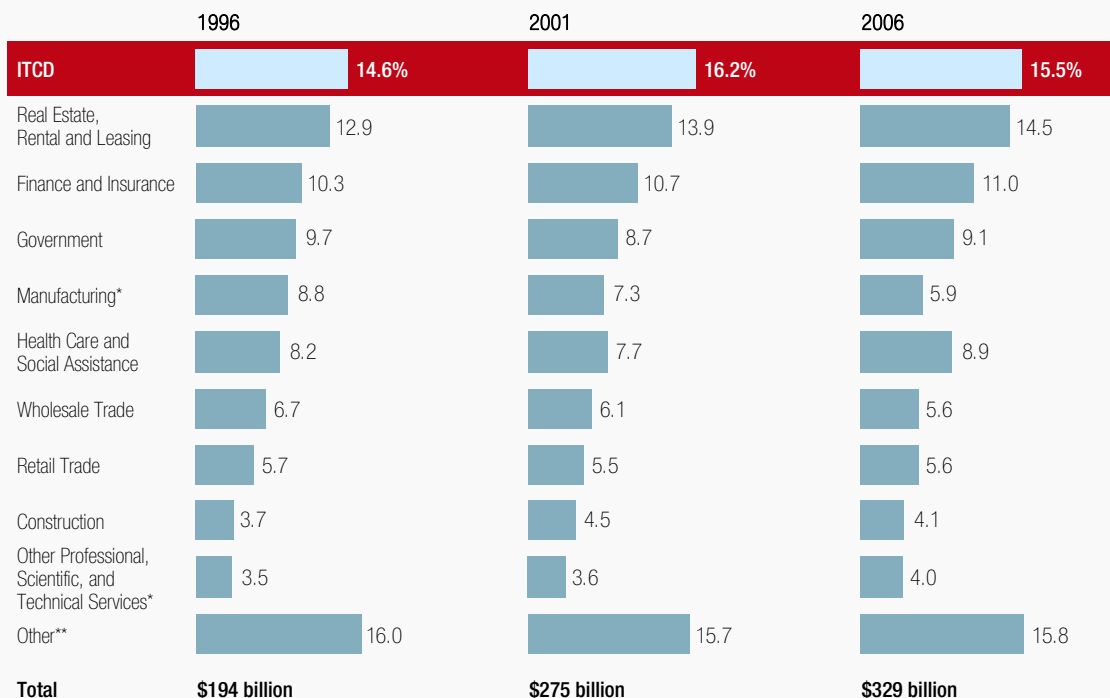
THE PRODUCTIVITY PARADOX

The arc of the ITCD sector highlights the macroeconomic challenge facing the entire state. In recent years the story of the tech industry – as well as financial services in Massachusetts – has been one of explosive productivity growth among highly skilled workers. This helped the Commonwealth beat national averages in economic growth, median family incomes and employment, despite declines in other segments of the area's economy.

But since the recovery from the 2001 recession, the state's knowledge industries have not produced enough growth to compensate for the “other” Massachusetts – a place of weak labor markets and falling incomes (Exhibit 3). Growth in median household income, which rose at almost twice the national rate before the 2001 recession, has trailed the U.S. median income since, and the state has lagged the nation in economic growth in every year but one in the 2001 to 2006 period. In 2006, for the first time in a decade, Massachusetts recorded higher-than-average U.S. unemployment.²

EXHIBIT 2

The ITCD Sector Remains the Largest Contributor to the Massachusetts Economy – Percentage of Massachusetts Nominal GDP



* Excludes focus ITCD sectors

** Admin. & support & waste management; mgmt of companies; accommodation & food services; educational services; transportation & warehousing; other services; utilities; arts, entertainment & recreation; agriculture, forestry, fishing & hunting; mining

Source: U.S. Bureau of Economic Analysis; Economy.com

This turnabout is alarming, given the demographic challenges facing the state. Population growth in Massachusetts has flat-lined and the populace is aging – by 2006, the percentage of workers reaching retirement age was approaching the number of workers entering the workforce, suggesting a human-capital gap that is likely to expand as more Baby Boomers retire.³ This could leave the state in an economic bind: A shrinking pool of wage earners trying to support a growing population of older citizens and retirees in need of greater services.

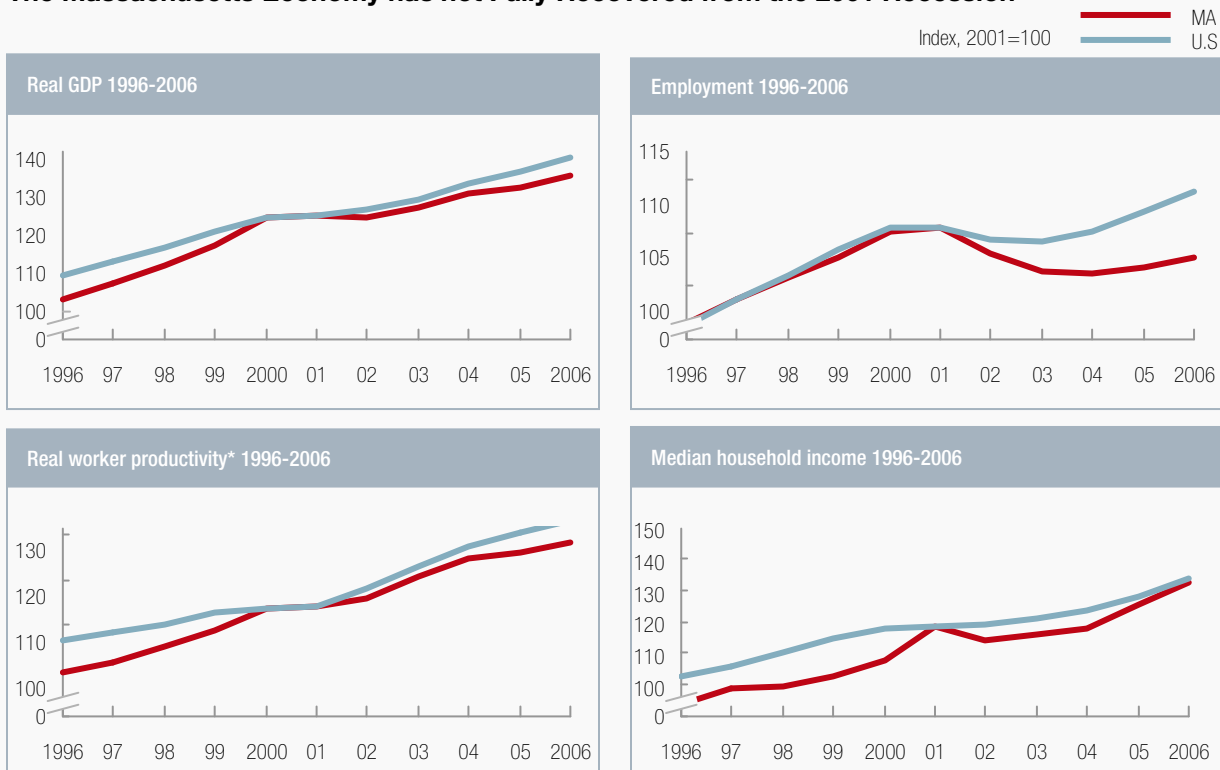
THE STATE OF THE TECH INDUSTRIES

These factors make the health of information technology, communications and defense companies a critical factor in the economic future of the state. At the close of 2007, the ITCD sector is healthy, but challenged. In the recent expansion from the 2001 recession, growth has been uneven and entirely

productivity-led. Total output for the tech and defense sector grew from \$48 billion annually in 2001 to \$59 billion in 2006,⁴ even as employment fell. In 2006, the average productivity per employee in the Massachusetts ITCD sector approached \$180,000, up from \$79,000 in 1996⁵ and 8 percent above the national average (\$164,000). Employment in computers, software, communications and defense in Massachusetts stood at 331,000 at the end of 2006 – up slightly from the post-recession low of 320,000 in 2004, but essentially flat with 1996 levels (Exhibit 4).⁶ Meanwhile, across the U.S., tech employment has expanded by 0.9 percent annually over the past decade⁷ while states like Virginia, North Carolina and Texas have significantly expanded their tech payrolls. Moreover, employment losses in the ITCD sector stemming from the 2001 recession have been more pronounced in Massachusetts than any other leading technology state (-3.5 percent

EXHIBIT 3

The Massachusetts Economy has not Fully Recovered from the 2001 Recession



* Real U.S. GDP/total employment and real Massachusetts GSP/total Massachusetts employment
 Source: U.S. Bureau of Economic Analysis; U.S. Bureau of Labor Statistics

annually versus -2.0 percent annually for all other leading technology states).

At the same time, the composition of the tech workforce in Massachusetts has changed; in every category except professional, scientific and technical services tech companies have shed jobs since 2001. The biggest losses occurred in computer and communications hardware and software and communications services, where employment has fallen 35 percent and 21 percent respectively since 2001 and at well above the annual rate of decline in other leading technology states over the period.⁸ These changes are a function of industry consolidation and a loss of Massachusetts-based companies and facilities.

More alarmingly, the productivity gains of earlier years are disappearing. Throughout the 1990s, as the computer hardware business consolidated and it

lost low-skilled jobs, the Massachusetts ITCD sector was able to substitute more highly skilled jobs. Net job gains were modest, but productivity and revenue growth were substantial. Now, that pattern has been broken: Between 2004 and 2006, productivity growth in the sector was around 4.5 percent⁹, compared with more than 8 percent in California and Texas.

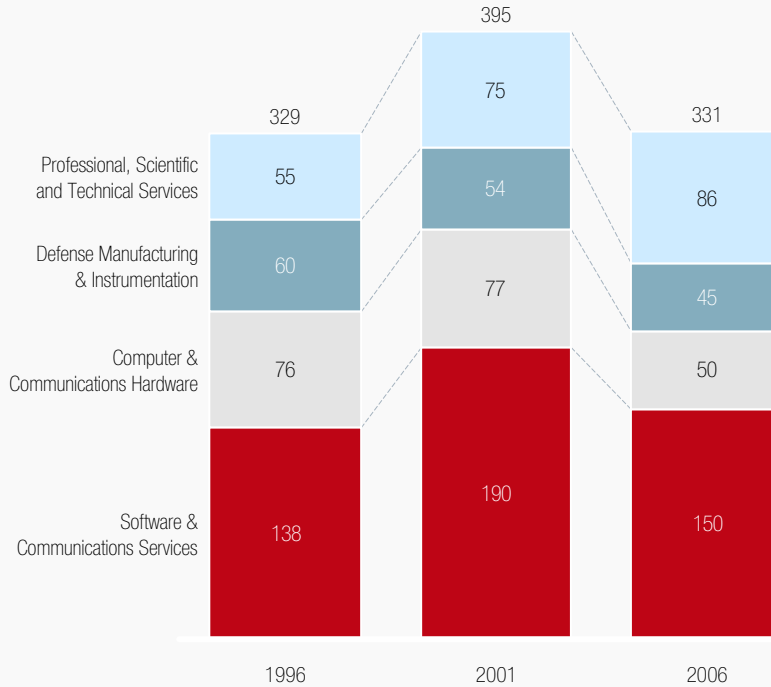
MOVING FORWARD

ITCD employment and sector growth will over time depend on how closely companies in the state are aligned with larger trends in their respective industries. In that respect, the outlook is decidedly mixed. Overall, the tech sector is oriented around more mature B2B products and markets, such as enterprise networked systems (used internally by major corporations). Also, a major driver of growth in the 1996-2006 period was expansion by out-of-state companies in these markets such as IBM

EXHIBIT 4

Overall ITCD Employment Has Been Flat During the Past Decade – Total Massachusetts Employment in IT-Communication-Defense

Thousands



Source: U.S. Bureau of Labor Statistics: Current Employment Statistics

and Hewlett-Packard, which built up operations that they had acquired or established within the state. EMC Corp., our sole addition to the Fortune 500 from the ITCD sector in the past decade, is also a B2B player, but it has made substantial progress in developing a range of high value-added software and service offerings around its core data-storage business. These include “solutions” (complex systems that combine hardware, software and services) for vertical markets, such as publishing, as well as consulting services. Also, defense contractor Raytheon continues to move up the value chain, by taking on systems-integration work and shifting as IBM did from a hardware to a software and services company.

