

# The Connected Commonwealth:

HOW THE MASSACHUSETTS  
TECH ECOSYSTEM  
IS CREATING NEW  
GROWTH OPPORTUNITIES



**This decade has been one of transformation. We've seen traditional companies and industries transform into modern, data-driven organizations and industries. On the subsequent pages, we engage with leaders in three broad thematic areas – healthcare tech; smart, connected machines and devices; and security. We benchmark the strength of our tech economy and highlight five examples of growing data-driven clusters: Artificial Intelligence (AI), Clean Tech, Consumer Tech, Ed Tech, and Fin Tech.**

Massachusetts has a culture and a legacy of innovation and excellence. Through the American Revolution, the industrial revolution and now today's information revolution, the people of Massachusetts have been leading and disrupting the traditional with innovative new approaches to the world. It's no wonder the future is being shaped in this laboratory of exploration and innovation that we call home. Whether it's the business models and approaches to caring for people and populations, or how people move and interact within our cities and the built environment, or how data is secured and yet made accessible, our connected Commonwealth is emerging once again as the architect of tomorrow. We are leading the way in this next phase of the digital wave, from securing and utilizing data to instrumenting the physical world and drastically changing the way in which healthcare is provided and delivered.

While the opportunity for economic dominance and widespread employment is real, challenges remain. We must work together to find a way to reach and bring in qualified individuals from underrepresented areas to help bridge the equality gap and support the needs of our growing economy.

The 2020 Challenge to create 100,000 new tech jobs, put out at the beginning of this decade, remains a useful metric to measure and calibrate the effectiveness of our collaboration and ability to instill 21st Century skills and thinking into our youth. We build upon a great foundation – we created the first high school in America, the first college in America, and the first public library – but need to do as our forefathers did and build the foundations and institutions that will propel our children and grandchildren to new heights.

**Tom Hopcroft, President & CEO, MassTLC**

## MASSACHUSETTS BY NUMBERS

908

**Technology investments**  
in MA companies  
2011-2015 Source: PwC

20+

**University incubators and  
accelerators in MA**

12.3%

**Tech growth rate**  
2010-2015

\$127.9K

**MA average annual  
tech wage #3 nationwide**

20+

**Industry incubators  
and accelerators in MA**

\$6.92B

**Value of technology  
investments**  
in MA companies  
2011-2015 Source: PwC

123,230

**Number of 2015 tech job  
postings in MA**  
Source: Burning Glass

10%

**Tech Industry Share  
of MA Private Sector  
Workers**

10

**MA company IPOs**  
2010-2015

19%

**Tech share of overall  
2015 payroll in MA**





Important Notice Regarding Industry Definitions, Data Sources & Methodology

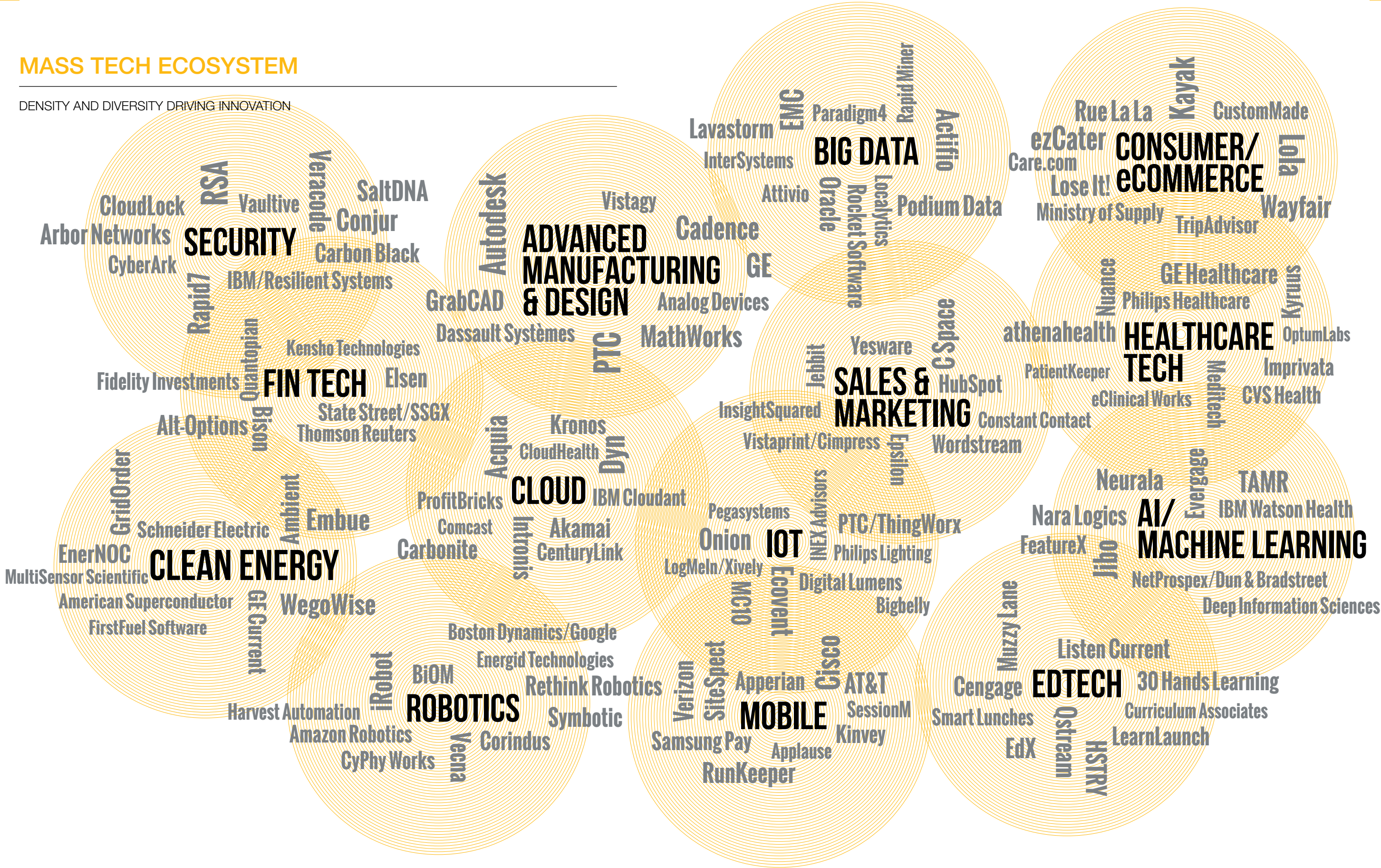
Please note that in 2016 we made significant changes to the industry definitions, data sources, and methodologies used in MassTLC's State of Technology report so any comparison to prior editions should be avoided. In 2016, we aligned our tech sector definitions with those of our national advocacy partner, CompTIA, and have sourced much of our data and analysis from their Cyberstates report. While this change added roughly 50,000 R&D and Testing jobs to our benchmark, we were able to standardize to common industry definitions and datasets nationwide and better support our advocacy work. We have recast our 2020 Challenge goals from 2010 onward using the updated definitions. MassTLC commissioned the UMass Donahue Institute to help analyze Cyberstates and other third-party data sources, conduct primary research on local job multiplier effects, benchmark women and minorities, and provide other insights for the report. All charts are sourced and attributed accordingly. Specific sector definitions, NAICS codes, and methodologies are available in the appendix to the Cyberstates report. Special care has been given throughout the report to clearly distinguish between tech sector jobs – technology and non-technology (ie, sales, marketing, HR) jobs at tech companies – and tech occupation jobs – technology jobs (ie, computer and mathematical jobs) at technology as well as non-technology companies.

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## DENSITY AND DIVERSITY DRIVING INNOVATION







## INTRODUCTION: INNOVATION AT THE BOUNDARIES

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Set apart from other states by its unique density and diversity of technology sectors, Massachusetts is a hub of vibrant growth and innovation. We offer unmatched leadership in technology sectors including software development, cloud, communications, big data, complex analytics, robotics, artificial intelligence, and security, as well as in data-driven sectors such as healthcare, financial services, education, life sciences, consumer, and clean energy. Add to this impressive roster our world-class academic and research institutions, a supportive and functional state government, and a leading investment community, and it's clear - our connected Commonwealth is like no other state.

This concentration of talent, resources, and innovation creates a rich landscape of possibilities - one where boundaries overlap, collaboration thrives, and new ideas come to life. This environment is not only fostering new start-ups, but also attracting well-established global leaders, such as General Electric, that see strategic value in being part of the Massachusetts innovation ecosystem. With unequaled opportunity to connect to technology, traditional industries and already established companies are also experiencing transformational changes to their businesses. Companies such as Philips, CVS Health, Schneider Electric, Fidelity, Blue Cross Blue Shield, and more have redefined themselves as successful tech-driven enterprises.

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History of Innovation

For Massachusetts, technological innovation has always been our calling card around the globe. We have the most educated population, are a leader in investment capital, and consistently perform at the top in national and international rankings for innovation capacity. Our legacy of invention and creation dates back to the era of maritime trade and the American Revolution, and extends through the industrial and information revolutions with the invention of game-changing technologies such as the telegraph, the telephone, the Internet, and more.

This legacy of breaking new ground fuels new generations of inventors and creators. Massachusetts is an innovation leader, not just in technology, but also in public good. Our leadership in this arena produced the country’s first public library, first college (Harvard University), and first subway system. As further evidence of our leadership, even the names to describe new innovative segments like “robot” and “Internet of Things” were coined here, at the hub of these emerging areas.

