NYC’S TECH OPPORTUNITY GAP
Strengthening Pathways and Collaboration Within High-Tech Workforce Development

NOVEMBER 6, 2019
Civic Hall is the nation’s leading center for learning and collaboration focused on advancing civic tech and problem-solving for the public good. Civic Hall’s mission is to embed civic values wherever technology and society meet, and to help people discover new ways of embodying those values in their work and life. Civic Hall serves as a dynamic and uniquely inclusive hub for ideas, tools, learning, relationships and ventures—both old and new—that can bring about a more just society.

Cognizant U.S. Foundation is a 501(c)(3) private foundation supporting STEM education and skills training. Launched in 2018 with an initial $100 million investment from Cognizant, the Foundation has since awarded $12 million to organizations working to educate and train the next generation of workers in communities throughout the U.S.

HR&A Advisors has over 40 years of experience advising on complex economic development and real estate projects in cities across the world. HR&A’s Urban Tech & Innovation Practice works with governments, technology companies, institutions, advocates, and developers to leverage the technology and innovation economy to increase economic competitiveness, improve quality of life, and broaden economic opportunity in cities. Firm clients include Google, Sidewalk Labs, Airbnb, WeWork, Industry City, CUNY, and the City of New York, as well as innovation districts and research parks across the U.S.

The development of this report was overseen by Sarah Holloway, Senior Planner, Civic Hall @ Union Square; and Rebecca Rosen, Fellow, Civic Hall @ Union Square. Civic Hall leadership includes Andrew Rasiej, Founder & CEO; Micah Sifry, Founder & President; and Jessica Quinn, Executive Director. This report was produced by Kate Wittels, Partner, HR&A Advisors; Bret Collazzi, Principal, HR&A Advisors; Renee Barton, Senior Analyst, HR&A Advisors; and Ashley So, Research Analyst, HR&A Advisors.
Introduction

As technological change transforms all facets of modern life and the economy, high-tech skills and the jobs that leverage them are growing in importance. This report was commissioned to better understand the nature and trajectory of jobs that require high-tech skills and how the NYC workforce ecosystem can better prepare New Yorkers to realize the economic opportunity provided by high-tech jobs.

This report’s findings will be used to help inform the planning of Civic Hall @ Union Square, a first-of-its-kind center focused on technology for good in New York. The building will include a three-story, 40,000-square-foot Learning Center opening in 2021, a future center of gravity for advancing our City’s tech workforce where any citizen can access 21st-century technology education.

The report’s findings are based on more than nine months of study that included: 1) a detailed analysis of labor market and economic data, and 2) interviews with more than 90 employers, training providers, City agencies, and community-based organizations who provided critical insights and informed recommendations. A full list of these supporters, to whom we are enormously grateful, is included in the report’s appendix.
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2. High-tech skills are growing in importance for all workers at a pace that will be accelerated by technological change and automation.

3. Today's high-tech workforce is not representative of New York's diversity, and this under-representation will have major implications as technology reshapes modern life and the economy.

4. Critical disconnects in information, data collection, and ecosystem collaboration must be addressed to ensure that all New Yorkers can benefit from high-tech opportunities.
Finding #1

High-tech jobs are a key driver of growth for both the New York City tech ecosystem and the New York City economy overall, offering well-paying jobs across all industries.

High-tech jobs are those focused on the creation and management of high-tech tools, products, systems, and support services. Within New York City’s tech ecosystem, these jobs are at the forefront of technology and typically concerned with the application of technical and digital skills across a range of industries and activities. They are distinct from other tech jobs that focus on low-tech activities such as the operation of hardware or jobs that may make use of basic digital skills.

High-tech jobs are a key driver of growth for both the New York City tech ecosystem and the New York City economy overall.

- **New York City’s 161,000 high-tech jobs make up nearly half of the broader tech ecosystem** and a significant share of jobs across both tech industries and other major New York City industries including financial services, media, professional services, and healthcare.

- **High-tech employment has expanded by 45%** since 2008, **2.5X** faster than the New York City economy overall, and added more than 46,000 jobs.

- **Wages for high-tech jobs are 80% higher than for New York City jobs overall**, with a median hourly wage of $54.

- **Demand for foundational high-tech skills is growing** across numerous jobs that have not traditionally been considered technical, including the more than 110,000 sales, marketing, administrative, and other “non-tech” jobs in New York City’s tech industries.
Finding #2
High-tech skills are growing in importance for all workers at a pace that will be accelerated by technological change and automation.

Technological change is driving a need for continuous learning among high-tech talent.

• Fast-paced change – both in software platforms and in macro-fields such as AI and machine learning – requires workers to seek continual training on new technologies.

• High-tech employers in a competitive market also seek candidates versed in specific languages and programs, requiring recent graduates and job-switchers to regularly build on foundational skills.

For all workers, foundational digital skills are increasingly essential.

• Foundational digital literacy increasingly provide a competitive advantage in corporate roles such as finance, operations, and HR, as well as sales and marketing, at both tech and non-tech firms; more than 70% of hard skills that grew in demand over the past two years were digital skills, including specific software systems and social media platforms.

The changing nature of work and automation will continue to displace and redefine skills and roles, increasing the importance of new models for reskilling.

• Past studies have estimated that as many as 1.4 million New York City jobs are somewhat or highly susceptible to automation, comprising over 30% of total employment.¹

• A growing share of employers recognize the need to plan for reskilling and will require a broader range of training to serve this need. Numerous training providers are planning their growth around reskilling, which comprises a significant and growing share of their business.

• Many non-tech jobs that are vulnerable to automation have compatible skills with high-tech jobs and are concentrated in industries with large high-tech workforces. Strategies that retrain displaced workers for entry level high-tech jobs may help ease disruption and diversify talent pools.

¹ Source: Center for an Urban Future
Finding #3

Today's high-tech workforce is not representative of New York's diversity, and this under-representation will have major implications as technology reshapes modern life and the economy.

Diversity in tech is critical to New York City's economic and civic future. As technology changes how life, the economy, and policy works, the high-tech workforce must reflect the lives it will impact.

- Recent challenges with AI applications and other technologies underscore the wide implications for potential negative externalities of emerging tech that could reinforce historic and systemic inequalities.
- The participation of historically marginalized populations in the creation and management of technology is critical to ensuring that those technologies benefit a diverse population.

However, a lack of diversity and ecosystem coordination persist.

- Women, black, and Latinx workers are underrepresented in high-tech jobs. Women make up only 24% of New York City's high-tech workforce (vs. 50% of the overall workforce) and Black and Latinx New Yorkers hold only 18% of high-tech jobs (versus 37% overall).
- High-tech jobs have high educational barriers to entry — 75% of workers hold a bachelor's degree versus 36% across the entire New York City workforce. Labor market data and employer conversations point to an overreliance on bachelor's degrees to screen candidates and judge aptitude.
- Improving coordination among employers, educators, and other training providers is essential to addressing these challenges and to creating an environment where any New Yorker can succeed in an increasingly high-tech economy.
Finding #4
Critical disconnects in information, data collection, and ecosystem collaboration must be addressed to ensure that all New Yorkers can benefit from high-tech opportunities.

Data collection and success tracking for training initiatives are inconsistent and not broadly shared, limiting improvement.