While some in the industry and media lament the loss of Massachusetts-based Fortune 500 ITCD employers, it is important to recognize that some of

the world’s top technology companies are investing heavily in the Bay State to increase their footprints here. In the past decade, tech titans Microsoft and IBM have undertaken a growth strategy of buying up smaller Massachusetts software firms as a way to expand in a critical market. Microsoft alone has acquired two firms in the past 3 years and has grown its Massachusetts workforce from approximately 250 in 2005 to more than 800 in 2008. The capstone to local growth for the Redmond, Washington-based company is the creation of Microsoft Research New England, a new Kendall Square lab in Cambridge that will allow Microsoft to interact more closely with university researchers and innovative companies. Following Microsoft’s lead in the hunt for the area’s top talent and research partners, Google has recently moved into a newly renovated 60,000 sq. ft. facility in Kendall Square. As part of the company’s overall initiative to push more technology development out of

Mountain View, California, Google's Massachusetts employment base has grown from 50 just a year ago to 175 local employees.

IBM has long been active in the Bay State and is currently undertaking plans for the creation of the largest software campus in the state. Comprised of sites in Littleton and Westford, the campus will bring together 3,400 of IBM's Massachusetts employees to focus on IBM's software unit. Furthermore, in late 2007, IBM acquired Ontario, Canada-based Cognos to expand its capabilities in business intelligence software. Cognos' U.S. headquarters are located in Burlington, Mass., and it employs nearly 400 workers in the state. Collectively, these moves ensure IBM will maintain its position as a top employer of high-tech talent in Massachusetts (Exhibit 5).

Consumer technology: A limited presence and primarily small firms

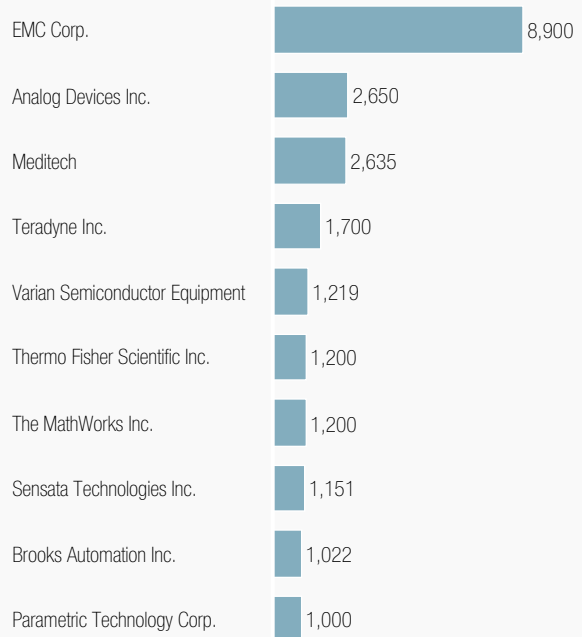
For the most part, the Massachusetts ITCD companies do not yet play a significant role in the hottest growth segments, including consumer-oriented applications – products such as MP3 players, advanced mobile phones and digital video recorders. These products constitute the so-called B2C segment. Massachusetts companies (EMC, Lotus/IBM) continue to excel in B2B applications, such as enterprise information systems and software, but they are getting less out of the B2C wave. Among the surviving Fortune 1000 tech companies based in Massachusetts, (EMC, Raytheon, Thermo Fisher Scientific, Analog Devices, Iron Mountain, PerkinElmer), only Analog Devices benefits significantly from B2C, by supplying components that are used in cell phones and high-definition television sets. The others are firmly tied to B2B and defense.

Massachusetts is represented in the B2C sector by smaller companies, notably the privately held Bose Corp. But there are not enough companies like Bose in Massachusetts: in interviews with Mass Insight researchers, leaders in the tech community expressed concern that other states are getting more out of the consumer-oriented tech business and they suggested that the state's venture-capital community has not been sufficiently supportive of

EXHIBIT 5

The Massachusetts high-tech sector is well-represented by the world's leading technology companies

Mass. employees at Mass.-based companies 2007



Mass. employees at out-of-state companies with Mass. presence 2007



Source: Boston Business Journal

the attempts by entrepreneurs to launch consumer-oriented tech start-ups.

Defense electronics: Well-positioned in systems and advanced electronics

By contrast, the state's defense sector is well positioned to ride an important secular trend: the increasing role of computers, software and advanced electronics in weapons, ammunition and military vehicles. Overall, the state's defense industry saw strong and consistent growth between 1996 and 2006, as sector GDP grew by more than 150 percent, from \$3.2 billion to \$8.1 billion annually. New high-tech weapons systems, from smart bombs to unmanned aerial vehicles (UAVs) depend increasingly on sophisticated onboard computers, guidance systems and software. Waltham-based Raytheon Corp., the No. 5 U.S. defense contractor, is a leading player in this industry and other Massachusetts companies in this area include Dynamics Research Corp., Draper Laboratory, MITRE Corp., iRobot, Foster-Miller, and Lincoln Labs. In addition, out-of-state defense contractors, such as General Dynamics, BAE, Lockheed Martin and Textron, have significant operations in defense electronics within the Commonwealth. Furthermore, the computer-science programs at MIT, UMass, and other universities in the state can supply talent for such employers. One major contributing factor to the strength of the sector is Hanscom Air Force Base in Bedford. Hanscom is a leading IT procurement and integration facility for the US military and generates more than \$3 billion in annual economic output for the region.

Digital media: A limited presence, but promising Web 2.0 start-up activity

Another global trend in high-tech is the continuing growth of digital media. This is driving demand for new platforms to deliver content and advertising to a multiplying array of digital devices, including mobile phones and media players. Similar to the move to consumer applications, however, there are few Massachusetts companies well represented among the industry's most successful companies. EMC is marketing storage "solutions" for media companies, including systems for managing print

and video content. In the critical area of on-line/mobile advertising, however, two prominent start-ups have been acquired by larger leaders based in other regions: Third Screen Media was acquired by AOL, and Maven was acquired by Yahoo.

The emergence of Web 2.0 and participatory media – relying on user-generated content – marks an inflection point in the evolution of digital media that may allow Massachusetts to gain prominence. There has already been significant start-up activity related to Web 2.0 in the state. For example, Communispace, based in Watertown, is a leader in creation of on-line customer communities, which can be used for product development research and other marketing applications. Other Massachusetts-based Web 2.0 companies include Aidpage, mybloglog, Sconex, nativetext.com, reddit, Kiko, voo2do, BlogBridge, Blogniscient, and Kayak. In the first half of 2007, \$102 million of the \$464 million invested in Web 2.0 companies went into New England start-ups, compared to \$91 million in Silicon Valley.¹⁰ It is critical for leaders in Massachusetts to take steps that enable the start-ups of today to become the industry shapers – and job generators – of the future.

In conclusion, it is clear that, with the exception of defense electronics, companies in the Massachusetts ITCD sector are not participating fully in the most dynamic growth areas of their respective markets. Massachusetts retains distinctive strengths in areas such as defense electronics and enterprise computing and software, which continue to be large and healthy businesses. However, to generate sufficient growth and create the kind of high value-added jobs that are needed to maintain the state's standard of living, the ITCD sector needs to leverage opportunities in emerging tech markets as well.



ACHIEVING THE 2015 VISION: Initiatives for Massachusetts

Mass Insight has identified three major strategic initiatives that can preserve and enhance the health of the ITCD sector. These initiatives can be undertaken independently of one another, but together they form a comprehensive response to the challenges that threaten the vigor of the critically important high-tech and defense sector of the Massachusetts economy. The initiatives are aimed at driving ITCD sector growth by:

- Developing and retaining human capital for existing and future employers
- Reinvigorating growth through commercialization of innovation and company creation
- Improving the business climate to encourage high-tech and defense companies to expand and locate here

If supported by public and private stakeholders, the three initiatives can improve the outlook for the ITCD sector in Massachusetts substantially by 2015, fulfilling a vision of restoring growth and ensuring that the state competes successfully for technology talent, investment and share of mind.

INITIATIVE 1: DEVELOP AND RETAIN A HIGHLY SKILLED TALENT BASE FOCUSED ON TECHNOLOGY-BASED CLUSTERS

To ensure the future health of today's ITCD companies and spur the innovation and business creation that will keep the Massachusetts high-tech industry vibrant in coming decades, the state must attract and retain the best and the brightest talent.

In the contest for highly-skilled technology workers, the Commonwealth holds an enviable position. It has world-class educational and research institutions, a strong and vibrant tech community, and Boston offers a desirable urban lifestyle with excellent recreational and cultural amenities—Boston is consistently ranked as a top city for singles and young professionals.¹¹ The state offers great diversity and has long welcomed men and women from around

“There are not enough qualified workers. . . . [I]f we could find the workers, we'd employ them.”

**– General Manager
High-Tech Company**

the world, who come to Massachusetts to attain and apply high-tech knowledge. Over the years, Massachusetts has been a leader in the economic transition from low-skilled manufacturing to high-skilled technology; average productivity per worker in Massachusetts was more than \$94,000 in 2006, well above the national average of \$84,000. In the ITCD sector, productivity per worker was \$178,000, versus \$164,000 nationally.

The dynamics of the global tech economy have worked against Massachusetts since the 2001 recession, a period that has been particularly challenging for high-tech companies. Since the September 11 attacks in 2001, foreign students have faced new barriers to entering the U.S. and many have chosen to study and launch careers elsewhere. At the same time, booming economies and rapidly improving lifestyles in China and India have encouraged students from those countries to stay home. Compounding issues further, Massachusetts sees a number of potential

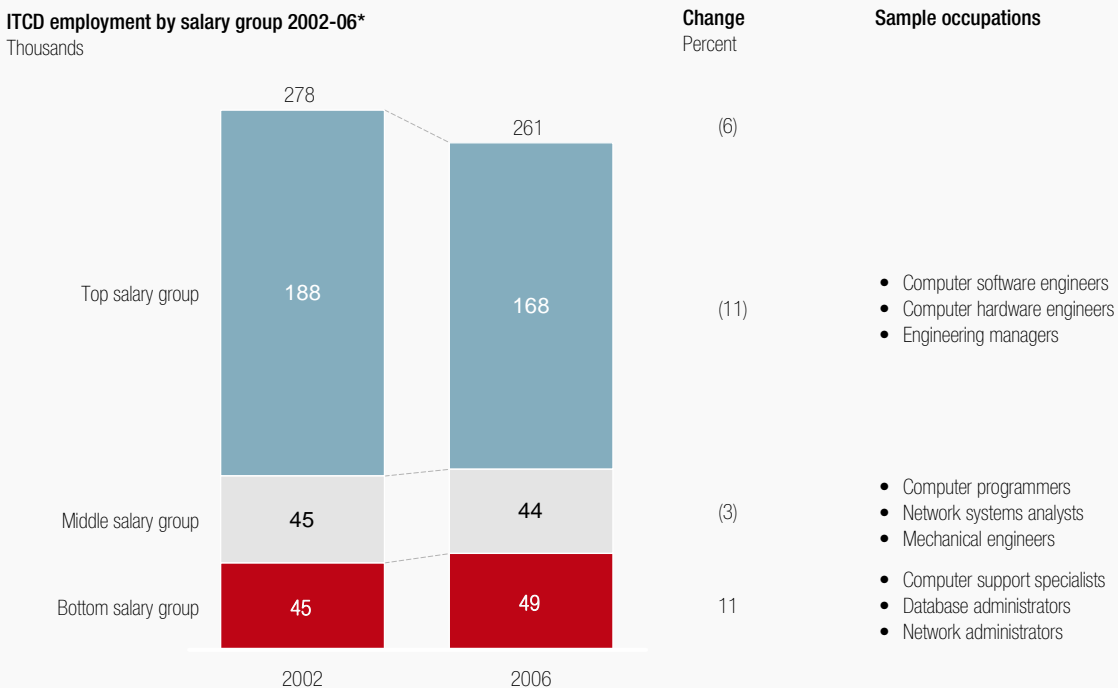
ITCD workers leave the state to accept job offers in places that offer lower living costs and milder climates.

To maintain a high level of productivity and generate more high-value jobs, which are critical to the overall economic health of the state, Massachusetts needs to adopt a comprehensive program to attract, retain and train high-tech talent. Quick action is needed to halt emerging trends that suggest a potential deterioration of the state's competitive position in high-tech.