Prepared for New Disruptions

For generations, whether by design or serendipity, Massachusetts has been laying the groundwork – in advanced manufacturing, electronics, data and analytics, sensors, actuators, communications, and research – for a coming technological wave that makes the Internet seem small. Massachusetts is emerging as a global hub for a revolution of smart, connected machines and devices that are increasingly instrumenting, automating, and connecting every corner of our world. As smart cities, industrial automation, intelligent transportation, connected health, and more become the norm, Massachusetts stands to reap the benefits of this work.

This evolution is taking shape in emerging areas where Massachusetts has deep expertise, such as healthcare; security; and smart, connected machines and devices. Examples in these areas include the development of autonomous, multi-modal transportation systems; smart, connected cities; and remote telemedicine and digital healthcare. These innovations will enable people in Massachusetts and around the globe to live longer, happier, more productive and independent lives.

Forward-looking people, investors, and organizations that want to help design and build the future are flocking to Massachusetts. Yet, this migration barely puts a dent in the demand for talent, capital, and innovative organizations that will be required by this next technology-driven socioeconomic transformation.

Navigating Roadblocks

The digitization and automation of our world takes us into uncharted waters as we seek to balance complex security, privacy, and interoperability issues. Success demands thoughtful and innovative approaches to ensuring appropriate governance, standardization, and trust. Achieving success depends upon our ability to navigate and design the technical and policy frameworks necessary to build upon tradition, drive innovation, and create economic growth and opportunity.

A key component will be our ability to educate tomorrow’s workforce with the 21st-century skills required to be productive citizens and workers in our knowledge economy. Talent is distributed evenly in populations, but the opportunities are not. The measure of success will be reflected in our ability to grow jobs and attract, develop, and retain the talent to work in them. A further measure will be our ability to reach into underrepresented populations, with the needed support and inspiration, to bring additional talent off the sidelines. In this way we can address the talent needs of industry and distribute opportunity and capital across a more diverse cross-section of our population.

The 2020 Challenge

In 2010, MassTLC set an ambitious goal for industry, academia, and policy makers: create and fill 100,000 net new technology jobs by 2020. The impact of success on the Massachusetts economy would be

- an additional \$8.8 billion in incremental tech wages,
- an additional 163K incremental non-tech jobs,
- an additional \$8.2 billion in incremental non-tech wages, and
- estimated incremental shareholder wealth of \$50 billion - \$75 billion.

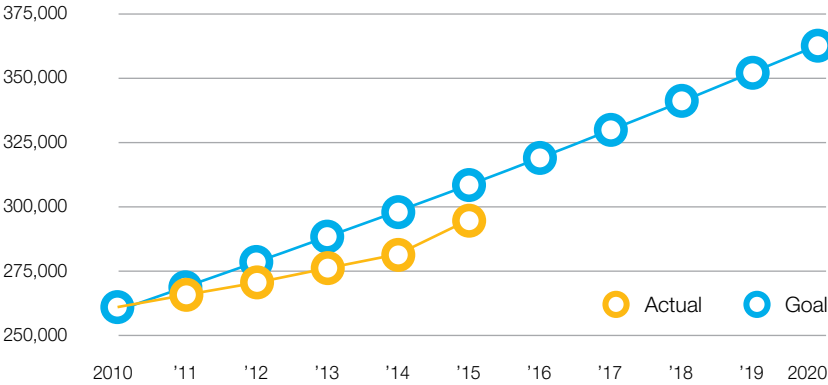
In the first five years of the 2020 Challenge, we’ve learned that creating jobs is not the constraint; filling them is. Massachusetts companies cannot fill current open job requisitions and in many cases are locating jobs in other regions to tap additional talent pools. The ability of Massachusetts to lead in the next major technological era will rest upon our ability not only to create, but to fill the jobs of tomorrow, thus putting the 2020 Challenge center stage in our ability to lead in the future.

We must be diligent in our efforts to attract talent, encourage innovation, and allow successful collaboration across tech sectors. Our progress in these areas will directly influence the state’s economic growth, the 2020 Challenge, and our leadership for generations to come.

BENCHMARKING THE IMPACT OF THE TECH SECTOR IN MASSACHUSETTS

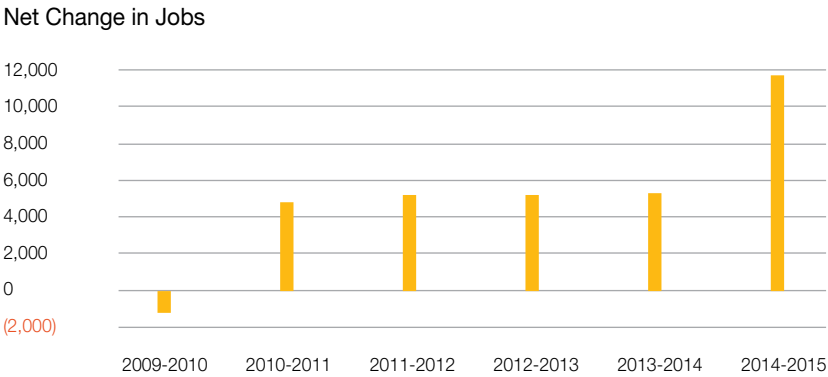
Growth in Tech Sector Jobs Nears MassTLC 2020 Challenge Target of 100K New Jobs This Decade

Source: University of Massachusetts Donahue Institute analysis of historic employment, 2010-2015, as reported in the 2016 CyberStates report. MassTLC 2020 Challenge targets were calculated by adding 100,000 tech jobs at a consistent rate from 2010 to 2020.



Strong Tech Sector Job Growth Doubles in Most Recent Year

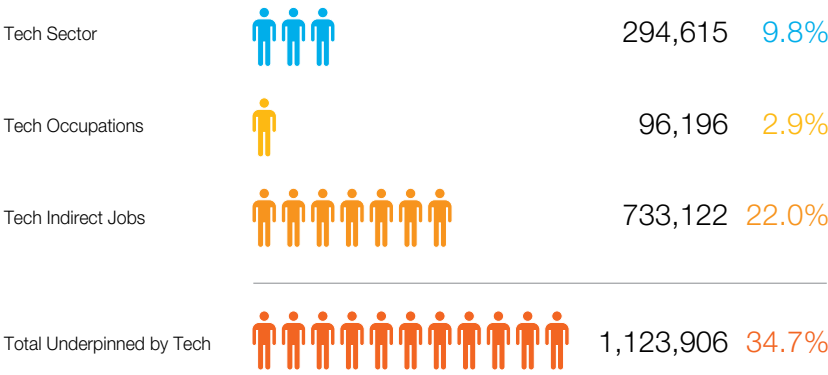
Source: University of Massachusetts Donahue Institute analysis of historic employment, 2010-2015, as reported in the 2016 CyberStates report.



Tech Is Responsible for 35% of Jobs in Massachusetts

State ranks 5th for greatest number of people directly employed in tech industry

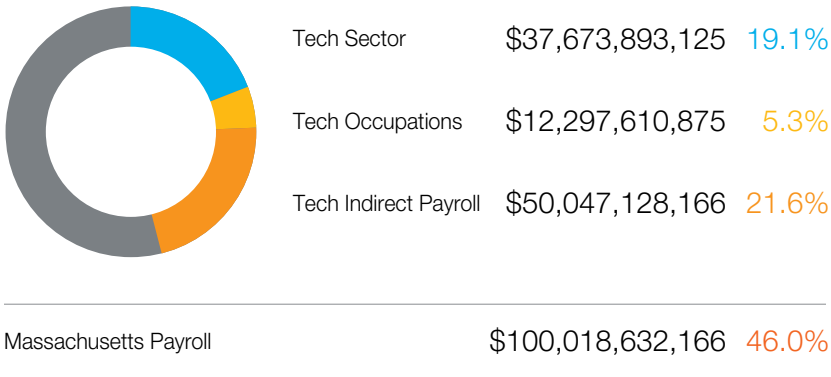
Source: University of Massachusetts Donahue Institute analysis of direct tech sector jobs and tech occupations, 2015, as reported in the 2016 CyberStates report. Economic impact calculations of indirect and induced jobs based on 2013 IMPLAN model for Massachusetts.



Tech Is Responsible for 46% of Massachusetts Payroll

Massachusetts is the 4th largest state by direct tech industry payroll

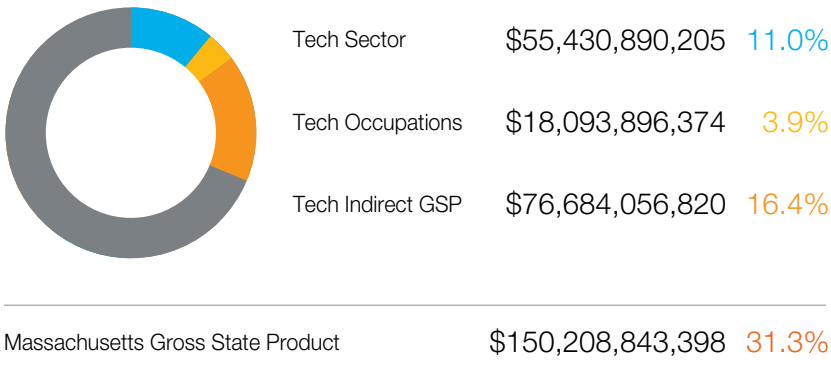
Source: University of Massachusetts Donahue Institute analysis of tech sector and tech occupation payroll, 2015, as reported in the 2016 CyberStates report. Economic impact calculations of indirect and induced payroll based on 2013 IMPLAN model for Massachusetts.