- While most training providers report metrics to their funders and government, there is no common set of metrics or system sharing information. This limits the collective understanding of who is training for what skills and what strategies work most effectively.

- While many employers are working to diversify recruitment, testing internships and apprenticeships, and providing input to schools and training providers, there is no clear database of these efforts or centralized repository for effective resources or partnership models.

High-tech jobseekers from underrepresented backgrounds frequently lack access to talent and professional networks, limiting access to career information and opportunities.

- The underrepresentation of women and Black and Latinx students at schools where they recruit is a major challenge for high-tech employers’ desires to recruit more diverse talent. In addition to broadening target schools, regional talent networks could help employers reach diverse talent.

- Centralized networking can improve career access for candidates not coming out of bachelor’s programs who lack networks typically developed in school, while providing exposure to tech cultural norms – how to whiteboard in an interview, what type of work experience is considered valuable, etc. – that are heavily weighted in tech talent recruitment.
Key Opportunities to Enhance NYC’s High-Tech Workforce Ecosystem

A diverse high-tech talent pool served by integrated, lifelong learning opportunities is critical to ensuring New York City’s workforce is more competitive and equitable.

**Standardize tools to support data collection, transparency, and improvements to high-tech training.**

- A voluntary database could help to track all high-tech training efforts citywide. The first step to improving New York City’s high-tech workforce ecosystem is to understand and aggregate information on the scale, reach, and focus of existing programs today.
- A single collection and reporting platform for outcome metrics could help standardize data collected on training and hiring practices, streamline reporting and reduce costs for resource-constrained providers, improve data quality on long-term outcomes, elevate best practices, and increase awareness of program effectiveness and ROI while remaining sensitive to the needs of individual populations served.
- A virtual system for aggregating tools, resources, and lessons for training providers and employers could improve the quality of training programs and employer hiring/recruitment practices, reduce program development costs, increase collaboration and information sharing among partners, and help take best practices to scale.

**Create infrastructure to facilitate continuous learning that meets the demands of rapid technological change.**

- Expanded digital literacy training for non-high-tech workers can improve opportunities for advancement and adaptation to changes in technology.
- Exploring targeted reskilling for non-tech workers vulnerable to automation for high-tech jobs within the same or similar industries could help limit disruption to employers and workers alike. Engaging tech producers in upskilling/reskilling efforts to provide training on their products can help to bridge the gap.
- Increased access to continuous learning can help to maintain a competitive talent pool for highly skilled high-tech jobs, including for recent college graduates and mid-career professionals.

**Create more inclusive on-ramps to high-tech careers by focusing on all levels of the career ladder and testing new hiring practices.**

- Enhanced physical and virtual networks for high-tech talent from underrepresented groups could improve access to employers and create support structures for career success and advancement.
- Increased training for growing jobs with lower barriers to entry, such as data analysts and network specialists, could broaden access to high-tech careers with greater career mobility.
- Deeper engagement between industries not traditionally thought of as ‘tech’ and training providers who focus on underrepresented populations could provide more accessible on-ramps to entry level high-tech jobs.
- Further investment in internship and fellowship models that provide extended training and evaluation could broaden access to high-tech jobs for candidates not emerging from bachelor’s programs at low risk to employers.
Coming Soon: Civic Hall @ Union Square

Civic Hall @ Union Square will serve as a universal entry point for high-tech job training.

A CENTER OF GRAVITY FOR ADVANCING THE CITY’S TECH WORKFORCE.

Civic Hall @ Union Square will be a first-of-its-kind center focused on technology for good in New York. The building will include a three-story, 40,000-square-foot learning center where any citizen can access 21st-century tech education.

Civic Hall @ Union Square will provide a full-stack of offerings that centralize resources and connections across the ecosystem to deliver on key opportunities to develop a more competitive and inclusive workforce.

- **Learning Hub**: Three floors of classrooms, meeting space, and collaborative workspace that will provide a home base for tech training providers and learners.
- **Community**: An inclusive front door to tech opportunities that building networks among learnings, community organizations, and employers through networking events, workshops, and mentorship.
- **Platform**: An open-source, technology-enabled platform for the New York City tech ecosystem, promoting best practices, sharing industry data, and providing thought leadership on high-tech workforce development.
Findings & Opportunities
**New York City’s High-Tech Workforce Ecosystem**

This study examines the scale and trajectory of **New York City’s high-tech jobs** and opportunities to strengthen the pathways and collaboration within **high-tech workforce development**.

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**What is a high-tech job?**

High-tech jobs are those focused on the creation and management of **high-tech tools, products, systems, and support services**. Within New York City’s tech ecosystem, these jobs are at the forefront of technology and typically concerned with the application of highly technical skills across a range of industries and activities. They are distinct from other tech jobs that focus on low-tech activities such as the operation of hardware or jobs that may make use of basic digital skills.

**What are digital skills?**

Digital skills are the **range of technical and information processing abilities required to use digital systems, tools, and applications**. They enable people to create and share digital content, communicate and collaborate, and solve problems, often using tools developed by high-tech workers. Entry-level digital skills required to make basic use of digital devices and applications are widely considered a critical component of literacy skills in the 21st century, including for non-high-tech workers.

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**What is the high-tech workforce ecosystem?**

An economic “ecosystem” is a network of organizations that enables the provision of goods or services. Traditional regional economic analyses have focused on the size and strength of specific industries (finance, manufacturing, etc.) and talent needs within those industries. When examining tech, this industry-focused approach fails to capture two important factors: 1) in addition to tech being an important industry, numerous other industries rely on tech and therefore require talent with similar skills as tech companies; and 2) tech and non-tech companies in New York City rely on a broad set of organizations to attract, recruit, and train talent, including academic institutions, private bootcamps, nonprofits, and government. The links among all these partners support the growth of high-tech skillsets in New York City. Collectively, they make up an ecosystem that is driving the city’s economic competitiveness.

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*A full list of industries and occupations considered by this report as defined by the U.S. Bureau of Labor Statistics (BLS) can be found in the Study Methodology & Acknowledgements section of this document.*

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## New York City’s High-Tech Workforce Ecosystem

High-tech jobs span **four broad occupational categories**.

<table>
<thead>
<tr>
<th>Developers</th>
<th>Data &amp; Systems Analysts</th>
<th>Network Professionals</th>
<th>All Other High-Tech Occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build and develop computer software, websites, and/or apps.</td>
<td>Analyze science, engineering, and data processing problems.</td>
<td>Install, configure, and support network systems and users.</td>
<td>Includes other managers, administrators, and researchers.</td>
</tr>
</tbody>
</table>

**Common Job Titles**
- Software engineers, software architects, application integration engineers, systems engineers, designers, web architects, web designers
- Applications analysts, business systems analysts and managers, computer systems analysts and managers, data processing analysts and managers
- Information security officers, security engineers, data security administrators, network analysts and managers, network and security engineers, systems engineers
- IT technicians, desktop support technicians, help desk analysts, hardware engineers, computer scientists

**Formal Occupational Codes**

### Developers
- Software Developers, Applications
- Web Developers
- Software Developers, Systems Software
- Computer Programmers

### Data & Systems Analysts
- Computer Systems Analysts
- Computer & Information Systems Managers
- Database Administrators

### Network Professionals
- Network & Computer Systems Administrators
- Information Security Analysts
- Computer Network Support Specialists
- Computer Network Architects

### All Other High-Tech Occupations
- Computer User Support Specialists
- Computer Occupations, All Other
- Computer and Information Research Scientists
- Computer Hardware Engineers

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*Occupational Codes correlate to Bureau of Labor Statistics Standard Occupational Classification (SOC) occupations and have been categorized for the purposes of this study to group together occupations with similar job functions, skill requirements, and career progressions.*
**New York City’s High-Tech Workforce Ecosystem**

New York City's high-tech workforce ecosystem spans a **diverse spectrum of actors and stakeholders** that represent supply and demand for high-tech talent and skills development.