- Productivity growth has slowed in recent years and Massachusetts has dropped from No.2 nationally in productivity among ITCD workers to No. 4
- Between 2002 and 2006, the state lost nearly 20,000 jobs in the most highly paid categories of tech employment (hardware and

EXHIBIT 6

Number of High-Value Jobs Have Declined in Massachusetts in Recent Years



* Occupations grouped by mean wage in 2002 and 2006; those occupations that moved between groups were omitted
Source: U.S. Bureau of Labor Statistics

software engineers and engineering managers), while adding new jobs on-line in low-skilled tech positions (support specialist, network administrators) (Exhibit 6)

- Young workers who come to Massachusetts to train for high-tech jobs are likely unaware of the great opportunities that exist within the state and many are discouraged by the high cost of living
- Massachusetts high-tech employers feel there is a mismatch between the skills taught by Massachusetts universities and the current requirements for early entrants to the ITCD workforce. *“There are not enough qualified workers. . . . [I]f we could find the workers, we’d employ them,”* a general manager of a high-tech company says. If this disconnection persists, major employers will look outside

Massachusetts to states (or countries) where the right skills are in abundance

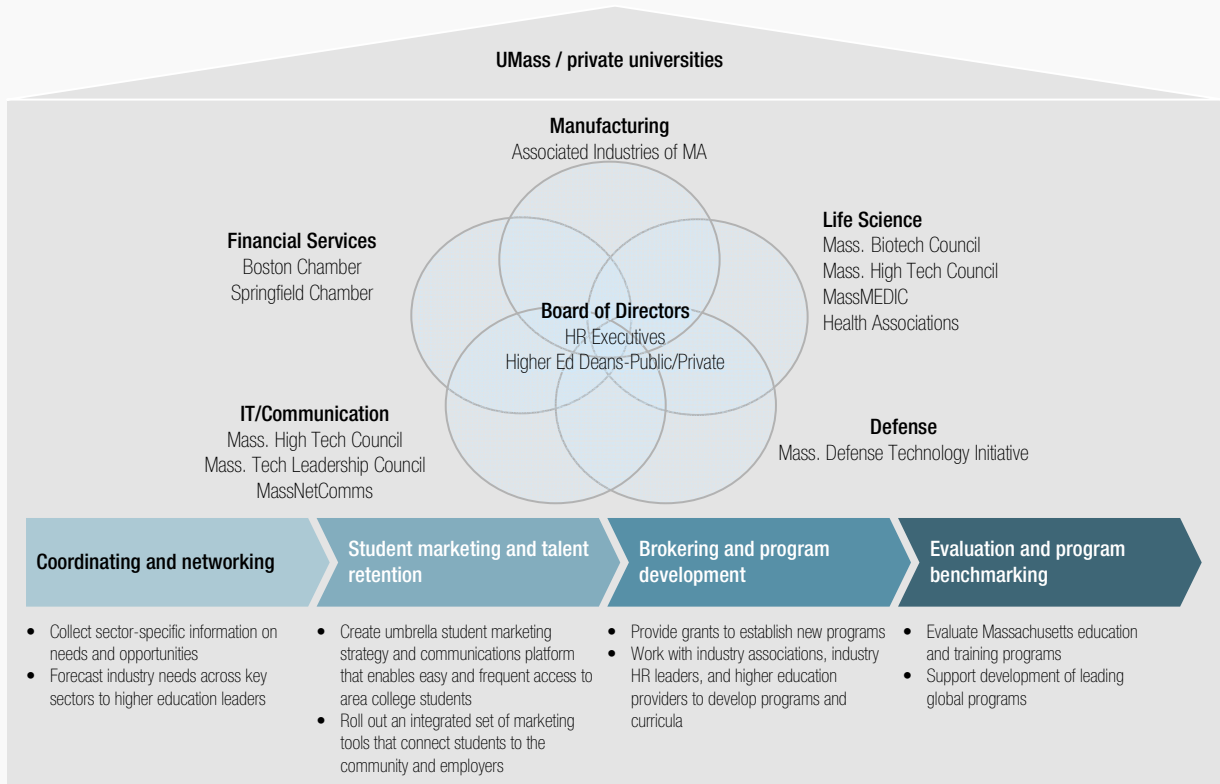
A. Align curriculum with industry needs

We recommend a systematic alignment of the academic programs at the state’s leading public and private institutions with the job requirements of Massachusetts’ high-tech employers. Employers need to know that they will be able to fill jobs in-state and young high-tech workers must be assured that they can find appropriate employment in the state.

The Commonwealth should consider creating a Massachusetts Talent Development Bank (TDB). The TDB would be an independent entity housed at an appropriate institution (such as the University of Massachusetts or the Mass Tech Collaborative) that would develop and coordinate an ongoing dialog between employers and academic institutions. The Talent Development Bank should be composed

EXHIBIT 7

Massachusetts Talent Development Bank



Source: Mass Insight Global Massachusetts 2015

of representatives from leading companies, tech associations and academic institutions across the state with representation from each of the state's pillar industry sectors (Exhibit 7). The goal of this effort is to make sure that universities and students understand what knowledge will be needed by Massachusetts employers in the foreseeable future.

A model for the Talent Development Bank is the DTI (Defense Technology Initiative) Defense Workforce Project. DTI was launched by the Mass High Tech Council in 2005 to ensure the state's leadership in the defense sector. The effort brought together leading defense companies and area universities that were committed to adapting engineering curricula to meet the future needs of the Massachusetts defense sector. The universities learned which specific skill sets would be in demand over the coming decade, including radio-frequency engineering, systems engineering and defense contract management. As part of the initiative, university representatives visited the defense firms to understand their talent needs, then detailed their own engineering offerings.

The needs assessment has now been updated annually and in 2007 more than 50 companies participated in the Defense Workforce Project. As a result of the program, several schools updated course offerings and created industry-outreach programs, including two new radio-frequency engineering classes at Worcester Polytechnic Institute (WPI) and an introductory course in systems engineering to suit the needs of Raytheon and Lockheed Martin.

For the broader ITCD initiative, it is imperative to enlist the cooperation of employers across the spectrum of ITCD companies and, on an annual basis, conduct a needs assessment. Each of the leading

“Collaboration is a great way for companies to create a pipeline for students.”

– University President

CONNECTING CURRICULUM WITH THE WORKPLACE

by Keith Peden

We have all seen the eye-opening statistics: the United States is generating a fraction of the scientists and engineers that competitor nations such as China and India are. For a technology-rich state like Massachusetts, the slowing of the engineering pipeline is a troubling trend.

Even more troubling is that many of the graduates from some of the top engineering programs in the nation lack some of the more critical skills needed to succeed in demanding private sector environments. Employers, particularly defense technology employers, crave “systems-of-systems” engineers who bring cross-disciplinary principles and leadership and creativity to their daily routine.

Last fall, Mass Insight brought together technology employers and the deans of leading engineering programs for a roundtable discussion on how better to connect the skills of graduates with the needs of the technology community. Mass Insight concurrently conducted a larger on-line focus group of defense/technology employers that revealed a disconnect between the skill sets of engineering school graduates with the job requirements of today's engineer career track. While most employers felt that graduates had good math and science fundamentals, they found them lacking in other priority skills such as critical thinking, creativity and leadership. Seventy-four percent of employers said that they were forced to retrain all or most of the graduates they hired.

Still, many employers have not made reaching out to universities a priority. Forty percent of employers surveyed by Mass Insight did not have a formal relationship with an area college or university. Also, while those that have ties to local colleges and universities generally run internship programs that provide students a glimpse of real-world engineering challenges, very few focus on the curriculum or supporting classroom training with experienced engineers.

The engineering deans realized that they need to make more of a concerted effort to work with industry. Some deans expressed frustration on how to create meaningful industry partnerships in an academic setting. It is critical to continue this discussion and formulate ideas that create both a practical need for industry and universities to come to the table, but also address the cultural gap that prevents universities from meeting the challenge of a global economy.

While the roundtable discussion was a positive development, more work is necessary to turn these conversations into concrete strategies and programs to create the next generation of engineering leaders with the skills needed for a 21st century global economy. Here are some potential next steps to achieve that imperative:

- Explore the creation of a more uniform co-op or enhanced education track for engineers. Northeastern University's Engineering Co-op Program will celebrate its 100th anniversary in 2009. The 5-year undergraduate program places students in real-world projects and internships with employers for 18 months of their college careers. Legitimate concerns that a fifth year of training may turn off more students from an already challenging field may be addressed by company-based training and financial assistance for students. Mass Insight has had discussions with Northeastern Dean of Engineering David Luzzi on how to replicate the Co-op model at other colleges and universities.
- Utilize large "global challenges" to attract, train and retain the next generation of engineers. Human resources professionals understand that age demographics play a significant part in the career choices of potential candidates. Quite simply, those from the so-called "Millennial Generation" (born after 1980) have far different priorities and concerns than their Baby Boomer or even Generation X counterparts. Recent graduates are more wired and connected than ever and seek careers that are both challenging and socially redeeming. Large-scale engineer research centers (ERC), which work to combat global challenges like climate change, energy independence or homeland defense, serve as magnets to recruit and retain top engineering talent.

One current example of an ERC is the Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) at the University of Massachusetts Amherst, which is a joint university-industry research center working to address global weather challenges. This report recommends the creation of a IT security center that would help attract and retain top IT talent. Industry needs to work more closely with university and government to promote these programs and allow for the free flow of workers between academia and industry.

- Scale up efforts to create a Talent Development Bank. In 2006, the Romney Administration and the Defense Technology Initiative (DTI) created the Defense Workforce Project (DWP), which held forums to connect employers and universities with the goal of creating partnerships and specialized programs. The program was a modest success but needs to be scaled up and institutionalized to make a lasting difference for the state's economy. This report identifies the need for a Talent Development Bank, which would institutionalize and scale up the DWP to reach other critical industries. The TDB, which would be supported by state, university and private sector funds but still be independent of state government (perhaps located at the University of Massachusetts or at a private university) would also provide an avenue to link companies and students/professors with internships and sabbatical programs – injecting more of the private sector business perspective into the academic setting and marketing students to remain in Massachusetts after graduation.

Keith J. Peden is senior vice president of Human Resources for Raytheon Company and Chair of the Mass Insight HR Executives Committee. He was elected SVP in March 2001. As Raytheon's top Human Resources officer, Mr. Peden is responsible for providing worldwide direction for the company's human resources initiatives. As such, he leads organizational change, leadership development, talent acquisition, diversity, performance development and the execution of contemporary human resources processes.

employers will be asked to provide a complete list of necessary skills for entry-level jobs, identified gaps among recent new hires as well as information about how skills requirements are evolving for current employees. The annual assessment should capture both near-term and long-term needs.

In addition to such high-level institutional collaboration, a comprehensive effort to generate better employment opportunities in the ITCD sector will depend on creating many informal contacts between industry and academic institutions. For example, faculty-staff exchanges between universities and industry should be integrated into the curricula, exposing students to experts from the “real world.” As these connections grow, the path between university and industry should become more apparent.

A key factor in the ability of other states to retain graduates in-state has been the availability of

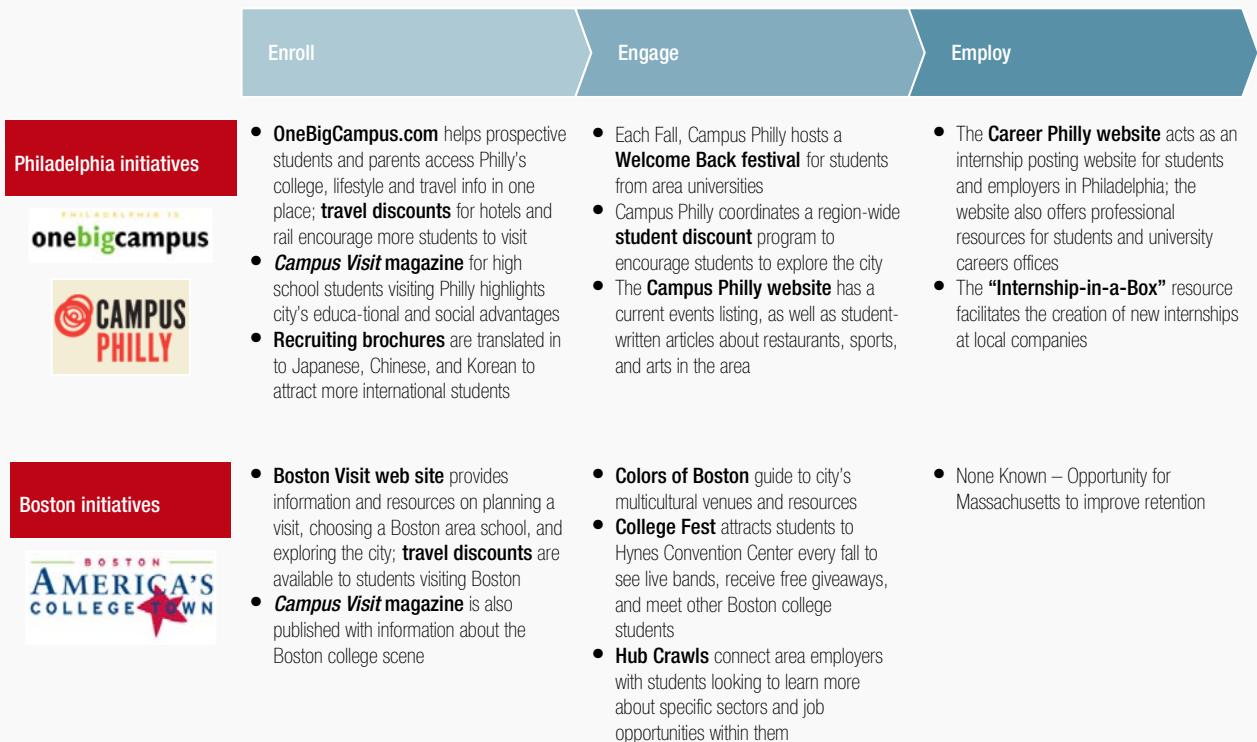
meaningful internships: depending on the industry, 30 percent or more of new hires are identified through internship programs. (Formal efforts to create internships are part of the second step in the talent initiative, described in the following section). “*Collaboration is a great way for companies to create a pipeline for students,*” says one university president.