Tech Is Responsible for 31% of Massachusetts Gross State Product (GSP)

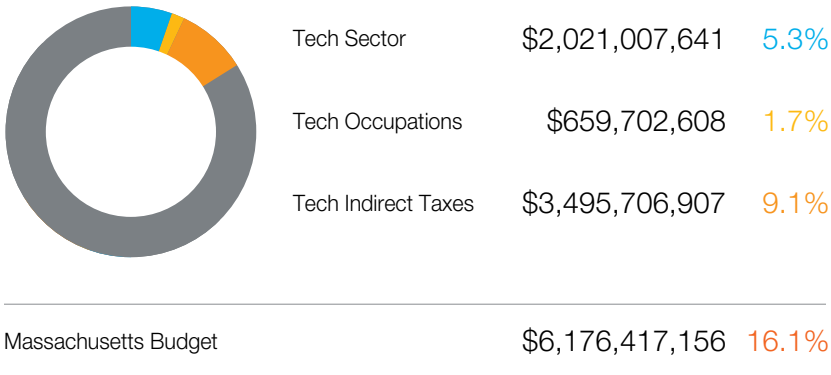
State ranks 4th for the largest direct tech industry share of GSP

Source: University of Massachusetts Donahue Institute analysis of direct tech sector and tech occupation contributions to GSP, 2015, as reported in the 2016 CyberStates report. Economic impact calculations based on 2013 IMPLAN model for Massachusetts.



State Taxes Resulting from Tech Account for 16% of the Massachusetts Budget

Source: University of Massachusetts Donahue Institute analysis of direct tech sector and tech occupation contributions to state taxes, 2015, as reported in the 2016 CyberStates report. Economic impact calculations based on 2013 IMPLAN model for Massachusetts. State budget is for FY2016.





## HEALTHCARE TECH: DELIVERING BETTER AND MORE COORDINATED CARE

Healthcare delivery and continued care, patient engagement, and medical research continue to provide enormous opportunities for technological advancements in order to provide better patient care, improve population health, and lower healthcare costs. Recent advances in technology have made the healthcare technology sector – a broad umbrella term that refers to innovative digital healthcare solutions, blended hardware and software systems (like robotic prosthetics), and health information technology (HIT) — into a dynamic and evolving industry.

Patients - aka consumers - are demanding more control of their healthcare, particularly within younger generations. They expect access to their health-related data, self-serve healthcare options, and on-demand services. To meet these expectations, healthcare and wellness companies are incorporating new and innovative technologies that blur the boundaries between fitness, well-being, and traditional healthcare, which has significant regulatory implications.

Massachusetts is well situated in the health tech sector, with its world-class healthcare and academic institutions, its robust life sciences sector, and its roughly 250 existing healthcare technology companies — 13 of which are in the top 100 largest HIT firms in the nation.<sup>1</sup> What's more, the Boston area is home to one of the most vibrant startup ecosystems and venture capitalist communities in the world, offering startups access to capital, mentoring, and network opportunities.

<sup>1</sup> "Massachusetts eHealth Cluster." Massachusetts eHealth Institute. 2015.

### INNOVATIONS ON THE HORIZON

Asked what the biggest innovations in the healthcare tech sector would be over the next 10 years, healthcare experts weigh in:



**Paul Bleicher, CEO, OptumLabs**

The explosion in availability of new kinds of patient data will be accompanied by a movement toward technologies leveraging prescriptive analytics to identify the best course of care. While cognitive computing and recommendation engines are two current paths to such prescriptive analytics, there will likely be many more new approaches to the analysis of individualized healthcare data.



**Arthur Harvey, VP & CIO, Boston Medical Center**

Over the next 10 years, we will see a push toward monitoring healthcare data down to the patient from the institution. Interoperability and computerization of care will continue to move forward as well. A few years back you had a separate inpatient and outpatient EMR that didn't talk to each other, and nobody thought anything of it—that is not the case today.



**Jim Noga, VP & CIO, Partners HealthCare**

Cancer diagnostics and therapies will be the disease area of greatest innovation. Technology-wise, precision medicine and distance health will have the largest impact by number of people. Cell-based therapy will also be hugely disruptive.



**Justin Steinman, CMO, GE Healthcare IT**

The biggest innovations in healthcare over the next 10 years will come in the area of population health. Healthcare today is awash in data, but lacking in insight. True insight will come from linking electronic silos together. Ultimately, we are all trying to drive value in healthcare by improving the quality of care delivered, reducing the amount of unnecessary care (for example, multiple scans for the same injury), and reducing the overall cost of care delivered. IT systems will be critical to connect all that data and help us move from managing illness to managing wellness.

Digital Health

To foster healthcare’s technology evolution, Massachusetts Governor Charlie Baker recently launched a comprehensive digital health initiative. The initiative puts a stake in the ground, declaring Massachusetts a leader and prioritizing the growth of the state’s digital health economy through incentives, promotion, and mandates. This initiative will not only further digitize healthcare across the state, but also continue the state’s leadership in Health IT (HIT) adoption and implementation.

**Harvey:** “Massachusetts has good healthcare, so you’d expect us to have good healthcare IT. And historically, this is where a lot of IT healthcare tech was invented—in the 70s and 80s a lot of the original Electronic Health Records (EHR) work was done here. HIT is both a practical and an academic discipline, and we have lots of people and institutions with experience in both. We also have a number of institutions here that have healthcare informatics programs.”

Digital health represents a \$32 billion market opportunity over the next decade, according to a report by Goldman Sachs.<sup>1</sup> It encompasses solutions for patient information tracking, clinical decision support, mobile health applications, electronic patient engagement, and more. Digital health also covers advanced technologies to assist providers in their healthcare procedures and practices, such as medicine distribution, population health analytics, remote health monitoring, and telemedicine.

**Noga:** “Information technology is integral to improving healthcare delivery, allowing clinicians to improve patient outcomes, enabling researchers to find the cures and treatments of tomorrow, all while making the delivery of healthcare more efficient and cost-effective.”

Data

Today, data is also an integral part of the healthcare landscape, providing insights that can make healthcare delivery more efficient and cost-effective.

**Noga:** “It is hard to overstate the impact of data, its capture, aggregation, and deployment into clinical workflows.”

Not only is data influencing clinical care, it’s improving every facet of it.

**Harvey:** “Hospitals aren’t IT shops, they provide healthcare. But today, they’re being asked to provide healthcare based on data. Data is important because it can improve care, patient throughput, help control costs, and fulfill the reporting requirements for various agencies. Healthcare has transformed into a data-driven industry – quality metrics, tracking longitudinal care for patients; it’s all critically important to the industry.”

**Bleicher:** “Data can be used for understanding individual patients with their consent, or with proper privacy protections, it can be used in an anonymous, de-identified fashion to study and understand the health of populations of patients. By combining different sources of data that exist on a patient, we can better assess and understand the impact of different activities and create predictions that not only provide better outcomes for patients, but also improve the cost and quality of their care.”

Collaboration

Stimulating further innovation, partnerships, and collaboration between all levels of the healthcare industry — from providers to payers to technology companies - is critical. Fortunately, this is an area in which the connected Commonwealth, bursting with numerous overlapping technology clusters, excels.

**Bleicher:** “We’re bringing together diverse groups, including payers, providers, life science companies, and consumer organizations that want to address these common problems, and enabling them to collaboratively work together to solve them. Data is central to this effort. OptumLabs’ partners benefit from different perspectives and insights from data that can be applied to improve processes and outcomes. Also, because different organizations are working together, they have the opportunity to translate findings into new methods of care as a cooperative group, and then to individually translate these findings into new methods and systems of care.”

**Harvey:** “Partnerships between providers and tech companies can be a good thing, but you have to pick a defined thing you want to accomplish, and ensure it will have metrics you can use and understand, and won’t suck up all the energy and resources of the IT department. It’s about aligning expectations and priorities between the vendor and the healthcare organization’s IT department.”

Challenges

The healthcare industry as a whole has a long way to go to meet its goals of improving health, lowering costs, and providing better care, and so does Massachusetts. The Bay State remains the most expensive state for healthcare in the nation.

**Bleicher:** “The healthcare sector faces two related big challenges. One is the alignment of incentives, and the other is information/data transparency. To effectively realign the incentives, technology needs to be available to create transparency of information. With increasingly advanced analytic approaches, data can be used by patients and providers to make better decisions, and by payers and employers to develop programs and guidance to encourage cost-effective and quality care.”

While data is a driving force in healthcare IT, it also presents numerous challenges. From interoperability to developing comprehensive standards to protecting patients’ privacy and securing the data — the industry is still working to tackle these enormous and complex issues.

**Harvey:** “Tracking across multiple locations of care is important. As we build bigger networks, patients get care across networks, and payers need to pay for everything a patient encounters, so you need to share the data. We also need standards. In order to share actionable data there needs to be agreement on how you will do that, both at the technical and semantic level.”

Policy

Massachusetts is poised to lead in healthcare technology. Policy makers can help support the sector’s growth and leadership and should consider acting in the following areas:

First, develop policies that improve piloting opportunities for startups while creating pathways for technology adoption. An example would be funding programs to connect innovative products from the digital health startup ecosystem to the needs and challenges of community hospitals.

Next, enable the release of de-identified data from the Massachusetts All-Payer Claims Database (APCD) to healthcare tech companies. This would reinforce the Commonwealth’s leadership in claims-based population research and give health researchers the opportunity to mine the data for inefficiencies and ways to improve the quality of care. It would also enable entrepreneurs to identify trends and opportunities for system and clinical improvements.

Finally, on the consumer side, create unique patient identification numbers (similar to drivers’ license numbers) that could be used to transfer patient data electronically. Patient data would be stored in a secure electronic database accessible to providers when patients provide their unique identification number. This would address the interoperability issues while providing consumers better access to and control over their health data.

<sup>1</sup> “Massachusetts eHealth Cluster.” Massachusetts eHealth Institute. 2015.