<table>
<thead>
<tr>
<th>Current and Future Workers</th>
<th>Employers</th>
<th>Training Providers</th>
<th>Supporters &amp; Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seek opportunities to enter or advance within high-tech job pathways</td>
<td>Seek high-tech talent aligned to shifting technical needs and inform training provider priorities</td>
<td>Provide high-tech skills development to skill-seekers, with Employers and Supporters &amp; Partners</td>
<td>Partner with or provide resources to the ecosystem to support skills development</td>
</tr>
</tbody>
</table>

| | STUDENTS | TECH INDUSTRY EMPLOYERS | TRADITIONAL SCHOOLS | GOVERNMENT |
| | PROSPECTIVE & NEW WORKERS | NON-TECH INDUSTRY EMPLOYERS | PATHWAY PROGRAMS | FUNDERS |
| | CURRENT HIGH-TECH WORKFORCE | PUBLIC SECTOR EMPLOYERS | ACCELERATED LEARNING PROGRAMS | COMMUNITY-BASED ORGANIZATIONS |
| | NON-HIGH-TECH WORKERS IN TECH INDUSTRIES | | | |

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The High-Tech Workforce Ecosystem

Key Findings: The Opportunity Gap

1. High-tech jobs are a key driver of growth for both the New York City tech ecosystem and the New York City economy overall, offering well-paying jobs across all industries.

2. High-tech skills are growing in importance for all workers at a pace that will be accelerated by technological change and automation.

3. Today's high-tech workforce is not representative of New York's diversity, and this under-representation will have major implications as technology reshapes modern life and the economy.

4. Critical disconnects in information, data collection, and ecosystem collaboration must be addressed to ensure that all New Yorkers can benefit from high-tech opportunities.
High-tech jobs are a key driver of growth for both the New York City tech ecosystem and the New York City economy overall, offering well-paying jobs across all industries.
High-tech jobs make up a significant share of the New York City tech ecosystem.

As New York City has become a thriving home for tech, the importance of high-tech jobs has grown. In 2018, the New York City tech ecosystem included 355,000 jobs that were enabled by, produced, or facilitated technology. The ecosystem includes tech jobs in traditional tech industries (e.g. a programmer at Facebook), non-tech jobs in tech industries (e.g. a marketing manager at Etsy), as well as tech jobs in industries not traditionally thought of as “tech,” including finance, healthcare, professional services, and government (e.g. a network security specialist at JPMorgan Chase).

In 2018, New York City was home to 161,000 high-tech jobs, comprising nearly half of the New York City tech ecosystem. These jobs—which require hard tech skills for success—span the tech industries as well as those industries not traditionally thought of as tech, including 69,000 high-tech jobs in tech industries and 92,000 high-tech jobs in non-tech industries.

Source: EMSI labor market data; HR&A analysis
New York City’s expanding high-tech workforce is a key driver of economic growth.

As technology has become embedded into all facets of the New York City economy, the importance of high-tech jobs has only increased. Since 2010, 46,000 high-tech jobs have been created in New York City, representing a 40% increase over nine years. High-tech jobs grew 2.4X times faster than the citywide rate of 17% over the same time period. While representing only 3.5% of New York City’s 4.58 million jobs, high-tech jobs account for 6% of all new jobs added to the New York City economy since 2010.

High-tech jobs provide quality employment opportunities for New Yorkers. Median hourly wages are $54, more than 80% higher than the New York City median hourly wage of $30. Within the high-tech workforce, jobs with an average educational attainment level below a bachelor’s degree also offer significant opportunity for New Yorkers, with median hourly wages of $38 relative to the citywide average of $21 for jobs typically not requiring a bachelor’s degree. Across the economy, the number of high-tech jobs paying below $40 per hour has declined by 19% since 2013.

<table>
<thead>
<tr>
<th>For All High-Tech Jobs</th>
<th>For Jobs with Average Educational Attainment Below A Bachelor’s</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$54</strong> median hourly wage, versus the New York City median hourly wage of $30</td>
<td><strong>$38</strong> median hourly wage, versus the New York City median hourly wage of $21</td>
</tr>
</tbody>
</table>

Source: HR&A analysis of EMSI labor market data
New York City’s diverse economy provides varied growth opportunities for high-tech workers. Software and web developers (i.e. engineers or coders) make up nearly 40% of high-tech jobs in New York City and have seen the fastest growth over the last decade, adding 20,000+ jobs. Growth has been strong across all high-tech categories, with surging demand for professionals who can manage and analyze data, design and manage complex digital networks, and provide support to customers and employees.

The New York City market has demonstrated a strong local competitive advantage for high-tech occupations that benefit from proximity to adjacent industries. For example, network specialists and cybersecurity analysts are vital to financial institutions, media companies, and other firms where network reliability and security are critical. Across New York City tech and non-tech firms, data analysts evaluate performance metrics and improve operations. These pathways align with key priority areas for the City’s workforce training efforts, including cybersecurity, machine learning, and data analysis.

### Demand for high-tech occupations represent strong growth opportunities for New York City.

<table>
<thead>
<tr>
<th>Key Trends</th>
<th>Developers</th>
<th>Data &amp; Systems Analysts</th>
<th>Network Professionals</th>
<th>All Other High-Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018 Jobs</td>
<td>60,000</td>
<td>45,000</td>
<td>28,000</td>
<td>28,000</td>
</tr>
<tr>
<td>Growth Since 2008</td>
<td>+52%</td>
<td>+10%</td>
<td>+25%</td>
<td>+31%</td>
</tr>
<tr>
<td>• Software Application and Web Developers grew the fastest and now make up more than half of all developer jobs.</td>
<td></td>
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<tr>
<td>• Web Developers have an average educational attainment below a bachelor’s degree, while still earning well above the city’s median wage.</td>
<td></td>
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<tr>
<td>• Computer Systems Analysts grew by 6,000 jobs to 24,000 jobs, representing a key entry point to high-tech careers.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>• 61% of these jobs are in non-tech industries, a sign of the growing importance of data and systems management.</td>
<td></td>
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</tr>
<tr>
<td>• Network Support Specialists grew by 2,000 jobs and Information Security Analysts grew to 3,500 jobs; both provide entry-level paths to advanced networking jobs.</td>
<td></td>
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<tr>
<td>• These roles have among the highest share of jobs in non-tech industries.</td>
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<tr>
<td>• Computer User Support Specialists grew by 9,000 jobs to 25,000 jobs in 2018.</td>
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<td></td>
</tr>
<tr>
<td>• User support specialists have the lowest educational barrier to entry of all high-tech jobs, while still paying $32/hour, well above the citywide median.</td>
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</tbody>
</table>

Source: HR&A analysis of EMSI labor market data
While high-tech job growth is concentrated in tech industries, a significant volume of high-tech growth has occurred in industries not traditionally thought of as “tech."