B. Make Massachusetts the place for future high-tech workers to train and remain

Several factors are at play in student decisions to leave Massachusetts after graduation, and most are addressable. Of the 50 percent of graduating students who attended schools in the greater Boston area and left the state in 2003, 25 percent cited job availability and 23 percent cited cost of living in the metropolitan area; only 4 percent of those leaving the Boston area relocated elsewhere in the state.¹²

EXHIBIT 8

Campus Philly Embraces Entire Student Life Cycle to Improve Talent Retention



Source: Collegia "Connecting the Dots"

A significant factor is the relatively limited view of high-tech employment opportunities that many students have. Mainly due to the B2B orientation of most large Massachusetts ITCD companies, many local companies are not top-of-mind for students. The state's tech and defense companies lack the high visibility and cachet of companies in the consumer technology areas – many of which are located in Silicon Valley. Further, an audit of press reports shows that the state's tech industry is under-represented in the media. There were 455 press hits per thousand dollars of GDP in computers and software for Massachusetts in 2006, compared with 654 for California and 523 for Texas. In defense coverage, Massachusetts rated an anemic 125 hits per thousand dollars of GDP, versus 470 for New York and 359 for Virginia. Many students may be totally unaware of how much opportunity is available in the state and may have misconceptions about what working in these companies would be like.

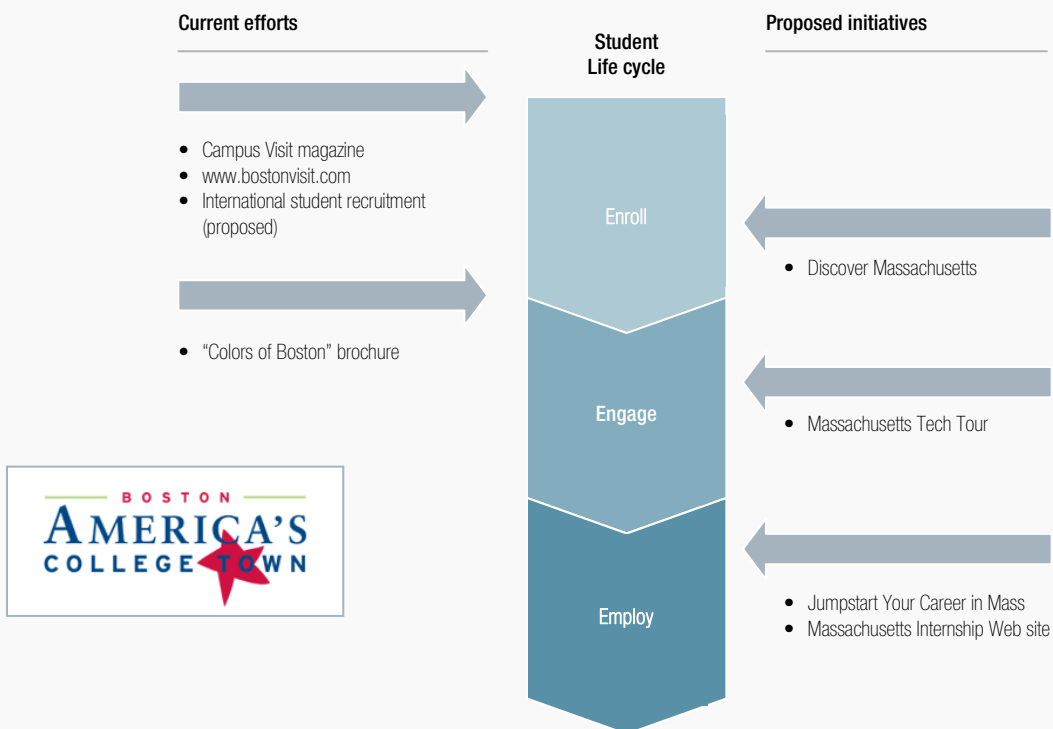
Companies in the ITCD sector could be far more proactive in communicating how students can pursue rewarding tech careers in Massachusetts.

Finally, Massachusetts lacks a formal program to retain students after graduation. The state and the City of Boston have programs to encourage enrollment in Massachusetts universities and to help students assimilate into their communities, but there the efforts end. Other states have addressed the needs of young people across the complete student life cycle: enrollment, engaging with the community, and moving on to employment and permanent residence.

Philadelphia's "Campus Philly" initiatives (Exhibit 8), exemplify what is possible. Through a variety of programs, the city has greatly strengthened its hold on students. From 2002, the year before Campus Philly was launched, to 2005, the number of

EXHIBIT 9

Proposed Initiatives are Designed to Complement Current Retention Efforts



Source: Collegia; Boston Chamber of Commerce

students who said they are considering remaining in Philadelphia after graduation jumped by 30 percent, to 65 percent of respondents. Efforts to encourage employers to offer internships – the “Career Philly” and “Internship in a Box” programs – have been important success factors. Between 2003 and 2006, the program helped arrange 5,000 internships at 1,500 companies. Two-thirds of students who participated in an internship said they planned to remain in the Philadelphia area after graduation. The Philadelphia program, which is run by Wellesley-based Collegia, has succeeded despite the area’s relatively poor prospects versus other cities: Philadelphia has lagged the nation in both GDP and employment growth since 2003.

To improve the odds that graduates with critical high-tech skills will choose to remain in the state, we recommend the following initiatives across the student lifecycle (Exhibit 9):

- **Discover Massachusetts.** This would be the most broad-based program, focused on getting high-school seniors and incoming freshmen to begin thinking about Massachusetts as a place to live, not just a place where their college is. Discover Massachusetts would consist of on-line content and be supplemented by an informative packet sent to freshmen at targeted schools and containing information about communities and organizations, discount coupons and information about how to apply for internships. The program would serve as a welcome mat to students unfamiliar with the area’s rich cultural and social offerings. Campus Philly sponsors a “Welcome Back Festival” for returning college students each fall and maintains a Web site with useful information, ideas that Massachusetts should study.
- **Jumpstart Your Career in Massachusetts.** Aimed at juniors and seniors, this would be similar to the welcome program, but with a narrower focus. Students at selected schools and in selected majors would receive information specifically aimed at generating

excitement about working in the state’s ITCD sector. Target schools would include MIT, Harvard, BU, UMass (all campuses), WPI, Wentworth, Northeastern, BC, Babson, Brandeis, Bentley, Suffolk, Tufts and Western New England. While the focus will be primarily on these Massachusetts schools, there should be an effort to provide the same information to select schools in other areas

A MISSING BRIDGE

by Scott Kirsner

A pivotal meeting took place in April of 2004 at the Charles Hotel in Harvard Square. Two Harvard undergrads arrived to meet with a young associate of Battery Ventures, the Waltham venture capital firm.

They hoped that Battery Ventures might invest in their Web site. But Battery decided to pass, in part because the founders seemed a little too young and a little too brash, and in part because the firm had earlier put money into a similar Web site that was going nowhere. The two students decided to spend the summer in Silicon Valley, where they quickly met and raised money from one of the founders of PayPal, the on-line payment service.

That, in a nutshell, is the story of how Facebook, founded in a Harvard dorm, wound up taking root in Palo Alto rather than Cambridge.

Every year, roughly 74,000 people earn undergraduate or advanced degrees in Massachusetts. (The number who drop out to pursue entrepreneurial ventures, like Facebook’s founders or Bill Gates of Microsoft, is less well-known.) About half choose to stay here. Given the Commonwealth’s high-profile position as an educator of the world’s young people, it seems we’re missing a giant opportunity. We need to do a better job connecting those students with high-energy tech companies here that will appreciate their creativity and brainpower, or assisting them in starting companies of their own.

But since Massachusetts hasn’t yet focused on building bridges that can carry students from the campus to the world of commerce, they’re drawn elsewhere – most notably to Silicon Valley, a region that celebrates the successes of young entrepreneurs like Facebook’s

of the country. The program would avoid the traditional feeders to other high-tech centers (Stanford in Silicon Valley, University of Texas in Austin). Rather, the targets will be students at universities with strong science and engineering programs located in places where lifestyle and career choices may be less appealing than in Massachusetts. These could include the University of Illinois, Carnegie Mellon University,

the University of Michigan, Cornell University, Purdue University, the University of Wisconsin, the University of Maryland, Northwestern University and Penn State University.

- **Massachusetts Tech Tour.** The now-defunct Hub Crawl, a series of company tours sponsored by the Boston Chamber of Commerce to promote employment in financial

Mark Zuckerberg or Sergey Brin and Larry Page, the pair of Stanford Ph.D.s who started Google.

The Massachusetts Innovation and Technology Exchange, a trade association, has kick-started one effort to connect students with job and internship opportunities at its member companies. Some of its suggestions are simple, like plainly advertising internship or summer job opportunities for students on company Web sites, or sharing information among companies about how to set up and run an internship program. Others would encourage recent grads to communicate with current students – for instance, by asking new hires at local companies to produce video journals about what they do, which would be available to students at their alma maters.

I've suggested that a good goal is to make sure that every student who gets a degree from a Massachusetts college or university be exposed in some way to one of our big tech companies (such as iRobot Corp., EMC Corp., or Akamai Technologies), an early-stage start-up, or a venture capitalist.

There are scads of great ideas about how to do that. Some programs already exist and just need to reach more schools and more students, and others need to be created from scratch. Just a few ideas:

- We need a “Tech Trek” that invites students to visit Massachusetts tech companies, either in a condensed week-long period in the spring, or throughout the school year. Tech Treks typically give business school students an opportunity to drop in on a series of companies, hear about strategy from a senior executive, and ask questions. Many b-school students visit tech companies on the West Coast and get a brief sampling of the entrepreneurial ecosystem there; only MIT organizes a series of visits to Massachusetts companies.

- Our state's trade associations and networking groups ought to offer a limited number of cheap student passes (\$20 or less) to every event they hold, and make it clear to students how they can secure a discounted pass.
- The cluster of venture capital firms based in Waltham ought to band together to put on an open house, inviting students to meet the investors, learn about some of their portfolio companies, and perhaps pitch a few ideas of their own. (If Facebook's founders had met more than one venture capitalist in Massachusetts, there's no telling what might have happened.)
- Every local tech company, whether start-up or behemoth, ought to have a handful of executives who are willing to go to local campuses once or twice during the school year to meet with students. A list of the available speakers on a Web page would make it easy for profs (and student-run entrepreneurship clubs) to identify and contact the right people.

Ever since the founding of Harvard in 1636, it has been our state's great fortune that many of the most promising young people in the world have come here to get smarter. Now, it's our obligation to get smarter about enticing them to stick around.

Scott Kirsner writes the weekly “Innovation Economy” column in the Boston Globe, and maintains the companion blog at <http://www.innoeco.com>. He is also a founder of two annual events for the New England tech community, Future Forward and the Nantucket Conference.

services and life sciences sectors, was prompted by an earlier “brain drain” study. This format should be a model for a Massachusetts Tech Tour, which would expose students to ITCD companies in the greater Boston area. The annual event, to be held each fall, should be funded by ITCD companies, but organized by a nonprofit organization such as the Talent Development Bank in partnership with the state.