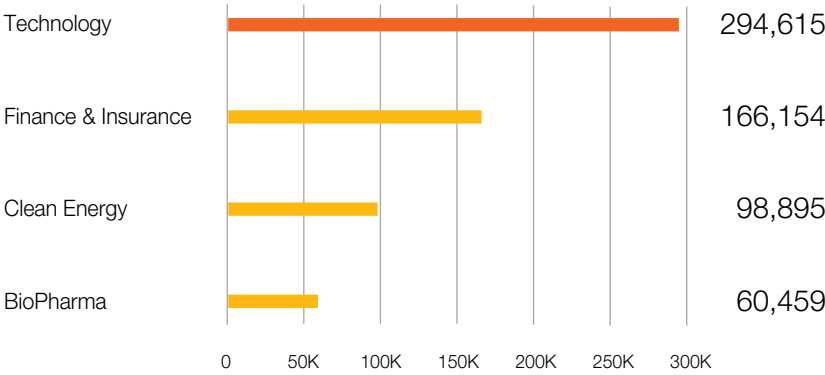


RANKING THE MASSACHUSETTS TECH SECTOR

Tech Sector is a Leader in Massachusetts Employment

Total Jobs by Industry Cluster

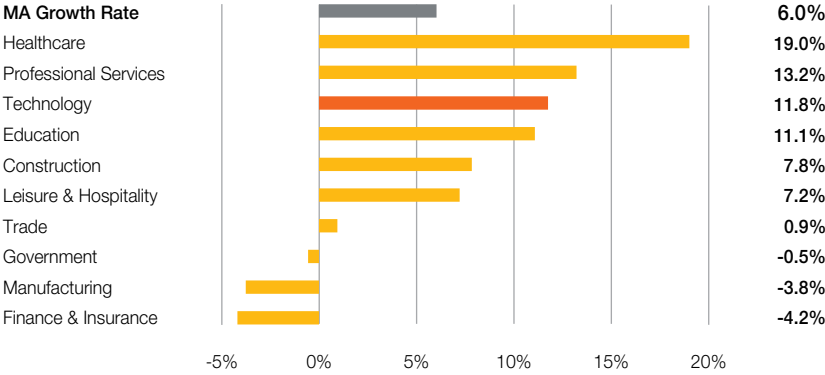
Source: University of Massachusetts Donahue Institute analysis of BioPharma: MassBio Industry Snapshot 2015 (jobs data are for 2014); Clean Energy: Massachusetts Clean Energy Center, Massachusetts Clean Energy Industry 2015 Report; Finance & Insurance: U.S. Bureau of Labor Statistics, 1st Quarter 2015; Technology: CyberStates, 2016.



Tech Sector Among Fastest Growing Sectors in Massachusetts

Percentage change in jobs by major sector between 2009 & 2015

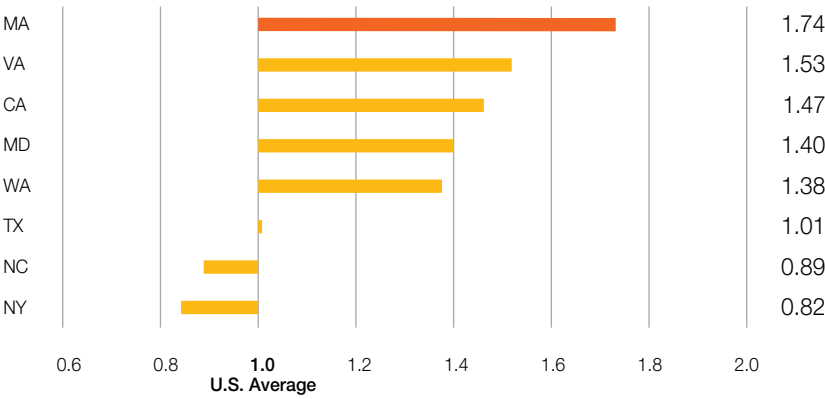
Source: UMass Donahue Institute calculations based on CyberStates, 2016, and U.S. Bureau of Labor Statistics.



Massachusetts has Most Concentrated Tech Sector Among Peer States

Location Quotient of Tech Sector Jobs Relative to the United States

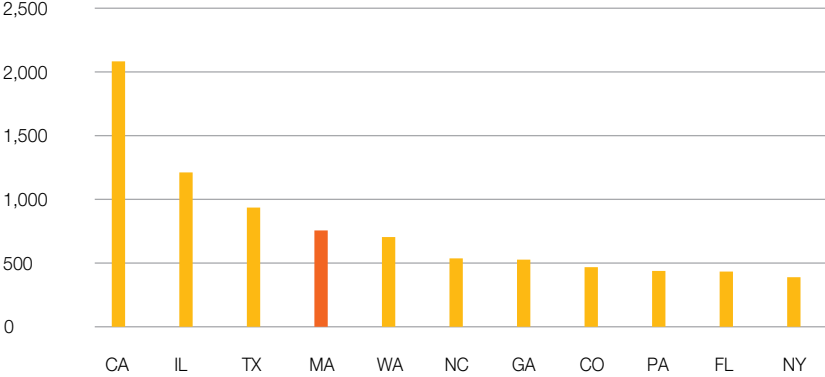
Concentrations are measured using location quotients (LQs), 2015.  
Source: UMass Donahue Institute calculations based on CyberStates, 2016.



Massachusetts Ranks 4th in Number of Tech Firms Added in 2015

State Ranking by Numeric Change in Tech Establishments, 2014 & 2015

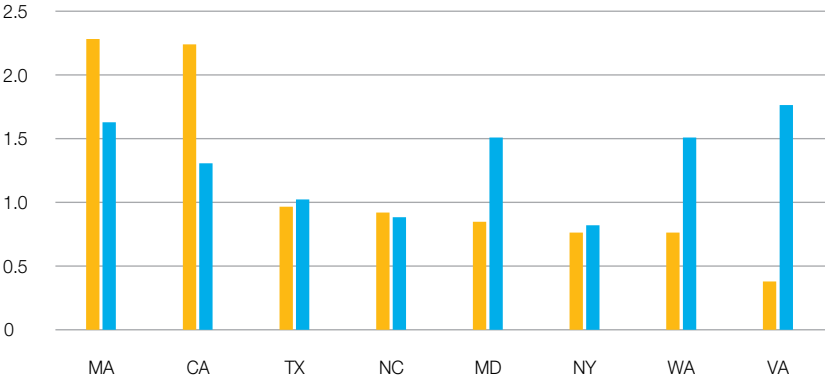
Source: UMass Donahue Institute calculations based on CyberStates, 2016.



Massachusetts Ranks Among Peer States

#1 Nationally in Tech Manufacturing  
#2 For Tech Services Concentration

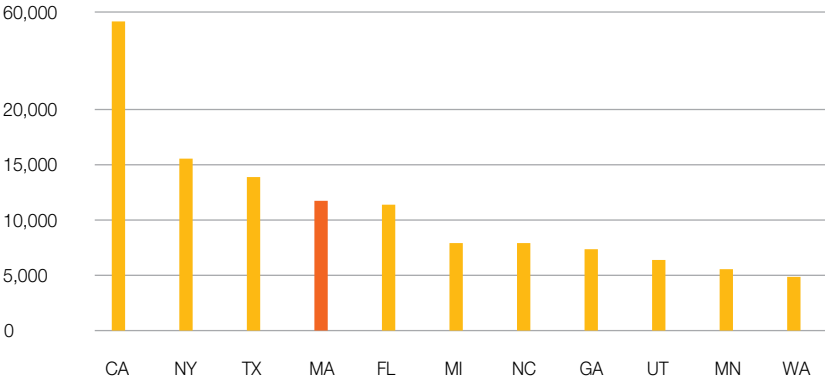
Concentrations are measured using location quotients (LQs), 2015.  
Source: UMass Donahue Institute calculations based on CyberStates, 2016.



Massachusetts Ranks 4th in Number of Tech Sector Jobs Added in 2015

State Ranking by Numeric Change in Tech Employment, 2014 & 2015

Source: UMass Donahue Institute calculations based on CyberStates, 2016.



## SMART, CONNECTED MACHINES AND DEVICES: REIMAGINING THE WORLD

Every day the world becomes more connected and data-driven. Intelligent building-management systems and smart grids save energy while better and more capable robotics and autonomous vehicles promise to make life safer and easier. There are exponential opportunities to reshape industry boundaries in agriculture, healthcare, robotics, and advanced manufacturing, just to name a few industries.

Boston has a commanding position in these evolving industries. The proximity of academic and commercial research and development, software and hardware capabilities, and forward-thinking leaders is critical to the development of machine intelligence innovations that are being pioneered here in Massachusetts.

Technology in Massachusetts is more concentrated than in any other state. The density of clusters and collision of ideas that occur due to proximity drive the region's innovation engine. Massachusetts also enjoys an advantageous geographic location and abundant direct air routes, 128 in total, that provide the free flow of products and ideas between new markets and innovation centers around the globe. The ability of global thought leaders in the Internet of Things (IoT) and Machine to Machine (M2M) to connect easily with Massachusetts helps reduce friction and accelerate innovation in these emerging areas.

### INNOVATIONS ON THE HORIZON

Here is a glimpse at what some of the most innovative minds in Massachusetts are working on today:



**Jim Heppelmann**, President and CEO, PTC

At PTC we continue to enhance and extend our ThingWorx platform. The IoT market is still in early innings, but the speed of innovation is incredible. All companies start by connecting things and creating IoT applications that solve a specific business challenge. As they mature, our machine learning analytics uncovers new business insights and opportunities from that data. The next wave of innovation is coming from Augmented Reality (AR), the ultimate convergence of the physical and digital world enabled by our Vuforia platform.