More than half—57%—of all New York City high-tech jobs are in non-tech industries. While the share of high-tech jobs in tech industries has expanded over the past few years, high-tech jobs remain concentrated in non-tech industries by volume, with steady year over year growth. This includes 15% of all high-tech workers employed within finance, insurance, and real estate, 3% of all high-tech workers in healthcare, and 7% of all high-tech workers in government. For example, the public sector employs approximately 11,000 high-tech workers, including approximately 4,600 by the City of New York, 3,500 by New York City’s public primary and secondary educational institutions, and 1,200 by the State and Federal government, among other public entities. These jobs are concentrated in high-tech occupations that are generally accessible to candidates without a four-year degree: 35% of all public sector high-tech jobs are Computer User Support Specialists and 24% are Network Professionals.

Similarly, the most accessible high-tech skills occupations—those with typical educational attainment levels below a bachelor’s degree—are heavily concentrated in other non-tech industries. 29% of all Computer User Support Specialist jobs and 24% of all Network Support Specialists and Computer Network Support Specialists—two occupations that do not require a bachelor’s degree—are in the Professional, Scientific, and Technical Services industries.1

In conversation, employers suggested more opportunities for inclusive hiring in non-technical companies.

1 Source: HR&A analysis of EMSI labor market data
2 Source: stakeholder interviews

There is a shortage of talent for high-tech roles in non-tech companies—we need talent for jobs that can’t be outsourced. 2
- Fortune 500 Company

Non-tech companies are less competitive for graduates from top-tier universities than the big shiny tech companies and are more willing to hire ‘non-traditional’ talent from bootcamps. 
- Fortune 500 Company 2
High-tech skills are growing in importance for all workers at a pace that will be accelerated by technological change and automation.
Technological change is reshaping the city’s workforce—and the market for skills training.

Automation and other technological shifts will continue to transform the nature of work over the coming decade, making some skills and roles obsolete. According to a recent study by the Center for an Urban Future, as many as 1.4 million jobs in New York City are somewhat or highly susceptible to automation, comprising 31% of total employment.1 Accounting, auditing, food prep and service, and stock clerks and packers are amongst the occupations most vulnerable to automation.

To date, the private sector, particularly large companies, have taken the lead on reskilling and upskilling workers. Numerous large firms have developed reskilling programs in-house to connect current employees with skills that are pending automation to other internal jobs that will remain relevant. These companies have partnered with academic institutions and training providers to upskill and reskill workers. A primary motivation is economic. Employers have found that replacing a worker costs on average 21% of the worker’s base salary; reskilling can be less expensive, and allows companies to retain staff who have institutional memory and cultural fit while maintaining a stable staff, increasing employee happiness and productivity.2 In the private sector, an estimated 25% of to-be-displaced workers can be reskilled with a positive cost-benefit ratio.3

Training providers also report that up- and re-skilling make up a growing share of their business; for example, one New York City accelerated training provider is currently training 12,000 Microsoft employees.

SELECT FORTUNE 500 EMPLOYERS THAT HAVE ANNOUNCED MAJOR RESKILLING EFFORTS

We up until now haven’t had as much of a necessity to upskill large groups of people. We think that may change and are planning on an 8- to 9-year timeline.

- Fortune 500 company

1 Source: Center for an Urban Future (CUF); the same study found that 450,000 jobs (10%) are highly susceptible to automation.
2 Source: Center for American Progress
3 Source: World Economic Forum
This shift has created a growing urgency—and an opportunity—to reskill workers with obsolete skills.

Companies face a common challenge as they develop new practices for reskilling—they require support to understand how their employees’ core skills, talents, and interests might prepare them for jobs with long-term growth potential.

Analysis of job postings data shows that some jobs with a high risk of automation may be ripe for reskilling into high-tech careers as they share similar core skills. Some of these at-risk occupations include tax and insurance professionals, film and media technicians, and industrial engineers. Many of these endangered jobs exist in industries that also employ a significant volume of high-tech talent, including finance, insurance, telecom, and media. One Fortune 500 professional services company reported success with such reskilling efforts. Its retraining programs led staff to map alternative career pathways and pursue relevant skills development, allowing two-thirds of staff with outdated skillsets to find new opportunities within the company, while the other third received training for opportunities outside the company.

Focusing on pathways between current at-risk occupations and compatible high-tech roles could reduce disruption for employers and workers, while providing a new pipeline of high-tech talent.¹

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**Training providers and employers were surveyed about shifts in talent needs.**²

**Reskilling programs** in partnership with major employers may account for **up to 50% of high-tech training providers’ business** in coming years.

**Major employers overwhelmingly cited the creation of upskilling and reskilling programs as necessary to keep skillsets up to date and reduce recruiting costs.**

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**NON-HIGH-TECH OCCUPATIONS WITH HIGH RISK OF AUTOMATION AND SKILLS COMPATIBILITY WITH HIGH-TECH OCCUPATIONS**¹

- Tax Preparers
- Insurance Underwriters
- Insurance Appraisers
- Credit Counselors
- Brokerage Clerks
- Audio-Visual and Multimedia Collections Specialists
- Broadcast Technicians
- Photographic Process Workers
- Electrical and Electronics Engineering Technicians
- Power Distributors and Dispatchers
- Engineering Technicians and Drafters
- Industrial Engineers
- Statisticians
- Computer, Automated Teller, and Office Machine Repairers
- Computer Operators
- First-Line Supervisors of Office and Administrative Workers

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¹ **Source:** HR&A analysis of EMSI data
² **Source:** stakeholder interviews
Across job postings for non-high-tech jobs, basic digital skills are growing in demand. Across all of the skills growing in demand across job postings for non-high-tech jobs over the past two years, the majority—71%—have been digital. While these digital skills are currently required less frequently than other skills for these roles, their growing importance is illustrative of the importance of tech.

While high-tech occupations within both the tech and non-tech industries are a major focus of training providers, non-high-tech occupations within tech industries also increasingly require digital literacy. Broader training of new and existing employees on basic digital skills could be valuable to:

Build synergies between technical & non-technical teams. To do their jobs and collaborate effectively with tech teams, even non-high-tech workers benefit from foundational digital skills knowledge. For example, sales roles benefit from an understanding of front- and back-end use of the products they sell. Administrative roles often now support the implementation and support of technical products, requiring an understanding of product design. Advancement within non-technical roles increasingly benefits from a foundation of some technical knowledge of these skills.

Improve efficiency of work processes and career growth opportunities. New digital tools and software systems are changing the nature of work, allowing for new efficiencies and providing an array of new tools to improve traditional business practices. For example, customer management platforms such as Salesforce are now common across all industries including tech and non-tech industries. The rise of digital media and marketing increases the importance of data analysis and platform management. Employers expressed a growing appreciation for corporate staff who can leverage digital tools or basic coding to automate repetitive tasks and free up time for more value-add work.