- **Internship Clearinghouse** would better connect Massachusetts students with employers in the state for internship opportunities and engage them earlier in the state’s business community. Given the critical role that internships have in helping employers and prospective hires find one another, this project should be a high priority. From our research, it is clear that existing methods for companies to recruit interns and for students to find appropriate slots are not adequate. Further, many of the numerous small to medium-sized Massachusetts ITCD companies do not have the scale to coordinate and fund broad-based recruiting efforts across the state. This effort will afford them the opportunity to reach a larger and more diverse wealth of developing talent and should be designed to inform students at select out-of-state institutions as well (the list of target out-of-state schools is given above under “Jumpstart Your Career in Massachusetts”)

Some of these efforts could be managed by the Talent Development Bank in coordination with technology trade associations like the Massachusetts Innovation and Technology Exchange, the Massachusetts Network Communications Council, the Massachusetts High Technology Council and the Massachusetts Technology Leadership Council.

C. Attack addressable cost-of-living issues

While the macroeconomic forces that drive the high cost of living in Massachusetts are beyond the scope of this analysis, there are measures that can make the state more economically attractive to young tech workers. Clearly there is a perception that living in Boston requires a sacrifice. This view

may not be totally accurate (living costs are high, but so are salaries), but graduates continue to vote with their feet: Nearly a quarter of those leaving cite cost of living as a key factor in their decision. A mere 4 percent sought jobs in other parts of Massachusetts.

How pricey Boston is depends on one’s perspective. In 2007, it ranked as the fourth most expensive city in the nation; the cost of living was 36 percent higher than the national average, down slightly from 37 percent in 2004. At 72 percent above the national average, San Francisco, the most powerful magnet for young high-tech workers, is second only to New York in cost of living. Austin and Raleigh, two other tech hubs, both boast cost of living just below the national average.

What is more important, however, is how living costs relate to salary and lifestyle benefits that – particularly for young people – may trump financial considerations. Indeed, because of the higher salaries paid by companies in the Boston area, workers may come out ahead of those working in places such as Austin. An analysis of the most recent economic data reveals that a worker in Boston earning the median income (\$67,700) is better off than the same worker in Austin, where the median income is \$47,200 (Exhibit 10). Even with higher costs for housing and transportation, the Bostonian will wind up with nearly \$5,000, or about a 7.1 percent cushion, after paying for necessities; the Austin resident may pay half as much of their income for housing, but still will come out behind, with \$2,600, or a 5.4 percent cushion. The San Franciscan, living on a median salary of \$72,600, will wind up \$6,900 in the red. However, Boston has a smaller average “salary surplus” than Raleigh or Seattle.

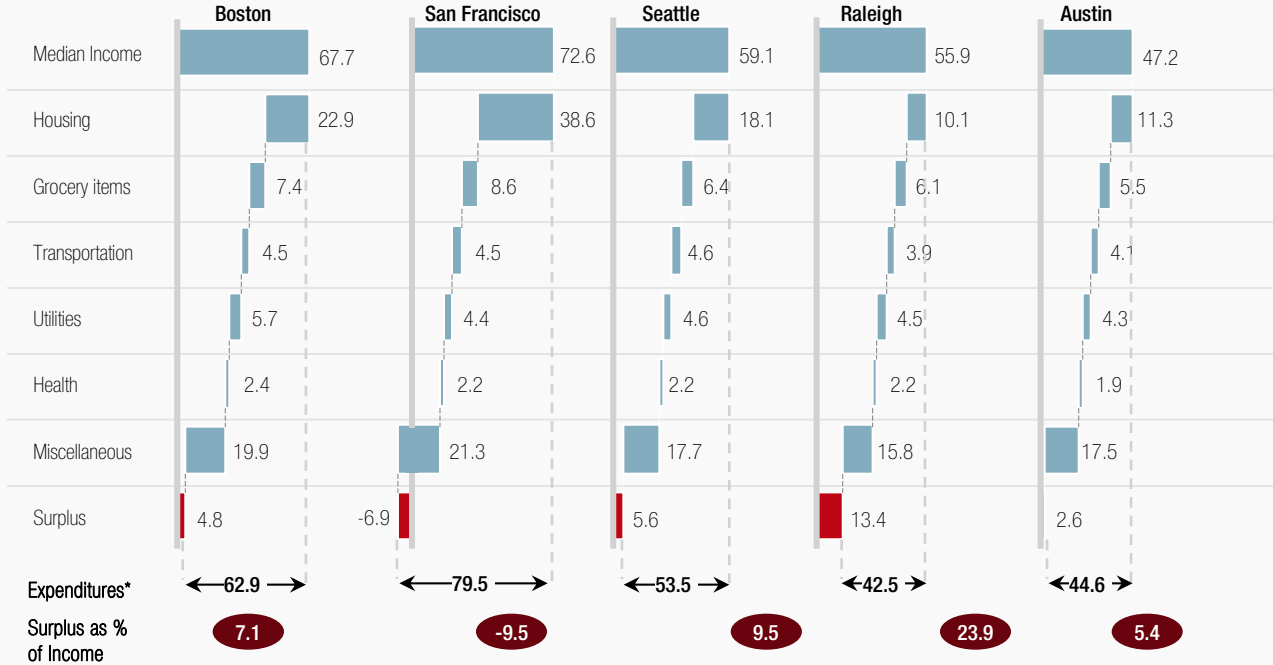
The biggest economic obstacle is housing, which in Boston consumes 36 percent of total spending for the median wage earner. That compares well with San Francisco’s 49 percent, is about equal to Seattle (34 percent) and is far above Austin and Raleigh, at 25 and 24 percent respectively. The \$417,000 median home price in Boston in 2006 was 5.8 times

EXHIBIT 10

Compared to Relative Earnings in Peer Technology Cities, Boston's Cost of Living Is About Average

Median income and cost of living per category 2005

\$ Thousands



* Expenditures based on U.S. total expenditures indexed to 100; excludes taxes.

Source: ACCRA cost of living index; U.S. Census & Moody's Economy.com; BLS Consumer Expenditure Survey

the median income, which is significantly below peer cities in California, New York City, and Seattle, but well above the multiple in Austin or in North Carolina's Research Triangle area.

The Boston area also exacts a high cost for car ownership, which is a necessity for most young tech workers, who overwhelmingly choose to live in the city, rather than in the northern and western suburbs where the major employers are located. The fully loaded cost of maintaining a car in the city and commuting to a job in the suburbs can easily exceed \$700 per month (including parking, insurance, tolls and car payments). The recent reforms by the Patrick Administration to inject more competition into the automobile insurance markets is a very positive step and should provide some cost relief, but commuting by car in an era of record-high gas prices remains an expensive proposition.

At this time, there is no state or federal effort to extend the Massachusetts Bay Transportation Authority's route system to provide a public-transit option to the state's high-tech clusters North and West of Boston. The MBTA, saddled with more than \$8 billion in capital debt, is unlikely to undertake costly expansion projects on its own in the foreseeable future.

But measures such as helping workers have access to public transportation from the workplace have proven effective in other high-tech settings. These can be adapted to the Boston area. In the Research Triangle Park area, Smart Commute@ RTP (a public/private effort) has sponsored a combination of incentives to reduce traffic and pollution, including carpooling, telecommuting, biking and public transportation. Nearly 12,000 employees have taken part in the effort. In the San Francisco Bay area, Google subsidizes a free shuttle service

to its “Googleplex” headquarters in Mountain View. Google buses, which run on biodiesel fuel, cover 230 miles of routes, or about twice the reach of the BART regional rail system. The buses carry 2,500 employees daily. Cisco, another Silicon Valley company provides shuttle services among its sites and between transit stations and its locations. Its profile – multiple facilities within the same suburban region – parallels that of many large Massachusetts employers.

In Boston, tech companies along the Route 128 and I-495 corridors could share the cost of a “Tech Shuttle,” which would provide free or subsidized transportation from their campuses to suburban trains running West and North of Boston. A combination of state and corporate funding would make this arrangement feasible. IBM, one of the

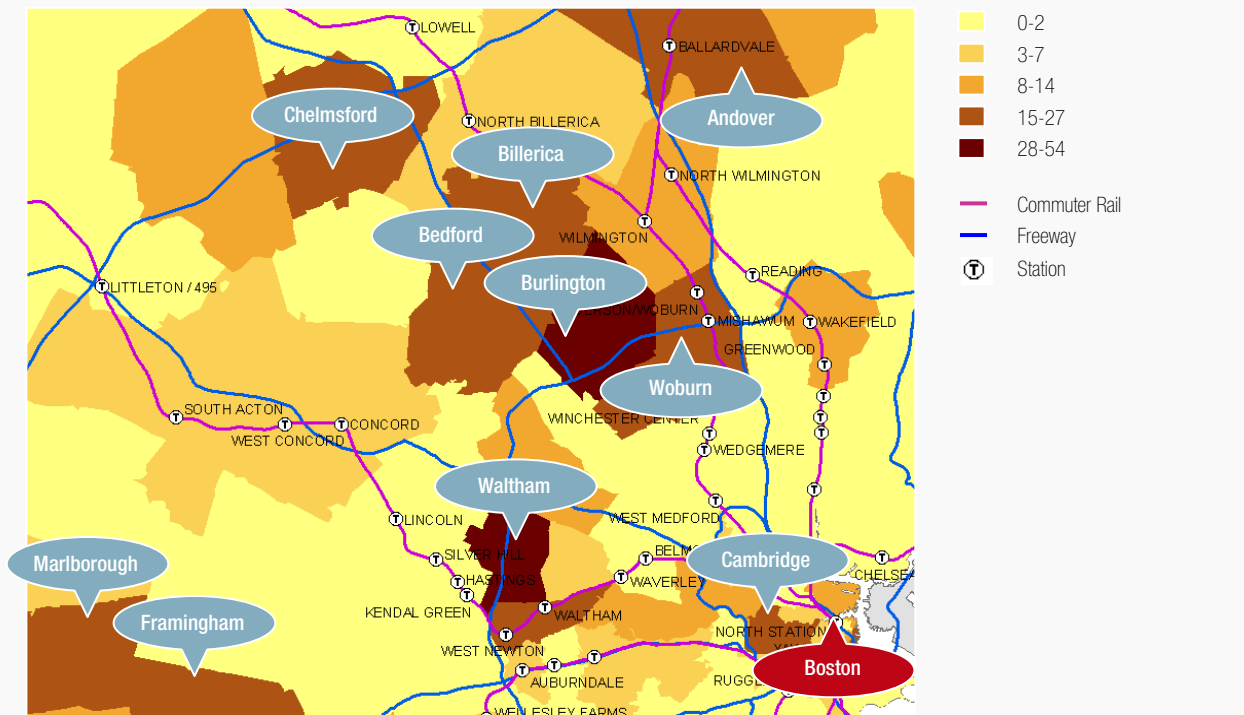
largest employers in the sector, is already considering the creation of a shuttle system for employees at its new Littleton/Westford campus. This concept could easily be expanded to include other companies along I-495 and connected to existing commuter rail stations in Littleton and Lowell. A similar opportunity exists along Route 128 (Exhibit 11).

A shuttle system would address cost of living in two ways:

- By making it possible for employees to live in or near the center of Boston without having to purchase a car to get to work
- Giving employees the option to seek more moderately priced housing further west and north of the major ITCD clusters and along existing commuter rail lines outside the city

EXHIBIT 11
Massachusetts ITCD Companies Ripe for Shuttles

Distribution of high tech and defense companies per zip code



Source: ESRI Business Analyst Extension, Dun & Bradstreet Zapdata

INITIATIVE 2: REIGNITE THE MASSACHUSETTS INNOVATION ENGINE THROUGH EXPANDED UNIVERSITY-INDUSTRY COLLABORATION

Ultimately, the health of the ITCD sector in Massachusetts will depend on how successful companies, research institutions and individuals are at creating new businesses around technological innovations. Whether it comes in the form of start-ups or fresh initiatives by existing companies, new business development is critical to maintaining the region's competitiveness and creating high-tech employment.

Again, Massachusetts starts from a position of strength. It is second only to California among technology-intensive states in R&D funding and also second only to California in the number of start-ups it produces. In addition, its return on R&D investment is nearly three times the national rate. MIT and Harvard are among the top universities in the nation when it comes to funding research and both give birth to new companies. Massachusetts leads the nation in small-business technology grants, with 10 times the national per-capita average.

Enhancing the process of turning the state's powerful research capabilities into commercial ventures will play a critical role in generating ITCD growth and employment – and sustaining the long-term economic health of Massachusetts. Despite the overall number of start-ups in the ITCD sector, the Boston area lags peer cities such as San Francisco/San Jose and Raleigh in company birth rate (the new-company count as a percent of overall sector companies). Indeed, in the 2001-2006 recovery from the tech meltdown, Massachusetts venture investors de-emphasized the ITCD sector. Investment flows have shifted to other sectors—life sciences, health and medical products—and, as venture investors have sought to reduce risks, less money has gone to early stage companies. The net of these trends has been to make it more difficult for entrepreneurs, university professors and students to turn innovative ideas into businesses in the state.