**Daniela Rus**, Director, Computer Science and Artificial Intelligence Laboratory (CSAIL), MIT

The car of the future — one that will never be responsible for an accident, and will become your friend. Cars will be safe. Cars will be intelligent and partner with their drivers to help and support them. It is already happening.



**Tom Ryden**, Executive Director, MassRobotics

I am excited about creating a center that will support robotics start-ups by providing co-working and prototyping space so that together with established companies they can gather, share, and grow their companies.



**Paddy Srinivasan**, Vice President and General Manager, Xively by LogMeIn

The Xively team at LogMeIn has the sole mission to demystify the IoT and make it easy. We love when companies come to us with new technology challenges like user and device management issues or the best way to import product data into existing business tools. Removing the barriers for these companies and knowing we have the ability to solve real-world IoT challenges is what drives us.



Research and Design

MIT’s Computer Science and Artificial Intelligence Lab (CSAIL), the Industrial Internet Consortium (IIC), MIT Lincoln Labs, MITRE and the Auto ID Center at MIT are just a few local organizations expanding the field of research and design. Added to these are global corporate enterprises such as Autodesk, Dassault Systèmes, iRobot, LogMeln’s Xively, PTC, and many more.

**Heppelmann:** “Historically, companies conducted R&D primarily in their own facilities, but to manage costs and accelerate innovation companies now shift some R&D activities to universities and ecosystems. This creates a unique opportunity for companies in Massachusetts to tap its renowned universities. Our PTC Academic Program has just released a series of online courses available worldwide. Students will gain IoT specific job skills that enable them to participate in the vibrant and growing IoT ecosystem.”

**Ryden:** “Massachusetts is a hotbed of robotics because of the rich amount of research being done at the large number of robotic labs in the state and because of the work commercializing this new technology by pioneering local companies such as iRobot.”

Data

The value of smart, connected devices lies not simply in their capability to connect, but in the volume of data they produce and the insights this data can provide into almost every aspect of our environment — from consumer behavior to the forces of Mother Nature. The data that is generated from instrumenting ‘things’ will provide businesses with new insights and processes, and promises to be a major disruptor, with new industries and competition evolving out of its midst.

**Srinivasan:** “The true power in IoT-connected products is the voice that it gives your products and how they are being used, how they can be optimized, and how they can be better supported. Companies can hear their customer’s voice through the product, and they can follow in real-time the customer’s journey.”

**Heppelmann:** “Data will also create new services or even new businesses that disrupt existing industries. As we have seen with ridesharing companies like Uber, data about underutilized vehicles and the location of individuals with transportation needs has disrupted the transportation and automotive industry.”

Challenges

While innovation is moving rapidly within the sector, there are several challenges that must still be addressed. For instance, building the Internet/communications network infrastructure necessary to support the rapid rise of connected devices is critical but remains difficult and costly. Meanwhile, there is also a need for agreement on key standards for communication and for credible security solutions. These barriers threaten to limit the market’s growth, making finding solutions a critical short- and long-term goal.

**Srinivasan:** “Developing and launching connected products requires an entirely new set of business processes and expertise that most product companies don’t have today. The trick is not just connecting your products to give them a voice, but giving that voice meaning. If companies don’t start on a solid foundation for modeling and management of their connected business, it prevents them from scaling and truly delivering new business value.”

Disruption also creates a fear of the unknown. From management to accountability, leadership and policy mandates will be necessary to ease concerns and reduce resistance on several fronts.

**Ryden:** “One of the biggest challenges is addressing the fears of what autonomy will bring. Whether there are fears about robots taking people’s jobs or fears about robots making decisions that impact people’s lives, there will be concerns about deploying this technology.”

Growth Opportunities

These challenges give the state a broad range of opportunities to develop thoughtful policies that will spur innovation and advance our industry leadership. With a rich history as a traditional manufacturing hub, the state has been experiencing a revitalization of manufacturing, particularly as companies emphasize delivering increased and continuous value in products and services. Traditional manufacturing companies have found themselves transformed into technology-driven organizations perfectly positioned to help manufacture a new wave of smart, connected machines and devices. Massachusetts’ strong industrial design cluster is also a driving force.

**Heppelmann:** “Massachusetts is home for three leading product design and development technologies in PTC, Autodesk, and Dassault Systèmes, creating a foundation of expertise and talent. We know a great deal about the “things” in the IoT.

The opportunity is to combine that product development and manufacturing expertise with new capabilities and an IoT vision. That evolution will be required to succeed in this smart, connected world, and that has been our focus at PTC.”

Policy Impacts

There is a steep learning curve among policy makers and public agencies to grasp the rapid pace of technological advancements and develop thoughtful policies that can keep up with emerging trends. Policy missteps have the potential to impede the advancement of the smart, connected machine and device sectors in Massachusetts, which could jeopardize our leadership position and ultimately result in companies and research institutions moving to other parts of the county and the world.

**Rus:** “We need Massachusetts to resolve the case for autonomous driving, especially in light of the new Department of Transportation announcement supporting level 5 autonomy. Massachusetts also has a great opportunity to participate in the new NIST Manufacturing Innovation Institute, and this requires support from the leadership.”

Standards bodies such as the Industrial Internet Consortium are working to identify the regulatory requirements that will be needed in these new uncharted areas. Policies and regulations that emerge will no doubt affect the development of the “things” as well as ensure that interoperability and security standards are in place to guide development.

**Ryden:** “The lack of clear regulations over the use of drones in our airspace and autonomous vehicles on our roadways is retarding the growth of robotics in the state and the country.”

## SECURITY: INNOVATING TO KEEP DATA AND INFRASTRUCTURE SECURE

Over the past two years we have witnessed data breaches involving major consumer, healthcare, government, and financial institutions. These very public breaches have helped to bring awareness to the need for comprehensive and proactive security programs for any organization that consumes and stores sensitive information. Varying state and international privacy laws and industry-specific regulations, such as in healthcare and financial services, create the additional necessity of complying with stringent legal standards regarding security and privacy.

The Bay State is home to many of the best and brightest security experts and boasts an unparalleled concentration of companies that provide solutions across the whole spectrum of security needs. We have seen a surge in the number of companies that are focused on protecting specific verticals, such as Imprivata with its healthcare security solutions, and others that secure against breaches at a specific level, such as Veracode, whose solutions focus on software code.

Massachusetts has reaped the benefits of this burgeoning industry as demonstrated by the recent public offerings of CyberArk, Imprivata, Rapid7, and Mimecast. And we continue to reinforce the state's strong leadership position in this space, as companies such as IBM have chosen Cambridge as their home; IBM Security, the world's third-largest security vendor, is now based in Cambridge.<sup>1</sup> While this is very good news, we must also work to meet the talent shortage, and ultimately the pipeline shortage, in this industry. Massachusetts employers have some of the greatest difficulties in the country filling security-focused roles, with jobs listings remaining open for an average of 51 days, according to Burning Glass.

<sup>1</sup> "Gartner Says Worldwide Security Software Market Grew 5.3 Percent in 2014." Gartner. May 27, 2015.

### INNOVATIONS ON THE HORIZON

Asked what the biggest innovations in the security sector would be over the next 10 years, security experts weigh in:



**Bob Brennan, CEO, Veracode**

Runtime Application Security Protection (RASP) is not only a major innovation for security; it will be transformational to the security market. Designed to protect applications by adding protection features into the application runtime environment, RASP allows enterprises to secure applications in real time. Additionally, from RASP we will see new methods and technologies arise that are used to secure applications.



**Ken Pickering, Director of Engineering, Rue La La**

Security will be more present and seamless in our everyday lives. Like the transition now from magnetic strip to chip-and-pin technology in credit cards, I could see multi-factor security mechanisms becoming more mainstream to reduce fraud. Additionally, machine learning and data mining will lead to a more algorithmic approach without as many false positives or negatives as current solutions. Lastly, I think security will evolve from an arcane concept to more of a process of doing business every day.



**Ivan Matviak, Executive Vice President, Head of State Street Global Exchange Americas**

Data security is front of mind for banks. One area we're looking at closely is distributed ledger and crypto-technology, such as blockchain, given the breadth of its potential application across the financial industry. Blockchain's ability to keep data secure while still facilitating its transmission could deliver real benefits across the industry.



**Ron Zalkind, CTO & Co-Founder, CloudLock**

We will see dynamic adaptive security controls that are attached to users. Right now, we set a security perimeter for users and expect them to operate within it. But we need to change this and instead have security follow users - wherever they live, wherever they go. Think of it as a user trust rating meets data containers - similar to app containers.



Growth

The move into the digital world has caused tremendous opportunity, but also tremendous risk of breach. Because the need for security traverses almost every sector as well as many aspects of our public and private lives, the security industry is not just a crucial component to the Massachusetts economy but is critical to enabling economic growth and innovation across almost all tech sectors.

**Brennan:** “Attackers will continue to find ways to penetrate organizations, and without reliable ways to reduce vulnerability and protect applications, innovation is going to falter. The security industry can be a leader by enabling this innovation through security.”

**Matviak:** “With its rich mix of resources, Massachusetts – and greater Boston in particular – is in an excellent position to influence the emerging FinTech sector. Our state is home to world-class universities; leading-edge financial and technology companies; a strong venture capital investment center; and a robust startup community. At the same time, our FinTech community must recognize the steep challenge of earning and keeping the trust of customers, given security considerations and the risks at stake. Not to mention the complex regulatory requirements that govern our industry.”

Data

Perhaps most critical to fostering innovation and business processes will be security’s role in the evolving world of big data, machine learning, and artificial intelligence (AI). With data and AI becoming the new currency, cybercrime is posing an increasingly high risk and corresponding opportunity. From helping secure financial, health, and consumer data to creating safeguards for end users and their personal devices, the security sector carries an enormous responsibility to deliver effective solutions.