### DEMAND FOR DIGITAL SKILLS FOR NON-HIGH-TECH JOBS IN TECH INDUSTRIES

<table>
<thead>
<tr>
<th>Skills Growing in Demand for Non-High-Tech Jobs in Tech Industries</th>
<th>Growth in Frequency Across Job Postings 2016-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salesforce</td>
<td>7%</td>
</tr>
<tr>
<td>High-Tech Marketing</td>
<td>3%</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>3%</td>
</tr>
<tr>
<td>Quality Assurance and Control</td>
<td>3%</td>
</tr>
<tr>
<td>Instagram</td>
<td>2%</td>
</tr>
<tr>
<td>Spreadsheets</td>
<td>2%</td>
</tr>
<tr>
<td>Product Management</td>
<td>2%</td>
</tr>
<tr>
<td>Social Media Platforms</td>
<td>2%</td>
</tr>
<tr>
<td>SAP</td>
<td>2%</td>
</tr>
</tbody>
</table>

1 Source: stakeholder interviews
2 Source: Burning Glass postings data
For high-tech workers, the rate of technological advancement requires continuous learning to build upon foundational skillsets and remain competitive.

Increasingly, high-tech workers require continuous learning to develop and deepen skills that can help them advance their careers. For example, a Fortune 500 professional services firm with a major New York City presence requires its staff to engage in a minimum of 40 hours of annual instruction through an internal learning portal, where staff can understand career pathways and develop new competencies. More broadly, tech’s emerging specializations, such as machine learning and AI, require skillsets that build upon foundational skills to adapt to new technologies.

High-tech workers early in their careers also need continual upskilling to remain competitive. Many of the core programming and systems that are taught in tech degree programs have remained constant over the past decade, while technological changes—such as advanced data science or new programming languages and systems associated with emerging technologies—require new skills that must be layered over these foundational skills. Many employers and providers report that they would rather pay a premium for talent that is prepared to hit the ground running in technical roles, but that many graduates require further skills development to make them more competitive at graduation. Some major employers also reported that they have talent gaps at the project management level in emerging tech areas, which prevent them from hiring more junior talent to fill out project teams.

A number of accelerated learning providers in the New York City ecosystem offer training programs targeted for degree-holders who are seeking upskilling. For example, major New York City high-tech training providers report that in addition to core software development skills, applied skills offerings such as data science and cybersecurity are becoming flagship products.

Source: stakeholder interviews
With constant technological transformation, high-tech skills alone are insufficient.

The rate of technological change is requiring a new emphasis on soft skills in addition to core high-tech skills. Tech skills alone are increasingly insufficient for workplace success. High-tech jobs are evolving from centralized silos of tech expertise into roles that increasingly involve collaboration with other functions across departments or adaptation to new tools, systems, and/or programming languages. Hiring managers increasingly look for “soft skills” like creativity, emotional intelligence, and cognitive flexibility and have reduced their emphasis on traditional hard technical skills. Having a strong set of soft skills not only strengthens a candidate’s application during recruiting, it also equips them for faster advancements within a company. Existing City initiatives such as Tech Talent Pipeline have similarly identified that critical thinking, communication, and problem-solving skills are more important than advanced degrees for workers entering new tech jobs. Developing these “soft skills” starts at a young age and continues throughout the career path. Today there are a range of K-12 programs that instill problem solving and analytical thinking skills through real world applications in addition to hard tech skills at the beginning of their career path. Later in the career pathway, career support services offered by accelerated training programs can provide wrap-around career coaching and critical thinking.

[Technical training is] **complimented with soft skill and professional development workshops.** We want to arm them with basic to intermediate knowledge of essential tools as well as ways to navigate those offices and thrive at the job after getting it.

- Major training provider ¹

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**DEMAND FOR SOFT SKILLS IN JOB POSTINGS FOR HIGH-TECH JOBS** ²

<table>
<thead>
<tr>
<th>Soft Skills in Demand for High-Tech Jobs</th>
<th>Frequency Across Job Postings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Skills</td>
<td>47%</td>
</tr>
<tr>
<td>Teamwork / Collaboration</td>
<td>32%</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>26%</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>20%</td>
</tr>
<tr>
<td>Writing</td>
<td>19%</td>
</tr>
<tr>
<td>Planning</td>
<td>15%</td>
</tr>
<tr>
<td>Research</td>
<td>15%</td>
</tr>
<tr>
<td>Detail-Oriented</td>
<td>13%</td>
</tr>
<tr>
<td>Creativity</td>
<td>11%</td>
</tr>
<tr>
<td>Organizational Skills</td>
<td>8%</td>
</tr>
<tr>
<td>Written Communication</td>
<td>5%</td>
</tr>
</tbody>
</table>

¹ Source: Stakeholder interviews
² Source: Burning Glass, 2016 – 2018 job postings for high-tech jobs
Case Study: Reskilling for a Stronger High-Tech Workforce

**Overview:** General Assembly (GA) is a global, New York City-based accelerated learning organization that provides training programs in web development, data science and analysis, user experience design, high-tech marketing, product management, and more. Students and partners can choose from a range of formats to help them best achieve their goals, including full-time intensive boot camp, part-time, and short-form options.

**Skills Development Offered:** In response to real-time employer needs, GA has developed programs such as data science and consistently explores emerging new areas such as information security that layer over more common high-tech skills. In response to this need, GA reports that as much as half of its revenue is now generated through upskilling and reskilling programs developed in partnership with major employers, such as Microsoft. In addition to working with tech companies to update skills, GA works with legacy companies shifting to a major high-tech focus, such as finance or insurance companies that may seek to retrain actuaries as data scientists. In addition, General Assembly offers single-day high-tech literacy programs at scale for non-high-tech workers who benefit from technical knowledge to perform their roles, such as sales representatives at high-tech product companies, training over 600,000 participants to date.
Today's high-tech workforce is not representative of New York's diversity, and this underrepresentation will have major implications as technology reshapes modern life and the economy.
The high-tech workforce is not representative of New Yorkers in terms of race and gender.

Consistent with national trends, New York City’s high-tech workforce is significantly less diverse in terms of race and gender than the economy as a whole. Historically, New Yorkers of color and women have faced systemic economic, social, and educational barriers that have limited access to employment opportunities, including within the tech ecosystem. In the high-tech workforce, there is significant under-representation among Black and Latinx New Yorkers and women. The highest-paying and fastest-growing high-tech jobs—especially Software Developers—are also the least diverse.

In recognition of these challenges, high-tech employers have adopted hiring and recruitment practices to diversify their workforces. Employers are focusing recruiting efforts at historically black colleges and targeting diversity groups such as “Women in CS” clubs to reach those often-underrepresented populations in tech.