While overall venture funding in the state recovered modestly from the freeze after the tech bubble,

investment in high-tech companies declined by 3.7 percent annually between 2002 and 2006. Over the same period investment in medical/health/life sciences ventures rose by a total of 46 percent. While this reflects a national trend of venture money away from traditional high-tech, the impact is more pronounced in Massachusetts. In the Commonwealth, total investment in high-tech dropped from 68 percent of portfolio values in 2002 to 52 percent in 2006. Across the U.S., the portion of venture money going to high-tech dropped from 69 to 58 percent; in California, the proportion fell from 73 to 64 percent.

The shift to later-stage funding also complicates the process of launching companies in Massachusetts. Between 2002 and 2006, start-up/seed financing activity grew from \$49 million to \$57 million annually. But early-stage funding, which is critical for getting new products and services ready for market, fell by nearly 8 percent annually, from \$363 million to \$262 million. The biggest obstacle for entrepreneurs is the inability to find adequate funding to move concepts from prototype to production, incubator managers say.

The health of the ITCD sector and the overall economy also depends on continuing expansion by companies that operate in the state. Here, too, the path from idea to innovation must be as smooth as possible. ITCD executives report that they often find it difficult to connect with academic researchers whose work may be useful to them. Compared to their counterparts in California, academic researchers in Massachusetts seem inaccessible and possibly reluctant to align with the business community. One venture capitalist complained, "Leading academic institutions in Massachusetts have an allergy to commercialism. If you actively impede the flow of new ideas . . . you actively restrict the flow of benefits to society."

To address these issues, we recommend three efforts that will help ensure that the best innovations coming out of the state's research labs become the foundations of new companies, expansions and new employment.

A. Create new centers of innovation and collaboration

We recommend a more intentional, institutionalized effort to bring together people and resources to help focus resources in key areas of research and commercialize university research.

MIT's Deshpande Center provides an excellent template for other university-to-market incubators. Created in 2002 to foster the commercialization of technological innovations at MIT, the center has invested more than \$8 million in 70 projects. It has spawned 14 start-ups that are now capitalized at over \$100 million. These enterprises have created 132+ new jobs. The center bridges the gap between academia and industry and serves to "increase the impact of MIT technologies in the marketplace". Start-ups that are created in incubators, where they have access to experts in management, finance and marketing, have proven to be more resilient: they are twice as likely to be in business after three years than independent start-ups. Deshpande, which is funded by founder Desh Deshpande and other private donors, serves researchers, students and professors through a series of programs:

- **Grant Program.** The center awards ignition grants of as much as \$50,000 for very early stage companies, which allow recipients to prove the feasibility of their ideas. Innovation grants, which range as high as \$250,000, are available to MIT students and staff who have a proven concept and a strategy to move toward commercialization. Innovation grants are intended to bring start-ups to the stage where they can solicit venture funding.
- **Catalyst Program.** The center connects funded researchers with the business community via a catalyst program. A group of qualified volunteers from the business community consult on a range of start-up issues. In addition, the center sponsors the annual IdeaStream Symposium, an event that brings in venture investors to meet with MIT researchers who are working on early-stage companies.



CREATING ENTREPRENEURS ON CAMPUS

by Abigail Barrow

Recognizing the importance of exploiting the \$5.5 billion spent on basic research at the universities, research institutions, research hospitals and federal laboratories in the state, the Massachusetts legislature created and funded the Massachusetts Technology Transfer Center in 2003.

MTTC's mission is to help transform academic research settings into fertile fields of entrepreneurialism. Its work and operation are very similar to that of the Deshpande Center at MIT, except the resources of the MTTC are available to all of the Commonwealth's public and private universities, research hospitals and research institutions.

A \$4.4 million total state investment in the MTTC has enabled the state's 35 leading public and private research institutions to begin working together in a collaborative fashion for the first time ever. The MTTC facilitates the activities of all technology transfer offices in the Commonwealth by developing programs and providing services to support their work with Massachusetts-based companies and investors.

As a result of the Center's activities, Massachusetts companies, industry associations and investors find it easier to access the vast store of emerging technologies at these research institutions. These activities result in increased economic opportunities for technology commercialization and new company formation across the Commonwealth.

The MTTC's programs:

- Facilitate and accelerate technology transfer between research institutions and Massachusetts companies

- **I-Teams.** Under the i-Teams program, groups of entrepreneurially-minded graduate students work in teams to evaluate the commercial viability of MIT research

The Deshpande model helps foster commercial innovation in a variety of ways: providing the business context that many researchers may lack; vetting new companies to improve the chances of securing early-stage funding from venture investors; and lending the imprimatur of a top institution to new ventures seeking investor and partner recognition. The von Liebig Center at the University of California San Diego follows a model similar to that of the Deshpande center and has also seen success in generating new business development. This suggests that the Deshpande model can be replicated.

There are at least two ways in which the Deshpande model can be applied beyond MIT. First, Massachusetts could develop a statewide Product Development Center of Excellence to play the role of a Deshpande center for multiple universities. Under this program, researchers and entrepreneurs would submit their ideas for commercialization. A full-time staff with expertise in new business development would review submissions and engage promising new ventures through early-stage funding, and provide access to expertise. One way to do this would be to recapitalize and expand the Mass. Technology Transfer Center (MTTC) (see sidebar above). Seeded with \$4.4 million in state funds, the MTTC is housed in the University of Massachusetts President's office but exists to help commercialize R&D at all of the state's public and private universities, research labs and teaching hospitals. Despite its success over the past few years, the MTTC needs to be given the proper resources to continue its work at institutions across the Commonwealth. Mass Insight recommends recapitalizing the MTTC at \$10 million and providing adequate operational resources to scale up the center's operations. To be truly successful, though, it will require active participation and support from leading universities that would act as the primary sources for innovation and link entrepreneurs to volunteers with expertise in business development.

Another approach is to create Deshpande-like centers at multiple universities. We believe that this is likely to yield the greatest long-term benefits by linking business incubators directly to university research centers. In the short run, however, a statewide center could provide the necessary scale to launch the effort and establish best practices for individual university centers to adopt.

In addition to benefitting from the creation of a statewide center of innovation, Massachusetts high-tech and defense companies would benefit from improved access to academic research. Simply by sharing information about research opportunities across the Massachusetts tech community – at universities and in private industry – the ITCD sector could speed up and multiply its commercialization and company-formation activities. Through the establishment of a gated research clearinghouse Web site, researchers, companies and investors could have a single resource to learn where projects of interest are being launched. Institutions would list the research expertise of faculty members and industry participants would list pending research proposals. Additionally, the clearinghouse would provide the added benefit of engaging the undergraduate and graduate student population. Posting boards would notify students about opportunities to work on industry-driven, cutting-edge research. This effort effectively expands the current work of the Massachusetts Technology Transfer Center, reaching further upstream to provide an improved link between industry needs and research interests. It would require a point person from each university and participating company to be responsible for maintaining listings. Initial funding from the state may be required to kick-start this effort with ongoing funding coming from a small posting fee.

B. Create an “early warning system” to guide increased state investment in collaborative R&D opportunities

Beyond Harvard and MIT, Massachusetts has some of the top research universities in the country. Boston University, Northeastern University, Tufts University and a revitalized University of Massachusetts

HANSCOM KEY TO STATE'S IT SECURITY

by Bob Nesbit

Since the American Revolution, Massachusetts has been an innovator in military strategy and technology. Today, in the shadow of the historic battlefields at Lexington and Concord, sits Hanscom Air Force Base, which is a leading center of technological integration for the US Armed Forces.

Hanscom, in particular its Electronic Systems Center (ESC), is the Air Force's top center for developing cutting-edge Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance (known as C4ISR) technologies. Technologies developed at Hanscom help facilitate the speed, precision and coordination of U.S. military activities across the globe.

Hanscom employs 9,000 direct employees and approximately 25,000 more in on-base contracting jobs and in the service industry supporting the base. But Hanscom's potential is even greater as the anchor of a defense technology cluster that delivers the next generation of defense technology and Information Technology advancement.

Massachusetts is one of 18 states competing for the Air Force's new Cyber Command Center (AFCYBER), which will become the first new command the Air Force has stood up in more than two decades. The Air Force has historically led the Pentagon's efforts in air and space, but conducts all military operations in cyberspace as well. AFCYBER will be responsible for coordinating all of the Air Force's cyberspace operations and protecting the nation's vast computer networks from terrorists and other threats.

AFCYBER's mission statement pointedly states that its goal is to prevent "an electronic Pearl Harbor." This reflects a growing reality that future wars will be waged not only on land, sea or air, but through the very technological systems that comprise the basis of our modern economy and society.

Hanscom, with its IT expertise and proximity to world-class universities, industrial partners, research labs (like MITRE and MIT Lincoln Labs) and skilled workforce, is the ideal site to host AFCYBER. The state's government, industry and university leaders are working cooperatively to develop the best possible pitch to Air Force leaders.

In addition to bringing up to 550 direct jobs and more opportunities for local partners, AFCYBER would

enhance the critical mass of activity around protecting our information systems in an increasingly open and data-rich environment.

Building on this concept, Mass Insight has recommended the creation of a separate IT Security Center that connects the assets of Massachusetts universities and industry to develop best practices and innovative strategies to protect our information systems.

This would not be strictly a defense or IT play; instead it would connect all of the state's key innovation sectors (including financial services)—each of which provides a different expertise on information security. For example, defense companies focus most of their attention on threats outside of the system, potentially leaving them open to attacks from inside their walls. Financial services companies understand that the biggest threat to IT security could come from their own employees—the enemy within.

In addition to sharing best practice across industries, the center could connect computer science experts from different universities. Everyone knows that MIT is an IT powerhouse, but not many beyond the Pioneer Valley recognize that the University of Massachusetts at Amherst has a world-class computer sciences department. Connecting those two critical assets will enhance scientific discovery and create economic opportunities outside of Eastern Massachusetts.

In particular, the first step is to create a working group and preliminary budget to outline the mission and structure of the IT Security Center. In particular, identifying priorities in federal research funding trends that could be tapped to develop a center and creating a network of potential partners in academia and industry.

Massachusetts is a leader in defense technology. However, in order to maintain our leadership position we must work collaboratively and anticipate the next evolution of the information technology world.

Mr. Robert Nesbit is the senior vice president and general manager of MITRE's Center for Integrated Intelligence Systems. He is responsible for the direction of MITRE research, development, and system acquisition support of advanced intelligence and information systems.

system all make significant contributions to both the national science agenda and the local economy. But historically there has not always been a strong sense of collaboration between universities or between universities and industrial partners. That is changing, however, because federal funding agencies have begun requiring multi-institutional collaboration in the grant awards process.

The creation of the John Adams Innovation Institute has also helped encourage collaboration by leveraging state grant awards. But to capitalize on the region's research potential, Massachusetts needs to institutionalize a system for anticipating and responding to future science and technology challenges. The state should create a high-level panel representing all of the key research universities, federal funded research labs, selected industry leaders and elected officials to serve as an "early warning system" for federal research funding trends. The panel would meet regularly to discuss the state's research agenda and submit reports to the Governor and Congressional delegation.

An "early warning system" would help Massachusetts land "Global Challenge Centers" – multi-disciplinary R&D centers organized around university-industry partnerships. These centers would match significant private and federal dollars with state investments to address global challenges in technology fields where Massachusetts can be a world innovation leader, such as new IT security or clean technology opportunities. The Global Challenge Centers would attract top research talent, students and jobs. They also would bridge the divide between academia and industry, advancing basic science through collaborative work on real-world solutions. For Massachusetts' leaders, the key questions are how and where to harness our substantial university and industry assets in collaborations that sustain and strengthen the Commonwealth's global leadership in technology and high-wage jobs.

Massachusetts needs to play on scale with competitors. One potential model is the \$300 million Calit2, one of four designated California science institutes focusing on the convergence

of information technology and telecommunications, with links to biomedical applications – areas where Massachusetts is a national leader.

C. Explore opportunities to enhance local networking fabric

In examining the factors that lead to greater entrepreneurial activity in other tech regions such as Silicon Valley, it is clear that community plays a subtle but powerful role. Networking and knowledge transfer are vital to the health of any entrepreneurial community – professionals need to have a way of sharing their ideas and learning about new opportunities. A key reason why California is generating and commercializing more innovation is the higher level of contact among academics, company researchers and investors. One simple metric – the number of connections listed on LinkedIn, the networking Web site – shows how relatively well-connected Californians are. In Silicon Valley, venture capitalists, private equity investors and software professionals have an average 60 percent more LinkedIn contacts than their counterparts in Boston; network security professionals in Silicon Valley have 30 percent more contacts. Boston's defense sector professionals are the only group that exhibit a broader network than those in Silicon Valley, having on average 20 percent more contacts than their counterparts. The absolute number of contacts for defense sector workers, however, is considerably less than the other groups, perhaps not surprising given the importance of maintaining confidentiality in the defense sector.