**Zalkind:** “Data is useful in security for two reasons: 1) to use large amounts of data to teach machine learning models and spot behavior anomalies and sensitive data, and 2) massive amounts of data collected from many different enterprises or users will increase the chances of detecting the most terrifying attacks that are the long duration ‘advanced persistent threats’, where attackers are slowly exfiltrating data from a network over a long period of time. Feeding global machine learning models will allow us to identify the more sophisticated footprints that remain undetected in data collected from single, smaller, environments.”

Talent

The Massachusetts security industry thrives on a concentrated and collaborative environment, yet it is constrained by a shortage of skilled security professionals.

**Pickering:** “We’ve got a lot of great enterprise programmers in Boston, hungry for work on cutting-edge technology. Security is a massive industry and it is growing every year. Massachusetts needs to grow with it, so we can keep our private and public sector organizations secure.”

Keeping up with the growth will be challenging. According to a recent Burning Glass Technologies Job Market Intelligence report, Massachusetts has seen 92% growth in cybersecurity employment listings from 2010 to 2014. One-third of these cybersecurity jobs call for an industry certification, some 84% require a bachelor’s degree, and 83% require at least three years of experience.<sup>1</sup> Thus, filling the talent pipeline will require long-term strategies. Coordination among employers, BATEC, and the state’s higher education institutions will be critical to filling the talent pipeline long term.

Competition

The growth of the security sector presents an additional challenge for companies — heavy competition and the need to differentiate.

**Brennan:** “While the security market is diverse in terms of the way each company helps reduce risk for the enterprise, the fact is not all companies will survive. The biggest challenge each company faces is demonstrating how its technology fits into the security puzzle.”

Policy

Data privacy laws in Europe such as “safe harbor”, and current and pending U.S. Federal and state data privacy legislation, stand to have a profound impact on the entire industry. Domestically, cybersecurity policy issues remain a challenge for U.S. lawmakers. Comprehensive cybersecurity reform has remained elusive despite many data breaches and the balancing act to both provide access to and protect, financial, consumer, and government agency data.

**Matviak:** “Massachusetts has some of the strongest data privacy laws in the nation. With the Massachusetts Division of Banks’ adoption of the Cybersecurity Assessment Tool, it’s clear that these regulatory requirements will have a big impact on both new and established businesses.”

<sup>1</sup> “Job Market Intelligence: Cybersecurity Jobs, 2015.” Burning Glass Technologies. 2015.

# OTHER KEY INDUSTRIES TO WATCH; AI, CLEAN TECH, CONSUMER TECH, ED TECH, FIN TECH

Data-driven insights are becoming the new currency and Massachusetts has a front-row seat. Our cities are filled with forward-looking companies that are harnessing data insights to change the way the world transacts business, shares knowledge, and cares for the environment.

As we look forward, it is imperative that Massachusetts and the tech industries we support look to each other for reinforcement and collaboration. Startups of all stripes — big data, cloud, mobile, robotics, security, etc. — are entering the fray to compete in a world of constant innovation. Those that succeed will need more than just a good idea. They will also need access to infrastructure that can support mobile, cloud, and big data initiatives, as well as multiple security levels and sound data governance to ensure that at every step the right processes are in place to protect the privacy of their customers and the security of their businesses.

Massachusetts, through its pervasive interconnectedness, offers numerous support systems and avenues for collaboration — making it the perfect location for start-ups as well as established businesses seeking innovation through partnership and acquisition. Outside of healthcare tech; smart, connected machines and devices; and security, there are many other promising tech sectors that are fueling the economy of our Commonwealth.

## Artificial Intelligence

Artificial Intelligence (AI) is commonly defined as the creation of computer systems and software that mimic human learning and intelligent behavior. The field draws from data analytics, robotics, communications and cloud infrastructure, machine learning, and natural language processing, all areas where Massachusetts has a leadership position. AI is currently used in applications as diverse as programmatic ad buying, securities trading, medical diagnosis, fraud detection, robot control, and more.

Combining the state’s unique position in enabling technologies with its leadership in academic and medical research on neural systems and human cognitive processes has led to a robust and growing AI industry. Startups are choosing to launch here, and established industry heavyweights, such as IBM Watson Health, are relocating to the state.

## Clean Tech

The 2015 Massachusetts Clean Energy Center (MassCEC) reported strong and steady industry growth trends for the fifth consecutive year. Notably, Massachusetts experienced the largest single year of growth in the industry, 11.9%, since the organization began tracking jobs data in 2010. Over that time, the clean energy sector added more than 40,000 jobs – a growth rate of 64% – and now represents 3.3% of the Massachusetts workforce. What’s more, these are well-paying jobs, with nearly three-quarters of full-time clean energy workers earning more than \$50,000 per year – above the median wage of \$44,678 in Massachusetts.<sup>1</sup>

Helping drive sector growth are companies such as EnerNOC, GE Current, and Powerhouse Dynamics that rely on developing software and using data as a way to change how clean tech is realized. The state is also home to a strong research and development environment, which includes local accelerators Cleantech Open, Greentown Labs, and the TechSandBox, as well as public entities such as the New England Clean Energy Council (NECEC) and MassCEC. Furthermore, investment in the sector is bullish — the state ranked first in 2015 in attracting early-stage investments, beating California by more than 149% — and it’s clear that the industry is on track to continue its upward spiral for the foreseeable future.<sup>2</sup>

## Consumer Tech

Massachusetts is home to a startling number and variety of consumer tech companies. There are companies whose business model is rooted in the Internet, such as Care.com, Kayak, TripAdvisor, and Wayfair. There are companies whose product is a blend of software and hardware, such as Bose, iRobot, Hubway, and Zipcar. And there are traditional companies in sectors whose business is increasingly augmented by technology, such as Staples, New Balance, CVS Health, and Dunkin Brands.

Momentum continues to build within the region’s consumer tech sector, particularly as it intersects with other strong regional clusters such as digital games, education, financial services, healthcare, retail, and more. Access to tech talent and capital continues to be both a regional strength and a constraint to growth for the sector. Efforts by MassTLC and others to raise the profile of consumer tech in Massachusetts are essential for attracting and retaining the uniquely skilled tech talent and capital needed to help the consumer tech market continue its rapid digital trajectory.

<sup>1</sup> “2015 Massachusetts Clean Energy Report.” Massachusetts Clean Energy Center. 2015.  
<sup>2</sup> “2015 Massachusetts Clean Energy Industry Report.” BW Research and MassCEC. 2015.



Ed Tech

With a world-renowned higher education sector and the top-performing K-12 school system in the nation, it is not surprising that Massachusetts has a strong foothold in the education technology sector. The state is home to industry leaders such as edX, a leading MOOC (massive open online course) provider, and Cengage, a digital learning company. It is also home to more traditional education leaders, such as Curriculum Associates, Pearson, and McGraw — to name a few organizations that are rapidly moving toward more tech-oriented offerings. In the Boston area alone there are roughly 300 ed tech and learning-oriented startups and dozens of growth-stage companies.<sup>3</sup> And that's just the start. Strong support for the industry through accelerators such as LearnLaunch continues to draw companies focused on ed tech from across the nation.

Ed tech is growing at a rapid pace in K-12, higher education, and numerous organizations with professional development needs. The potential for expansion in the industry is enormous — 2015 saw record-setting investment in ed tech nationwide, while most other

tech sectors saw a decline. In the last quarter of 2015, buoyed by a number of \$100M+ deals, investment in ed tech grew over 300% from the previous quarter.<sup>4</sup> Perhaps most significant, the sector is dramatically changing the way in which people engage in learning and teaching, altering outcomes and extending equal learning opportunities around the globe.

Fin Tech

The financial industry provides 4.8% of the state's workforce and 9% of GSP, making it the largest for-profit sector in the state's economy. As both enabler and product of the success in the region's financial services sector, fin tech is poised for further growth and innovation. Seizing this opportunity, large financial firms such as Boston-based State Street and Fidelity are seeding local innovation through corporate investment organizations and support of the FinTech Sandbox.

As we've seen in other tech-driven segments, talent continues to be at once our greatest asset and a barrier to further growth. Home to the nation's third-largest number of data scientists, Massachusetts offers competitive access to much-needed talent. Yet we are unable to keep pace with demand.

A recent study commissioned by MassTLC forecast that Massachusetts could have as many as 120,000 big data-related jobs by 2018. Partnering with colleges and universities to develop specialized skill-based training programs will be critical to filling the talent pipeline and maintaining the state's competitive position in fin tech.

<sup>3</sup> Landry, Lauren. "10 Boston Ed-Tech Startups to Watch in 2015." BostInno. Dec. 29, 2014.  
<sup>4</sup> Venture Pulse Q4 2015: Global Analysis of Venture Funding. KPMG and CB Insights. Jan 19, 2016.





# 2020 CHALLENGE: CRACKING THE TALENT CONUNDRUM

Massachusetts has the best tech talent in the world. We have the most educated population in the nation. We have the greatest concentration of technology workers. We are the region with the greatest innovation capacity.

We have the best, but we simply don’t have enough of it. According to Burning Glass, there were over 123,000 tech job postings in Massachusetts in 2015. Unable to fill these positions, local companies are forced to tap new markets and distribute a number of these jobs to satellite locations around the country and the world.

Five years into the decade-long 2020 Challenge, which was set forth to grow the Massachusetts’ tech sector by 100,000 net new jobs, it is clear that creating jobs is not the problem.