<table>
<thead>
<tr>
<th>HIGH-TECH OCCUPATIONS DISTRIBUTION BY RACE/ETHNICITY</th>
<th>Median Hourly Wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYC Overall</td>
<td></td>
</tr>
<tr>
<td>17% Black or African American</td>
<td>$13</td>
</tr>
<tr>
<td>20% Hispanic or Latino</td>
<td>$21</td>
</tr>
<tr>
<td>47% Other</td>
<td>$47</td>
</tr>
<tr>
<td>13% White</td>
<td>$54</td>
</tr>
<tr>
<td>NYC Tech Ecosystem</td>
<td></td>
</tr>
<tr>
<td>11% Black or African American</td>
<td>$20</td>
</tr>
<tr>
<td>12% Hispanic or Latino</td>
<td>$30</td>
</tr>
<tr>
<td>54% Other</td>
<td>$51</td>
</tr>
<tr>
<td>21% White</td>
<td>$60</td>
</tr>
<tr>
<td>High-Tech Overall</td>
<td></td>
</tr>
<tr>
<td>9% Black or African American</td>
<td>$12</td>
</tr>
<tr>
<td>9% Hispanic or Latino</td>
<td>$20</td>
</tr>
<tr>
<td>49% Other</td>
<td>$30</td>
</tr>
<tr>
<td>31% White</td>
<td>$40</td>
</tr>
<tr>
<td>Developers</td>
<td></td>
</tr>
<tr>
<td>4% Black or African American</td>
<td>$12</td>
</tr>
<tr>
<td>6% Hispanic or Latino</td>
<td>$20</td>
</tr>
<tr>
<td>44% Other</td>
<td>$30</td>
</tr>
<tr>
<td>44% White</td>
<td>$40</td>
</tr>
<tr>
<td>Data &amp; Systems Analysts</td>
<td></td>
</tr>
<tr>
<td>9% Black or African American</td>
<td>$12</td>
</tr>
<tr>
<td>9% Hispanic or Latino</td>
<td>$20</td>
</tr>
<tr>
<td>51% Other</td>
<td>$30</td>
</tr>
<tr>
<td>30% White</td>
<td>$40</td>
</tr>
<tr>
<td>Network Professionals</td>
<td></td>
</tr>
<tr>
<td>12% Black or African American</td>
<td>$12</td>
</tr>
<tr>
<td>12% Hispanic or Latino</td>
<td>$20</td>
</tr>
<tr>
<td>54% Other</td>
<td>$30</td>
</tr>
<tr>
<td>20% White</td>
<td>$40</td>
</tr>
<tr>
<td>All Other Digital Professionals</td>
<td></td>
</tr>
<tr>
<td>12% Black or African American</td>
<td>$12</td>
</tr>
<tr>
<td>12% Hispanic or Latino</td>
<td>$20</td>
</tr>
<tr>
<td>54% Other</td>
<td>$30</td>
</tr>
<tr>
<td>20% White</td>
<td>$40</td>
</tr>
</tbody>
</table>

Source: HR&A analysis of EMSI labor market data

<table>
<thead>
<tr>
<th>HIGH-TECH OCCUPATIONS DISTRIBUTION BY GENDER</th>
<th>Male</th>
<th>Female</th>
<th>Median Hourly Wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYC Overall</td>
<td>50%</td>
<td>50%</td>
<td>$12</td>
</tr>
<tr>
<td>NYC Tech Ecosystem</td>
<td>65%</td>
<td>35%</td>
<td>$20</td>
</tr>
<tr>
<td>High-Tech Overall</td>
<td>76%</td>
<td>24%</td>
<td>$40</td>
</tr>
<tr>
<td>Developers</td>
<td>79%</td>
<td>21%</td>
<td>$44</td>
</tr>
<tr>
<td>Data &amp; Systems Analysts</td>
<td>70%</td>
<td>30%</td>
<td>$44</td>
</tr>
<tr>
<td>Network Professionals</td>
<td>81%</td>
<td>19%</td>
<td>$44</td>
</tr>
<tr>
<td>All Other Digital Professionals</td>
<td>76%</td>
<td>24%</td>
<td>$44</td>
</tr>
</tbody>
</table>
With New York City’s growth as a global tech hub, lack of diversity in tech has major implications for society at large.

As technology reshapes modern life, it is critical that the talent behind the technology reflects the lives that it will affect. Technology increasingly shapes systems that have profound importance in people’s lives, as the public and private sectors seek efficiencies and attempt to remove human error and cognitive biases from decision-making. However, a lack of representation among the teams that develop these products can lead to significant unintended consequences. For example, algorithms used to sentence within the criminal justice system, make mortgage decisions, and screen job applicants have been found to reinforce systemic inequalities by penalizing certain populations based on race, gender, or place of residence. The participation of historically underrepresented populations in the creation and management of transformational technologies is critical to ensuring that the technologies are developed in a fair and impartial manner.

Diversity is also critical to ensuring New York City businesses remain top performers. Major New York City high-tech employers cited the importance of diversity (of race, gender, and experience) to creating more creative and intellectually rigorous teams, leading to better products. Nationally, companies in the top quartile for gender diversity were 15% more likely to outperform their competitors, while those in the top quartile for ethnic diversity were 35% more likely to see financial performance above the national industry median.¹ Over time, employers have found that diversity is self-reinforcing, as female, Black and Latinx tech talent are more likely to select firms with diverse teams.

HOW DIVERSITY IN TECH IMPACTS CIVIC LIFE

**Access to Healthcare**

An algorithm used to predict at-risk patients was found to produce assessments that were racially biased against black patients because it utilized data that did not account for historic systemic barriers to accessing healthcare. The algorithm, sold by a leading health services company, used patients’ anticipated future healthcare cost as a core metric, failing to flag black patients as at-risk in many cases given that, historically, black patients have used health care at lower rates or face barriers to accessing medical support.

**Employment Opportunities**

A leading tech company recently terminated an experimental hiring tool that utilized artificial intelligence to screen candidates because of its unintended gender bias against women. Learning from data on the company’s existing workforce over a ten-year period, the recruiting engine learned to penalize resumes that included female gendered words, such as “women’s.” This case exposes the limitations of machine learning and serves as a lesson to a growing list of large companies that are looking to automate their hiring processes to consider historic barriers to workforce participation.

In addition, most high-tech jobs have high educational barriers to hiring, creating challenges for a large population of New Yorkers to compete for high-paying job opportunities.

Generally, educational attainment requirements are higher for high-tech occupations than that of either the broader tech ecosystem or the New York City economy. 75% of high-tech jobs have a typical entry-level educational attainment requirement of a bachelor’s degree or higher, versus 56% across the tech ecosystem and 36% across the New York City economy. This emphasis on degree attainment may exclude a large population of New Yorkers from competing for high-tech jobs.

Employers at major tech companies attribute degree requirements to higher expectations for skill level at the time of hiring, with talent needs focused on mid- to senior-level skills. Software developers and systems architects, for example, require a deeper understanding of computer science and knowledge of multiple programming languages. Smaller tech companies, in particular, cited the challenge of training entry-level staff in an environment where every employee needs to operate at full capacity.

However, disparities between job posting requirements and the educational attainment of actual workers suggest an overreliance on degrees to judge aptitude. For example, 92% of job postings for Network Professionals and 93% for Data and Systems Analysts require a bachelor’s degree, while only 54% of actual Network Professionals and 72% of Data and Systems Analysts have such qualifications. Numerous employers cited internal efforts to test alternative screening methods to broaden their recruitment, including consideration of experience in lieu of a degree or 100% skills-based hiring.³

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¹ Source: HR&A analysis of EMSI labor market data  
² Source: HR&A analysis of Burning Glass job postings data  
³ Source: stakeholder interviews
Employers and training providers are testing new models to broaden pathways into high-tech jobs that have the potential to shape broader efforts citywide.