There are many reasons for the relative lack of community among Boston ITCD professionals, including different cultural/social norms. Also, despite the intensity of the ITCD sector in Massachusetts, the Boston/Route 128 area does not have the same "company town" feel of Silicon Valley, which went from a region of fruit orchards to the epicenter of high-tech in a generation. Efforts to clone the culture that arose spontaneously in California have rarely fared well. But there are simple ways to seed community building in Massachusetts. And there are barriers that can be addressed:

the strict enforcement of non-compete agreements, which hamper worker mobility and make it difficult for colleagues in competing firms to pursue new business creation.

Leaders of the Massachusetts ITCD industry should launch a series of efforts to foster more community networking and idea-sharing:

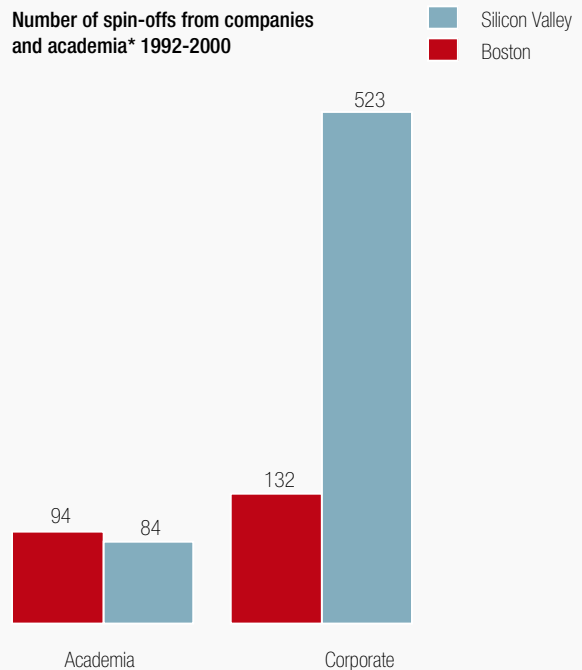
- ITCD Companies should host informal “Topic Saturday” events that bring together members of the community who are interested in a particular topic. These events should be open to anyone who wishes to attend. Companies would benefit from the knowledge sharing and enhance their reputations as leaders in the sector
- Encourage and participate in student networking activities, to expose undergraduates to business leaders and to help young people entering technology fields to establish professional networks. This would have the added benefit of helping the state’s efforts to retain graduates (see previous chapter) and may help young inventors bring new products to market. One way to help this happen is to open industry councils to students, allowing young people to meet business leaders and other students with similar interests
- The venture capital community can play an important role in fostering community. Through the New England Venture Capital Association, the venture capital community can help connect ITCD professionals by sponsoring events and reaching out to young men and women entering the field
- State government leaders should convene a taskforce to examine the impact of current legal and social policies on business creation activities in Massachusetts. Non-compete agreements, while appropriately aimed at protecting valuable intellectual property, may ultimately have the effect of stifling overall community innovation. *“Non-competes make Massachusetts less competitive than California,”* one venture capitalist declares.

An important piece of evidence is the low rate of spinouts from existing tech companies in Massachusetts, as compared to that of Silicon Valley (Exhibit 12). Over the 8-year period leading up to 2000, MIT and Harvard produced 94 start-up companies – ten more than the number produced by Stanford and UC Berkeley and further testament to the culture of innovation rooted in area schools. However, an analysis of start-ups coming from leading tech companies in the two regions yields a very different result. Silicon Valley companies produced an astonishing 523 new company start-ups over the same period – nearly four times as many as did the Boston area. The examination of how non-competes hamper would-be company launchers in Massachusetts is critical and should include reviews of regulations and statutes in other states, including California and New York.

EXHIBIT 12

Boston Lags Silicon Valley in Corporate Spin-Offs

Number of spin-offs from companies and academia* 1992-2000



* From leading companies and institutions
 Source: “High-Tech Start-Ups and Industry Dynamics in Silicon Valley,” California Public Policy Institute, 2003

While Massachusetts cannot legislate greater creativity and innovation from its high-tech companies and research institutions, it can use the measures described in this chapter to create the proper conditions to help turn new ideas into businesses. Clearly, Massachusetts has the right elements to fuel creation of tech-based businesses, including a critical mass of university resources in such key fields as materials, computer science, electrical engineering and aerospace engineering. It has strong concentrations of professional talent in its computer software, communications and defense companies. Also, it has a well-established infrastructure for creating new companies (intellectual-property lawyers, accountants, venture investors, business consultants). By working together, the state, industry and universities can ensure the Commonwealth will continue to capitalize on Massachusetts-born innovation.

INITIATIVE 3: MAKE MASSACHUSETTS THE PREMIER STATE FOR LAUNCHING AND GROWING A HIGH-TECH BUSINESS

In foregoing sections we examined ways to expand the high-tech talent pool and better commercialize innovations that are bubbling up in Massachusetts research labs. These efforts, to a large degree, can be accomplished by the ITCD establishment – the companies, universities and financiers who now participate in the industry. But the long-term health of the industry also depends on policies that can only be affected at the state level and with the commitment of elected officials. For Massachusetts to compete for jobs and investment in the ITCD sector, the state and industry must address structural and regulatory obstacles. These include reforms that would make Massachusetts an easier place for all companies to do business and a more aggressive approach to keeping companies in state and recruiting new investment by out-of-state companies in the sector.

The high costs and relative difficulty of establishing and/or expanding businesses in Massachusetts are significant handicaps for ITCD companies. The industry has already seen hardware manufacturing

and programming jobs disappear or migrate to other parts of the U.S. and to low-cost offshore sites. Now, it is higher value-added work that is threatened. Given the increasing availability of highly skilled talent all over the world and the ease of communicating and collaborating over broadband networks, it becomes more difficult for business executives and entrepreneurs to justify investment in new operations in Massachusetts – even for such high-skill functions as fundamental research and product development.

Efforts by the state and by business groups to make the area more hospitable to new and expanding businesses have not yet made enough of a significant difference. ITCD sector executives complain that the state's business groups are fragmented compared with those of other states. In particular, they say, the state does not present a clear strategy for encouraging ITCD companies to operate here.

Costs are the over-arching concern, however. On that dimension, Massachusetts has moved in the wrong direction. It is now the fourth most expensive state in which to do business, up from number five in 2006, according to data from the Milken Institute. Massachusetts is the second most expensive leading technology state. Taxes are only the most obvious cost driver; the Commonwealth's flat 9.5 percent rate on business income is among the highest in the nation. Executives also complain about high property taxes, prevailing wages and utility rates as well as a range of use taxes, fees and regulations that add to their costs. Electricity costs, for example, are 88 percent above the national mean, commercial rents are 65 percent higher and wages more than 20 percent higher. Massachusetts has the highest employer unemployment insurance costs in the nation, and reform efforts have been blocked or watered down in the legislature. Employer health care costs are among the highest in the nation, and the state's new universal health care program puts mandates and costs on small businesses and start-ups that entrepreneurs do not face elsewhere.

In addition to high costs, Massachusetts also presents businesses with substantial logistical

hurdles. Businesses engage with multiple layers of government and a range of state agencies to build facilities and operate them in the state. Other states that compete for ITCD facilities, notably North Carolina, have tried to simplify and speed up processes such as obtaining building permits. *“Permitting has been a problem in the past. It has taken far too long to get things done and the costs are too high. Permitting in North Carolina costs zero,”* said the director of one high-tech company. North Carolina has earned a reputation for being business-friendly, both in tax/regulatory policy and in attitude: the state’s Business ServiCenter, for example, offers a list of pre-certified development sites, sparing companies a lengthy search for viable locations. The center also provides a single point of contact for all state development services.

The past two gubernatorial administrations and the legislature made real strides over the past few years to reform state and local permitting. A state interagency permitting task force now exists to ensure that the myriad of state departments – transportation, environment, housing, energy – are all on the same page when it comes to permitting policy and regulations. The state has also created a permitting ombudsman in the Executive Office of Housing and Economic Development to help businesses and local communities navigate the state and local permitting process.

However, the main impediment to economic and housing growth remains on the local level. The permitting reform bill of 2006 created an opt-in system for streamlined permitting by cities and towns. As of June 1, 2008, only 44 of the Commonwealth’s 351 municipalities have adopted fast-track permitting – although more have city and town votes pending for fall 2008. While the state is working closely to encourage local communities to opt-in, the business community – particularly technology employers – needs to do its part. In 2006, the Mass High Technology Council launched Masstrack.org, an interactive Web site which ranks the high-tech competitiveness of the state’s communities. Masstrack.org is a tool to ensure that positive state policies – taxes, development,

education – are implemented properly on the local level. Fast-track permitting status was added as a variable in 2007 and immediately had a significant impact on the rankings – and received attention in the media and local communities. Communities that fared well in the rankings now publicly tout their status as pro-technology towns. Those toward the bottom of the rankings have reached out to the Council to see how they can improve. One town went as far as to create a local task force designed to make their community more attractive to ITCD employers.

Massachusetts’ high taxes, high costs and cumbersome economic-development process are a growing disadvantage. When it comes time to calculate where to reallocate their resources, ITCD companies are taking a hard look at other options. Some have scaled back employment in the state (Thomas & Betts, Intel, Keane), while others have steered expansions to their facilities in other states (Raytheon). Still others have simply shuttered Massachusetts operations (Alcatel-Lucent, Suntron, Performance Technologies). California and Texas continue to hold on to more ITCD facilities and companies: Nearly 78 percent of the top 113 U.S. tech companies that are not headquartered in Texas have operations there. In California, the figure is 75.4 percent. In Massachusetts, the figure is 61.2 percent (Exhibit 13). That indicates significant opportunities for improvement – if the right circumstances are created.

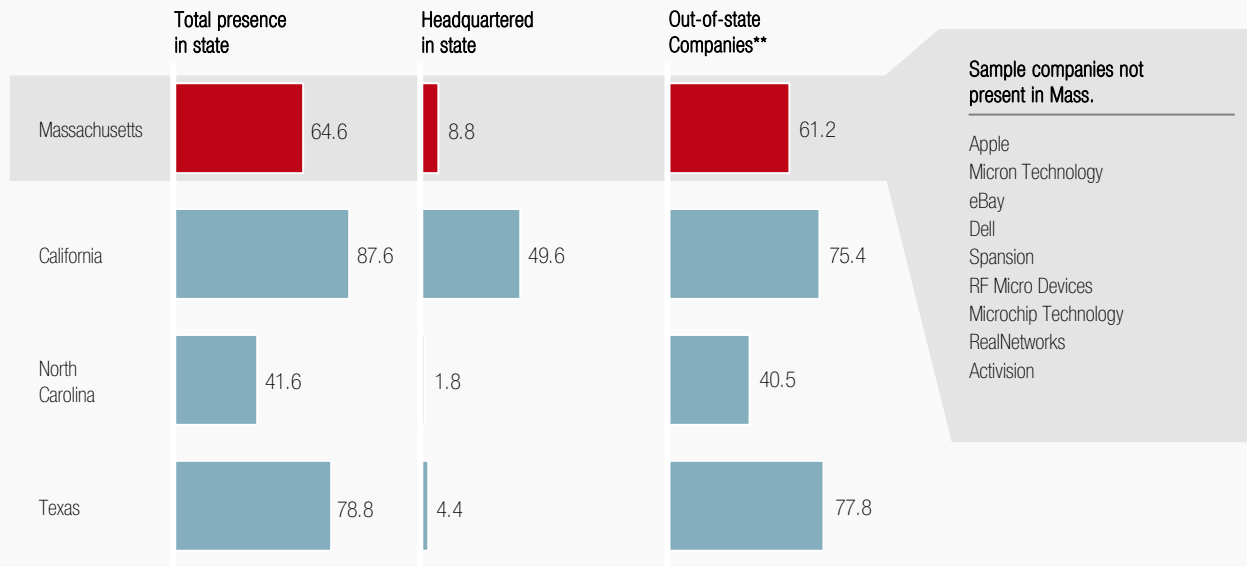
A. Remove barriers to business launch and expansion

To address the many structural problems that make it harder for new companies to take root in Massachusetts and discourage existing ones from expanding here, the ITCD industry must coordinate with other business groups and present a clear, cogent case to state officials. In interviews with leading executives and policy experts in the sector, we heard frequent complaints about the fragmented and duplicative efforts by the many groups representing technology and defense businesses. At the same time, there are dozens of groups representing other

EXHIBIT 13

Massachusetts Has the Opportunity to Better Attract Out-of-State ITCD Companies

Percent of top tech companies*



* Combined list of 113 U.S. companies on the BusinessWeek's InfoTech 100 and Baseline's Top 84 R&D Spenders (2007)

** Percent of out-of-state companies with a presence, not based on total list

Source: Baseline and BusinessWeek rankings; Yahoo! Finance; Hoover's

industries in the state vying for the attention of elected officials and policymakers, diffusing the overall influence of business owners who generally seek common goals.