Filling them is. Our inability to fill these jobs will have dramatic consequences for economic output, opportunity for Massachusetts residents, and our ability to capitalize on the region’s leadership position in the next technological wave of innovation.

## A Digital Divide

Talent is distributed evenly in populations, but opportunities are not. There is an increasing divide between those who work in the knowledge economy and those who do not – a divide that is highly correlated by gender, wealth, and race.

Innovative technologies are transforming and democratizing entire industries, and with that comes new opportunities. Tech-related jobs today account for 10% of all advertised jobs nationally, 30% of which are in software development.<sup>1</sup> The opportunity can be quantified by the amount of time these jobs remain open in search for talent. Massachusetts ranks third in the nation, with an average of 51 days to fill these jobs.<sup>2</sup>

Yet, at a time of such extreme demand for talent within the tech sector and demand for opportunity.

## 21st Century Skills

While Massachusetts has a nation-leading education system, we still fail to adequately prepare our youth with the skills to be creators and not just consumers in the 21st century. As a Commonwealth, we need to take a look at how opportunities are distributed – in schools and in underserved populations – and ensure that any person with the talent and drive can participate in the tech economy, a sector that pays about twice the state average.

Employers commonly engage colleges and universities through internships, externships, adjunct teaching and other collaborations to help align student learning with future career opportunities. While this addresses some of the employers’ short-term needs, experts agree that we must start preparing our youth much earlier, to get them inspired and on a pathway that provides opportunities.

## K-12 Pipeline

Today, kids in wealthy towns are being disproportionately prepared to benefit from the extreme reliance on technological capabilities in the workforce. Those with the access and means will be the majority of innovators and industry leaders.

To level the playing field, experts agree that a long-term pipeline solution must start as early as kindergarten and first grade.

To provide equity for all Massachusetts children and help drive the economy, educators and policy makers will need to work with technology leaders to prepare our students. There are successful models for bringing awareness in K-12 and for working with industry to create programs to provide additional support in communities that most need it. Some of these programs, such as Hour of Code, FIRST Robotics, Tech-novation, and Science Club for Girls, are part of national and global efforts to reach students and teachers early.

We must work with policy makers, educators, and community organizations that are embedded in less advantaged communities to engage students in workforce training programs and focused, fast-tracked certificate programs that already exist within community colleges.

<sup>1</sup> Middle Skill Employment: Understanding the Opportunities and Skills Requirements for an IT Workforce.” Burning Glass and BATEC National. Center of Excellence in Computing and Information Technologies. 2015.

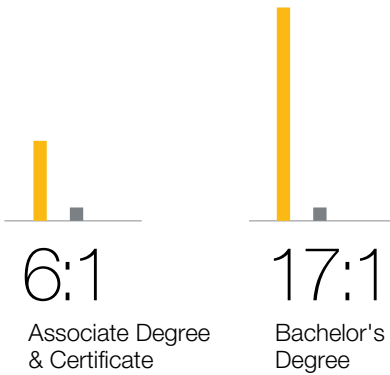
<sup>2</sup> Burning Glass 2015.



TECH TALENT DEMAND AND OPPORTUNITY INDICATORS

Rising Need for College-Educated Workers

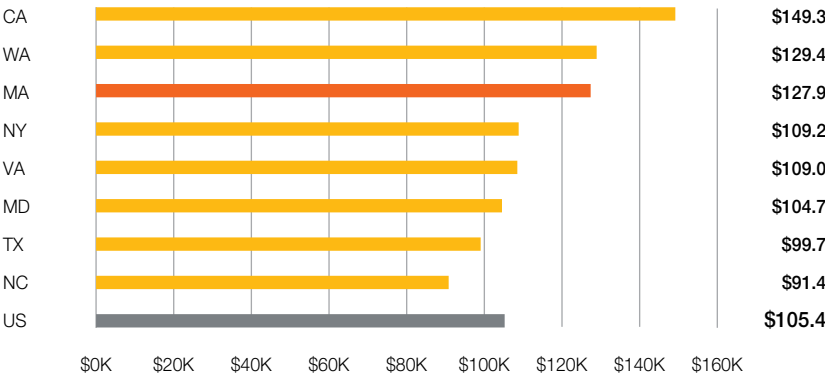
Current ratio of Massachusetts information technology & computer science job openings to recent graduates holding degrees and certificates



Source: Massachusetts Department of Higher Education Degrees of Urgency report, October 2014.

Massachusetts Ranks Third for Highest Wages Paid in the Tech Sector

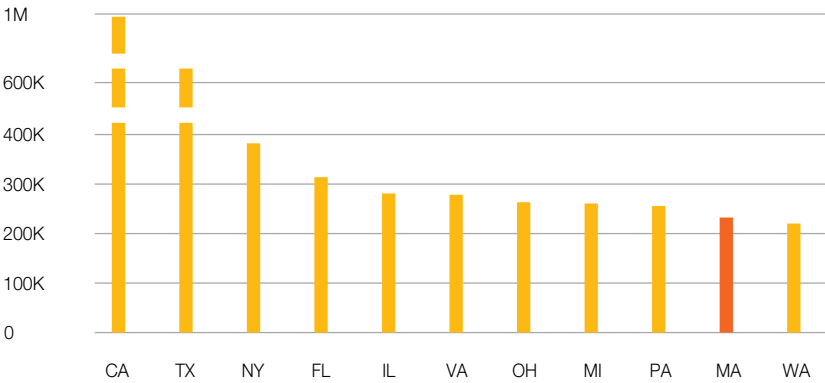
Average Wages in the Tech Sector, 2015



Source: UMass Donahue Institute calculations based on CyberStates.

Massachusetts Ranks 10th in Number of Tech Occupations Across All Sectors in 2015

State Numeric Ranking by Tech Occupations Across All Sectors, 2014 & 2015



Source: UMass Donahue Institute calculations based on CyberStates.



# THE OPPORTUNITIES: OPENING DOORS FOR WOMEN AND MINORITIES

Women are becoming a major economic force. In two-thirds of American households, women are the breadwinner or co-breadwinner,<sup>1</sup> and yet they are still highly underrepresented in computer and mathematical occupations. In Massachusetts, women comprise only 24% of these workers.

But it's not just women who are struggling to gain traction in the tech industry. Combined, Latinos and African Americans make up only 8% of computer and mathematical workers, while whites comprise 72%, which is consistent with statewide averages but under-representative of the makeup of the Massachusetts population.<sup>2</sup>

It is imperative that we, as a society, make the positive decision to provide support to unlock the potential of women and minorities.

Fortunately, organizations in the state are becoming aware of the imbalance of women and minorities in technology occupations and are working to close these gaps.

MassTLC's charitable Education Foundation, for instance, is the regional organizer for Technovation, a global mobile application competition for middle school and high school girls. The program provides role models, mentors, team building, and regional competitions. Two Massachusetts teams were the highest-ranked in the country in 2015, coming in second and third place globally.

Massachusetts Clean Energy Center's (MassCEC's) efforts through its clean internship program are also making a difference. In 2015, 39.5% of all interns placed were women. Its Successful Women in Clean Energy (SWICE) program also prepares qualifying low- and moderate-income women for clean energy positions.<sup>3</sup>

The Urban Massachusetts Louis Stokes Alliance for Minority Participation (UMLSAMP) focuses primarily on providing access and support for low-income, underrepresented minority students to complete post-secondary education in STEM-subject degree programs.

We are also seeing new tools, such as The Tech Connection's recruitment platform that supports professional development in underrepresented populations, providing the bridge to close the gap between diverse technical talent and emerging startups.

A number of companies, such as Amazon Robotics, Athenahealth, Carbonite, Hubspot, SmartBear Software, Trip Advisor, and Wayfair, just to name a few, have specific programs in place to foster the growth of women.

Nationally, the movement to provide industry mentors is seen as an important element in bridging the gap. Here in Massachusetts the success of the global Technovation Challenge is an example of how a mentor program for young women can change the face of high tech, as these women learn to see the world and themselves in a new way. Science Club for Girls is another, national effort to reach students, and teachers, as early as possible.

In addition to reaching women and underrepresented minorities early, companies can allow industry mentors to play a role. Upstart organizations like Innovation Women are helping to create more opportunities for women and minorities to be visible role models, but there is plenty of work yet to be done. Women serving on company boards, including private and public companies, while up 2% from our 2014 ranking, make up a meager 12% — a dismally low leadership representation, particularly given that gender diversity on boards is correlated with increased return on invested capital and business success.

Business leaders and policy makers must focus attention on bringing innovative strategies that move the needle on providing opportunities for women and minorities to scale in Massachusetts. This is an area where we are well positioned to again lead the nation.

<sup>1</sup> Wang, Wendy, Parker, Kim, and Taylor, Paul. "Breadwinner Moms." PEW Research Center. May 29, 2013.

<sup>2</sup> US. Census Bureau, American FactFinder, ACS Series B24010 (Sex by Occupation for the Civilian Employed Population 16 Years and Over).

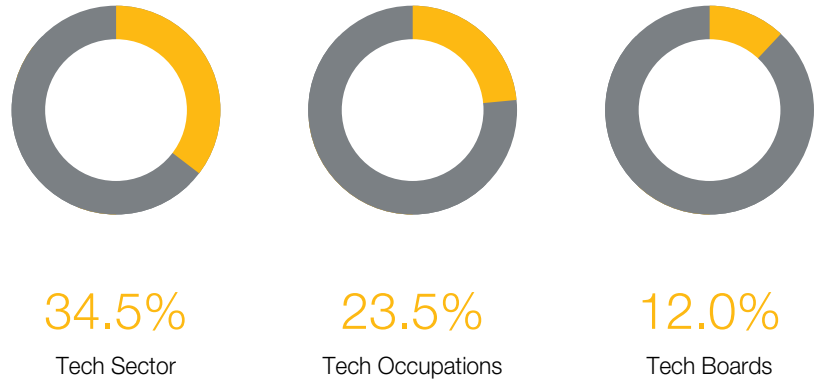
<sup>3</sup> "2015 Massachusetts Clean Energy Industry Report." MassCEC. 2015.