Employers cited internships and apprenticeships as effective ways to evaluate and onboard talent who do not come from four-year degree programs, including in partnership with community colleges, bootcamps, and nonprofit training providers. Training programs that prepare participants with the skills and professional connections required for specific occupations can create pathways to hiring. At an educational level, basic skills required for these roles can be taught more quickly and accessibly in accelerated training programs than traditional degree programs, relative to more technical roles that require a broader base of skills. Specifically, roles such as Network Support Specialists and User Support Specialists do not require the same level of technical talent as senior developer or engineering roles. Ambitious entry level workers in these roles, with the appropriate training, dedication, and enthusiasm for learning, can transition to more advanced Network Specialist or Data and Systems Analyst roles.

Employers recognized the role that social networks and economic disadvantages play in furthering structural inequities. Structural inequalities may restrict access to professional networks developed in traditional four-year degree programs or social networks reinforced by socioeconomic standing. For people unable to attend a four-year degree program, this can equate to challenges accessing peers, mentors, and employers and thus potential referrals, introductions, and recommendations that may help them to secure high-tech jobs.

Employers are adopting evaluation tools that support more accessible entry points to high-tech jobs. For example, screening for aptitude and skills can help to decrease the role of bias in candidate evaluation. Several major employers have begun to remove bachelor's degree requirements for select roles to focus more closely on demonstrated skills and any relevant experience, developing custom training programs and evaluation tools that can help to remove bias from candidate screening processes. Tools can include problem-solving tests, whiteboard interviews, and other aptitude testing mechanisms that allow candidates to be evaluated more objectively. While many larger employers develop in-house testing platforms to test for soft skills as well as technical skills, medium or smaller size employers may lack the resources to develop such tools. Standardizing aptitude testing could help smaller employers counter bias and help training providers best prepare jobseekers with the skills employers seek.
CASE STUDY: CREATING MORE INCLUSIVE PATHWAYS TO OPPORTUNITY

**Within large companies, inclusive hiring practices create tangible benefits.**

**Overview:** JPMorgan Chase is a leading global financial services firm headquartered in New York City, where it has a major regional presence of high-tech talent. JPMorgan Chase is ranked by S&P Global as the largest bank in the United States and the sixth largest bank in the world by total assets.

**Approach to Talent:** To support its American and global operations, JPMorgan Chase has significant high-tech talent needs spanning a range of its businesses. In New York City alone, the company hires hundreds of junior high-tech roles annually. The company places a high premium on increasing the diversity of its workforce, to foster a more inclusive, diverse and innovative technology culture through over 70 strategic Emerging Talent Programs globally that broaden the entry-level talent pipeline. For example, through their Emerging Talent Programs portfolio, JPMorgan Chase recruited talent from a range of alternative, non-traditional pipelines including coding bootcamps and workforce development programs such as NPower and Per Scholas. The company also engages in apprenticeship programs that provide opportunities for prospective workers to develop and demonstrate competencies on the job, including a partnership with CareerWise NY where they are working with more than 20 high school juniors from the NYC school system. These individuals offer both cognitive and experiential diversity to JPMorgan Chase's workforce. The benefits of hiring through alternative channels has been demonstrable through the strong retention and performance data coming from the talent that participate in these programs. In today's talent marketplace, many companies are seeing average retention rates of their millennial workforce at between 18-24 months. However, when talent enters via a strong workforce development organization such as an Emerging Talent Program, companies like JPMorgan Chase are seeing that retention rate jump to approximately 45 months. This dramatic improvement helps reinforce corporate culture and reduce costs associated with turnover.
CASE STUDY: CREATING MORE INCLUSIVE PATHWAYS TO OPPORTUNITY

E-COMMERCE TECH COMPANY

Tech companies with advanced technical talent needs are recognizing and acting upon challenges with sourcing diverse high-tech talent.

Overview: Since its founding in 2005, this e-commerce tech company has grown to over 1,000 employees worldwide, including 650 in New York City.

Approach to Talent: This company has a significant software engineering talent need, with software engineers comprising nearly half of their employee base. Due to the flexible and advanced nature of technical skills needs, the company typically hires high-tech talent at more senior levels, with the majority of these employees holding computer science degrees from local universities or having completed intense bootcamp programs.

To increase diversity and mitigate any potential bias in the hiring process, this company has developed and adopted several approaches to its hiring and screening practices that apply to all hiring decisions. To help diversify the pipeline of talent for high-tech roles, the company is partnering with a local training provider in high schools to help diversify entry points to the beginning of the high-tech career pathway, and is exploring potential opportunities to recruit talent from non-traditional backgrounds. To address potential bias in its hiring decisions, the company has developed a detailed competency matrix that is utilized in hiring decisions. The competency matrix considers a range of skills including collaboration, leadership, management, and effectiveness, in addition to technical skills, that are evaluated by hiring panels. Hiring panels are trained to ask the same questions in the same order to each candidate, and to score candidate responses against predetermined “great,” “satisfactory”, and “weak” answers to further reduce the weight of individual opinions in the hiring process. For many junior- to mid-level roles, the company has also developed a coding challenge to evaluate technical skills as a way to surface strong candidates who may not have computer science degrees.

While all of these initiatives are relatively new, the company has already seen positive impacts reflected in the diversity of its hiring and in its operational efficiency: the company has begun to see progress on its soft hiring targets, and the time to fill roles has been reduced from 90 to 50 days with the formalization of its more inclusive and streamlined evaluation process.
Critical disconnects in information, data collection, and ecosystem collaboration must be addressed to ensure that all New Yorkers can benefit from high-tech opportunities.
The high-tech workforce ecosystem comprises a diverse range of actors representing supply and demand for high-tech skills development and training.

<table>
<thead>
<tr>
<th>Current and Future Workers</th>
<th>Employers</th>
<th>Training Providers</th>
<th>Supporters &amp; Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seek opportunities to enter or advance within high-tech job pathways</td>
<td>Seek high-tech talent aligned to shifting technical needs and inform training provider priorities</td>
<td>Provide high-tech skills development to skill-seekers, with Employers and Supporters &amp; Partners</td>
<td>Partner with or provide resources to the ecosystem to support skills development</td>
</tr>
</tbody>
</table>

**STUDENTS**
Future high-tech skills job seekers spanning elementary school to secondary education, including 6K+ computer science degree graduates and 130K+ public school students receiving basic computer science education

**PROSPECTIVE & NEW WORKERS**
New entrants to the high-tech workforce, including 5K average annual new high-tech jobs

**CURRENT HIGH-TECH WORKFORCE**
161K existing high-tech workers who may seek reskilling or upskilling opportunities

**NON-HIGH-TECH WORKERS IN TECH INDUSTRIES**
114K current non-high-tech workers who may benefit from digital literacy to enhance work outcomes

**TECH INDUSTRY EMPLOYERS**
Over 10K payroll firms, spanning small- and medium- enterprises, with significant high-tech and non-high-tech talent needs, currently employing 69K current high-tech workers

**NON-TECH INDUSTRY EMPLOYERS**
Organizations in industries not traditionally considered “tech,” spanning small and medium-enterprises and nonprofits and currently employing 81K high-tech workers

**PUBLIC SECTOR EMPLOYERS**
Public entities spanning local, state, and federal government, currently employing 11K high-tech workers

**TRADITIONAL SCHOOLS**
Degree and certificate programs including the 49+ universities, colleges, and community colleges offering computer science degrees and certifications

**PATHWAY PROGRAMS**
Preparatory courses focused on underrepresented populations that help participants develop skills and qualifications to enter advanced training or employment opportunities

**ACCELERATED LEARNING PROGRAMS**
Programs focused on layering new high-tech skillsets over existing skills

**GOVERNMENT**
Public entities providing critical educational and resource support at scale to address systemic barriers to high-tech skills opportunities

**FUNDERS**
Various philanthropic and private resources for high-tech skills development, much of which originates from the tech industry, which contributed $9B nationally to philanthropy in 2017

**COMMUNITY-BASED ORGANIZATIONS**
Over 120 organizations providing critical bridge and wraparound workforce support services for underrepresented and underserved populations citywide

NYC’s Tech Opportunity Gap | 39
Despite significant activity and creativity in the high-tech workforce ecosystem, there is a lack of market data on the scale and content of training programs in New York City today.