To develop a single voice, the various leading business and business-development organizations should convene annually to review the issues that affect economic development in their industries and across the state. They should establish a clear set of priorities and release a coordinated agenda for change, to share with the public and to pursue with state and local officials and legislatures. We believe that in the ITCD sector the Mass High Tech Council and the Mass Technology Leadership Council can lead the way in such statewide efforts, given how much economic activity and employment – and how much of the state's economic future – revolves around their industries.

On the government side, it would help to have a coordinated effort to set economic-development priorities in the ITCD sector. The governor's office, along with the key legislative committees such as the Joint Committee on Economic Development and Emerging Technologies, should convene an annual forum with industry groups to review the most important issues and develop a coordinated agenda.

We also recommend the appointment of a state government taskforce, to push for the changes outlined in the public-private agenda. This group also should investigate innovative ways to improve the state's business climate to attract out-of-state companies and encourage development and growth of small companies. Useful initiatives would include improving the R&D tax credit program, subsidizing/financing shared lab space for R&D efforts, and developing targeted economic zones. The taskforce

should also review efforts by other states to support tech businesses, such as the New Jersey legislation that allows small companies to sell unused R&D tax credits and net operating losses to larger companies.

B. Put Massachusetts back on the high-tech map

Part of the program to ensure the ongoing health of the technology and defense companies in Massachusetts must include economic development policies that bring more tech companies to the state and a related program to raise the industry's profile around the nation, around the world, and within Massachusetts. Today, Massachusetts ITCD companies do not get the attention they merit, even within the state; in terms of public perception, the Massachusetts high-tech industry disappeared with the minicomputer and has been replaced by life sciences. *"The state government thinks that we've had our peak and tech is not a viable alternative. Tax policies are geared to bio and film,"* complains one tech executive. Overall, the state and industry groups must forge a set of policies that will enable Massachusetts to be proactive, rather than reactive, in retaining ITCD companies.

Sector promotion

There are excellent models for this ITCD initiative, including the Commonwealth's own efforts to establish Boston as an international hub for the life sciences industry. In June 2006, the Massachusetts legislature passed enabling legislation to create the Massachusetts Life Sciences Center, a quasi-public agency designed to promote the sector within Massachusetts and invest in life science research and economic development. The center was set up with \$10 million to fund biotech start-ups.

Then, in mid-2007, in what the Boston Globe described as the most ambitious policy initiative of his new administration, Governor Deval Patrick unveiled a \$1 billion, 10-year plan to cement the state's leadership role in biotech. That includes \$500 million in bonds for capital projects that will support development of biotech hubs, \$250 million in research grants, including an estimated \$100 million

for research at UMass, and \$250 million for targeted tax credits to Massachusetts-based companies. In addition to the legislation, the administration has used its influence and largess to promote biotech; in April 2008, Organogenesis announced plans to expand in Canton, Mass., citing nearly \$13 million in state incentives. A delegation of state officials, led by Governor Patrick, attended the BIO 2008 in San Diego to tout Massachusetts as a life sciences hub.

One example of a successful Massachusetts program is the John Adams Innovation Institute's (JAII) federal matching grant fund, which helps Massachusetts secure research grants from federal funding agencies like the National Science Foundation (NSF) and National Institutes for Health (NIH). Originally capitalized by the state through the first Economic Stimulus bill in 2003, the program has turned \$30 million in state investment into more than \$260 million in federal and private research funds – a nearly nine-to-one return on investment ratio. However, the funds have nearly been exhausted and state leaders are more interested in creating new programs than reinvesting in one of the state's most effective science and technology investment vehicles.

Other states use a variety of targeted development tools that can be adapted to the Massachusetts ITCD sector. For example, the Virginia Investment Partnership Grant Fund supports expansion of manufacturing and R&D companies that have operated in state for 5 years or longer. Virginia's Governor's Opportunity Fund can also be tapped for infrastructure improvements that are needed to secure a relocation or expansion project for the state. The One North Carolina Fund provides special financial assistance for companies that are deemed vital to the state and are in danger of being lured elsewhere. Florida has the High-Impact Performance Incentive, which provides grant money to companies in target sectors, if a minimum number of jobs are created and a minimum capital investment is made.

As Massachusetts has shown in biotech – and as competing states have shown in the ITCD industries – a sharply focused program to target companies in

a particular sector with customized incentives can be very powerful. A successful strategy to preserve and expand the ITCD base in Massachusetts requires:

- Creation of a consistent economic-development marketing identity, including promoting Massachusetts as the most fertile environment for R&D activities
- Collaboration among leading academic institutions and industry organizations to create a personalized approach to out-of-state businesses
- A dedicated resource in the state economic development office to support the ITCD sector
- Regular dialogue with the top high-tech and R&D companies around the U.S. to ensure they know are knowledgeable about the advantages of locating and expanding in the state

The economic-development effort must be supported by a wider marketing effort, to make Massachusetts “top-of-mind” in information technology,

communications and defense industries. The state and the industry can do a better job of conveying the excitement and entrepreneurial energy that exist within the ITCD sector. This can be done by leveraging the talents of local public relations and advertising firms to rebrand the region, providing an identity that is comparable to that of Silicon Valley. There should be frequent press releases aimed at national and industry media, promoting successes and developments among ITCD companies and research institutions. Annual dinners or other events should be scheduled to showcase accomplishments of ITCD entrepreneurs.

By reframing the approach to the ITCD sector and treating these companies as the growth drivers that they continue to be, the state and industry groups can set the stage for fresh development.



3.

A CALL TO ACTION

HOW TO MOBILIZE BEFORE AN EMERGENCY

How do you convince people to come to your aid when it's clear that you are not in immediate peril – but you know you will be soon? That is the crux of the problem that the Massachusetts technology industry faces as it attempts to mobilize private institutions, public policy and government support on its behalf. The house is not on fire. The landlord is not serving an eviction notice. No wolf is at the door.

Yet, as we have outlined in the preceding chapters, it is increasingly clear that the vitality of the Massachusetts ITCD (information technology, communications and defense) sector can no longer be taken for granted. The sector has been showing signs of stress, including job losses above the national average, since the recovery from the 2001 recession. Also, trends in global technology industries do not play to the current strengths of the Massachusetts tech community, whose success is based largely on more traditional, business-to-business products and services. Only defense electronics, with its strong capabilities in “smart” weapons technology, is riding a secular growth wave today.

Massachusetts still has the most critical ingredients for success in ITCD industries: a highly skilled workforce and the academic institutions that produce innovative ideas and knowledge. We have identified the gaps in culture, institutions and infrastructure that make Massachusetts less competitive when it comes to retaining young workers and encouraging the birth of new companies that will drive sector growth and job creation. We have laid out a series of initiatives to address these gaps, ranging from aligning curricula with industry skills requirements to reforms that would put the Commonwealth on a better competitive footing when companies are deciding where to build and grow. The next generation of innovation may very well emanate from the state's campuses and research labs, but there is no guarantee that these discoveries will create commercial opportunities or jobs in the Massachusetts ITCD sector.

In almost every instance, the viability of these initiatives requires the cooperation and collaboration of industry, academia and the public sector (Exhibit 14). We recognize that there have been considerable efforts across the Commonwealth, particularly in the private sector, to address many of these issues. There has been progress in some important areas,

EXHIBIT 14

Implementation Requires Ownership Across the Public, Private, and Academic Sectors

	1. Develop and retain a highly-skilled talent base			2. Reignite the Mass. innovation engine			3. Make MA the premier state for launching and growing a high-tech business	
	A. Align Curriculum with Industry Needs	B. Make Mass. the place for future high-tech workers to train and remain	C. Attack Addressable cost-of-living Issues	A. Create new centers of innovation and collaboration	B. Create an “early warning system” for collaborative R&D opportunities	C. Explore opportunities to enhance local networking fabric	A. Remove Barriers to Business Launching and Expansion	B. Put Mass. back on the high-tech map
Public sector	<ul style="list-style-type: none"> Provide initial funding and track progress 	<ul style="list-style-type: none"> Provide funding to enable student lifecycle strategy 	<ul style="list-style-type: none"> Establish tech shuttle connector along Rt. 128 and I-495 clusters 	<ul style="list-style-type: none"> Establish state-wide innovation center Provide initial funding for research clearinghouse 	<ul style="list-style-type: none"> Provide structured approach to identification of large-scale research funding opportunities 	<ul style="list-style-type: none"> Establish taskforce to address regulatory restrictions on worker mobility 	<ul style="list-style-type: none"> Establish taskforce to address key ITCD sector concerns 	<ul style="list-style-type: none"> Implement best practices for company outreach Actively promote ITCD sector
Private sector	<ul style="list-style-type: none"> Provide leadership and ongoing funding Perform needs-based assessment of key MA sectors 	<ul style="list-style-type: none"> Spearhead multi-pronged talent retention strategy (e.g., Tech Tour, student internships) 	<ul style="list-style-type: none"> Participate and encourage employee involvement 	<ul style="list-style-type: none"> Provide counsel and expertise to innovation center Provide leadership and for research clearinghouse 	<ul style="list-style-type: none"> Offer expertise and guidance in selection of research opportunities to pursue 	<ul style="list-style-type: none"> Actively participate/host networking events and increase inclusion of student population 	<ul style="list-style-type: none"> Develop cross-organization unified agenda identifying key ITCD business issues 	<ul style="list-style-type: none"> Actively collaborate in company retention/attraction efforts (Industry Councils)
Academia	<ul style="list-style-type: none"> Create and revise curricula based on gap analysis Designate liaison to talent development bank 	<ul style="list-style-type: none"> Provide greater access to students 		<ul style="list-style-type: none"> Actively participate in innovation development center and research clearinghouse 	<ul style="list-style-type: none"> Offer expertise and guidance in selection of research opportunities to pursue 			<ul style="list-style-type: none"> Actively collaborate in company retention/attraction efforts

such as working directly with universities to create relevant curricula. The establishment of the nation’s first undergraduate robotics engineering major at Worcester Polytechnic Institute is one example of success.

The Massachusetts tech sector has also benefitted from the effective advocacy by groups representing private industry. The Defense Technology Initiative has shown how the industry can work together to influence government actions, punctuated by its successful campaign to preserve Hanscom Air Force Base and the Natick Army Soldier Center during the 2005 federal military base closing process. The Mass High Tech Council has a 30 year track record of high profile public policy victories, especially in pushing for more a more competitive tax climate. The Mass Technology Leadership Council for 20 years has been an articulate advocate for STEM education and other policies to grow the state’s

technology economy. Since its creation in 1993, the Mass Network Communications Council has promoted Massachusetts as a global center for telecommunications and networking.

These efforts must be coordinated and redoubled. That makes securing adequate public and political support a critical need. Taxpayers must know the importance of the ITCD sector, which has faded in terms of its public profile even as it has consistently maintained its position as the largest single sector in the economy and – for the foreseeable future – the best hope for the Commonwealth to protect and retain its high standard of living. By adopting the programs recommend herein, the people of Massachusetts would honor a tradition that goes back to the New England town meeting: to anticipate the needs of coming generations and work together to define and pursue the common good.

END NOTES

1. U.S. Bureau of Economic Analysis
2. Massachusetts Department of Workforce Development
3. U.S. Census Bureau
4. U.S. Bureau of Economic Analysis
5. U.S. Bureau of Labor Statistics
6. U.S. Bureau of Labor Statistics
7. U.S. Bureau of Labor Statistics
8. U.S. Bureau of Labor Statistics
9. U.S. Bureau of Economic Analysis
10. Dow Jones VentureOne; Ernst & Young
11. Forbes 2006 and 2007 Best Cities Rankings
12. Preventing A Brain Drain: Talent Retention in Greater Boston (October 2003), Greater Boston Chamber of Commerce
13. Preventing A Brain Drain: Talent Retention in Greater Boston (October 2003), Greater Boston Chamber of Commerce
14. U.S. Small Business Administration
15. Dow Jones VentureOne