BENCHMARKING WOMEN AND MINORITIES IN THE TECH SECTOR

Massachusetts Ranks 5th for the Greatest Number of Women Employed in the Tech Sector

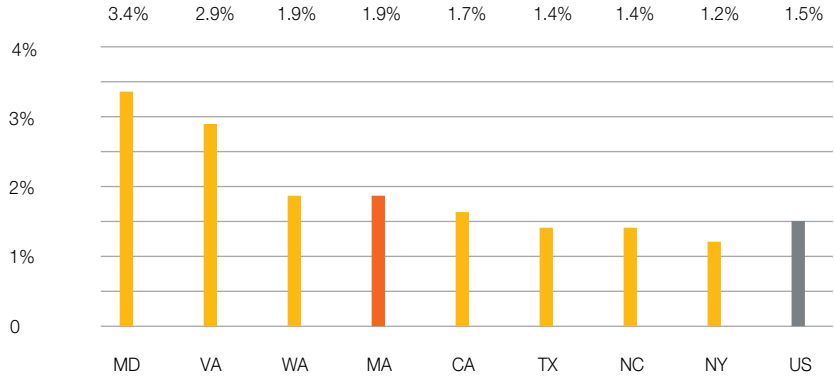
Source: University of Massachusetts Donahue Institute analysis of tech sector and tech occupation gender distribution and ratios, 2015, as reported in the 2016 CyberStates report. MassTLC conducted an informal review of 88 public and private Massachusetts-based technology companies. Sources include company websites as well as data collected by Bentley University for the 2016 *Census of Women Directors and Executive Officers in Massachusetts*.



Women in Massachusetts Are More Likely to Be in Computer and Mathematical Occupations Than They Are in Most Competitor States

Share of Women Workers in Computer and Mathematical Occupations by State, 2014

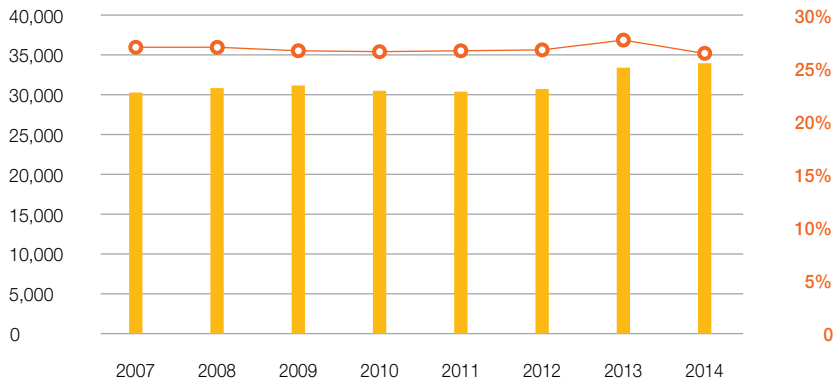
Source: UMass Donahue Institute calculations based on U.S. Census Bureau, American FactFinder, ACS Series B24010 (Sex by Occupation for the Civilian Employed Population 16 Years and Over).



The Number of Women Working in Computer and Math Occupations Has Remained Relatively Steady in Massachusetts

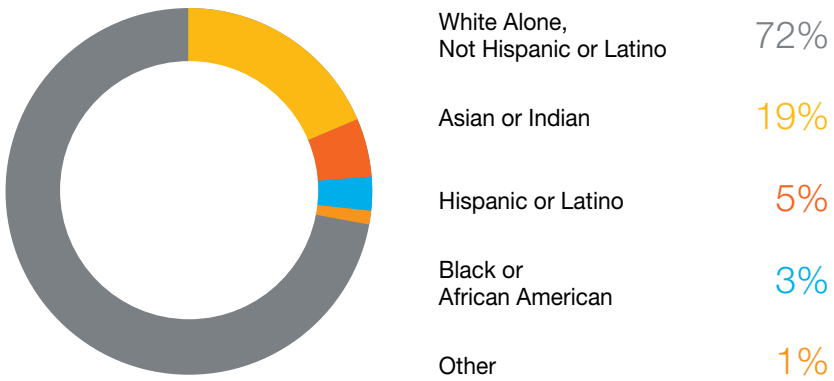
Massachusetts Women Working in Computer and Math Occupations, 3-Year Moving Average, 2007-2014

Source: UMass Donahue Institute calculations based on U.S. Census Bureau, American FactFinder, ACS Series B24010 (Sex by Occupation for the Civilian Employed Population 16 Years and Over).



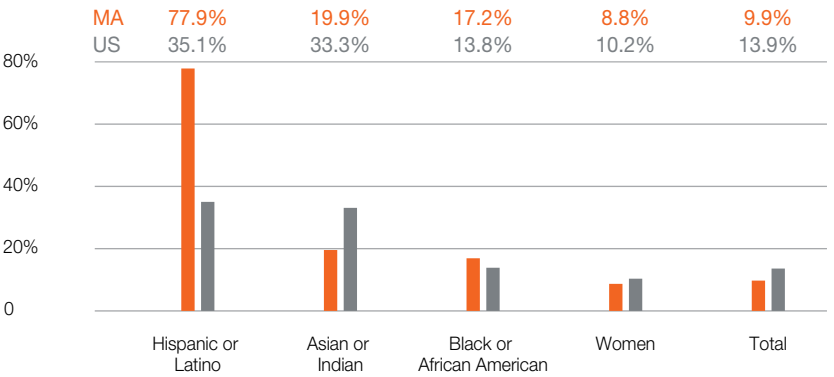
Massachusetts Workers in Computer and Mathematical Occupations by Race, 2014

Source: UMass Donahue Institute calculations based on U.S. Census Bureau.



Percent Change in Computer & Mathematical Occupations in Massachusetts and the United States, Averages of 2007-2009 & 2012-2014

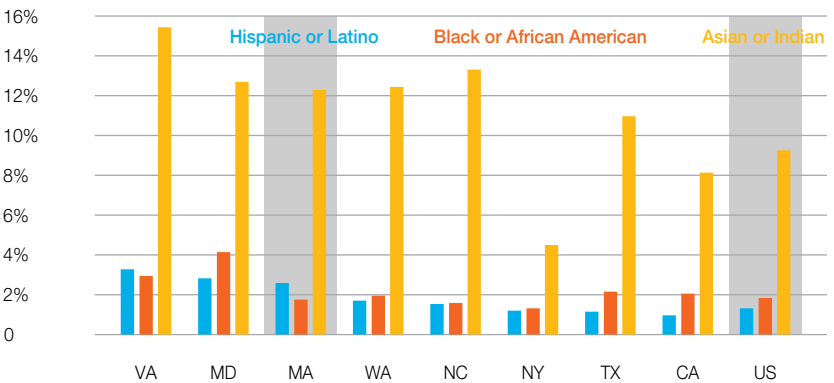
Source: UMass Donahue Institute calculations based on U.S. Census Bureau, American FactFinder, ACS Series B24010 (Sex by Occupation for the Civilian Employed Population 16 Years and Over).



Major Racial Groups in Massachusetts Are More Likely to Be in Computer & Mathematical Occupations Than They Are in Most Competitor States

Share of Workers by Gender in Computer & Mathematical Occupations by State, 2014

Source: UMass Donahue Institute calculations based on U.S. Census Bureau, American FactFinder, ACS Series B24010 (Sex by Occupation for the Civilian Employed Population 16 Years and Over).





## THE ROAD AHEAD: INVESTING IN THE FUTURE

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The state of technology in Massachusetts remains one of the strongest and most promising in the nation. The future looks bright on every front — from research to startup opportunities to the potential of traditional companies to transform.

For decades — through the boom of the mainframe and mini-computing eras, the concentration of research and development, our leadership in advanced manufacturing, sensors, robots, communications, security, big data, and more — we've been laying the groundwork and building the unique talent foundation for what is known as the fourth industrial age. Massachusetts sits poised to lead in the era of machine intelligence as we instrument and automate the physical world.

True to our history of leadership and innovation, the Commonwealth's tech sector continues to push the boundaries of what is possible through research, cutting-edge startups, and numerous companies working to create technologies to solve our world's biggest and most complex issues.

But to hold onto our leadership position, we must stay diligent and focused on the challenges that still lie ahead. By continuing to lay the groundwork for policies that will further fuel innovation and grow talent within our state's borders we allow our state's tech economy to remain vibrant and adaptive.

Smart investments in education, public and private partnerships, and innovation that attracts the best and brightest from within and outside our state's borders will allow us to continue to seize upon new opportunities, grow our talent base, and achieve our 2020 Challenge goal.

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## About the Mass Technology Leadership Council

With 500 member companies, the Mass Technology Leadership Council (MassTLC) is the region's leading technology association and premier network for tech executives, entrepreneurs, investors, and policy leaders. MassTLC's mission is to accelerate innovation and growth by connecting people from across the technology landscape, providing access to industry-leading content and ideas, and offering a platform for member companies to collectively advance their interests. For more information, please visit [www.masstlc.org](http://www.masstlc.org).

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## About the MassTLC Education Foundation

Founded in 1996, the MassTLC Ed Foundation is a 501c(3) whose mission is to increase the number of students pursuing computing education and careers. To realize this mission, the Ed Foundation works to help ensure students in Massachusetts have access to meaningful computing education and understand the principles of computer science and how it applies in the world.

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