In the past few years, New York City has been established as a leader in training programs for high-tech skills. The diverse ecosystem of training providers, employers, supporters and partners that has emerged to train and connect New Yorkers with high-tech employment opportunities has grown, spanning a range of high-tech disciplines. While there are some efforts underway to map the ecosystem of offerings, including a forthcoming study by the Center for an Urban Future and the City’s Tech Talent Pipeline initiative, there is no continual process or reporting mechanism tracking the full ecosystem. Other industries with accredited training, such as medicine, have reporting requirements that provide simple tracking mechanisms for the scale and content of training and apprenticeship programs. While high-tech accelerated training programs are regulated by the New York Certification Board, data on these programs is not reported as it is for other forms of educational training.

This lack of information creates confusion for stakeholders across the ecosystem. For example, current and future workers do not know where to go for information about potential careers or training opportunities; employers may not know how to reach non-traditional jobseekers; training providers must focus on niche populations or work directly in partnership with employers to understand skills needs; and CBOs and training providers don’t have an easy way to make referrals or partner with likeminded organizations.

### ECOSYSTEM DATA NOT WIDELY TRACKED

<table>
<thead>
<tr>
<th>Scale</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total participants per year in tech training programs</td>
<td>Employer high-tech skills needs (technical and soft skills)</td>
</tr>
<tr>
<td>Total placements in internship and apprenticeship programs</td>
<td>Training provider curriculum content</td>
</tr>
<tr>
<td>Total talent need from employers</td>
<td>Training provider requirements</td>
</tr>
<tr>
<td>Existing partnerships</td>
<td>Internship and apprenticeship</td>
</tr>
<tr>
<td></td>
<td>Existing training/hiring partnerships</td>
</tr>
</tbody>
</table>

Training providers and employers identified best practices that they would like to implement if appropriate resources were in place.

Providers interviewed strongly agreed that facilitating partnerships and information sharing between ecosystem actors should be a focus of new ecosystem training investment.
Inconsistent tracking of outcomes data limits understanding of what strategies work best.

Inconsistent tracking of outcomes and a lack of data sharing limit opportunities for continuous improvement and collaboration. While most nonprofit training providers report outcomes metrics to funders, there is variation in what data is collected, and the data is typically not shared publicly. There is no system to solicit outcomes data from employers, who often run training and recruitment programs independently. One promising development is that some private bootcamps have adopted common outcomes metrics, a potential template for a broader system. For the ecosystem at large, sharing training outcomes is critical to understanding the ROI of various approaches; ensuring continuous improvement and elevation of best practices; and facilitating partnerships among organizations.

Barriers to tracking exist: in addition to the lack of a universal standard of metrics or common database, many metrics require surveys or interview of participants and are therefore time-consuming to maintain; others require ongoing coordination between employers and providers, such as employer satisfaction. Providers also report being constrained by a lack of systems and tools to collect and report information. These barriers must also be balanced with a need to ensure that metrics remain fair to each of the historically underserved populations that training programs may serve, requiring best practices that recognize unique needs. Addressing these challenges is important to making actionable data available.

Based on outreach, success metrics typically fit into two key areas:

- **Individual Program Outcomes**: The efficacy of high-tech training programs, evaluated in terms of participant success post-completion, and provider outcomes, including effectiveness and reach.
- **Ecosystem Outcomes**: The aggregated impact of high-tech workforce initiatives across New York City, evaluated in terms of overall labor market trends.

Source: Stakeholder interviews and surveys.
### Lack of shared outcomes data limits evaluation of *program effectiveness for participants.*

#### INDIVIDUAL PROGRAM OUTCOMES

Across the ecosystem, participant outcomes are collected and reported inconsistently, while provider outcomes are not widely reported. The common metrics summarized at right—drawn from existing common reporting systems that do exist and ecosystem interviews—focus on outcomes for individual training, both immediately after training and over their careers.

#### OUTCOMES

<table>
<thead>
<tr>
<th>PARTICIPANTS</th>
<th>METRICS</th>
<th>CURRENT ECOSYSTEM MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Job Placement</strong></td>
<td>Rate of program completion</td>
<td>Widely tracked, inconsistently reported</td>
</tr>
<tr>
<td></td>
<td>Job placement rate</td>
<td>Inconsistently tracked and reported; some gaps</td>
</tr>
<tr>
<td></td>
<td>Job placement in role trained for</td>
<td>Inconsistently tracked and reported; some gaps</td>
</tr>
<tr>
<td></td>
<td>Length of time until hiring</td>
<td>Gaps in tracking and reporting</td>
</tr>
<tr>
<td></td>
<td>Rate of unemployment after 12 months</td>
<td>Gaps in tracking and reporting</td>
</tr>
<tr>
<td><strong>Wage Growth</strong></td>
<td>Median annual base salary</td>
<td>Inconsistently tracked and reported</td>
</tr>
<tr>
<td></td>
<td>Increase in overall wage</td>
<td>Inconsistently tracked and reported</td>
</tr>
<tr>
<td></td>
<td>Benefits package</td>
<td>Inconsistently tracked and reported</td>
</tr>
<tr>
<td><strong>Job Stability &amp; Mobility</strong></td>
<td>Rate of job retention</td>
<td>Inconsistently tracked and reported</td>
</tr>
<tr>
<td></td>
<td>Rate of promotions</td>
<td>Gaps in tracking and reporting</td>
</tr>
</tbody>
</table>

#### PROVIDERS

| **Program Effectiveness** | Participant & employer satisfaction | Inconsistently tracked and reported |
| | Pass rates/scores on competency exams | Inconsistently tracked and reported |
| | Diversity of program participants | Widely tracked, inconsistently reported |
| | Participant retention | Widely tracked, inconsistently reported |
At the ecosystem level, this lack of data constrains the ability to refine offerings or align behaviors with best practices.

### ECOSYSTEM OUTCOMES

**Ecosystem impacts are not widely shared among actors.** While some outcomes can be evaluated using labor market data, as this report has done, this data is not widely reported for evaluation across the ecosystem. Training providers such as the Queens Library have indicated the lack of quality labor data as a challenge to designing effective programs. Other outcomes such as hiring behaviors are also a black box unless reported by employers.

<table>
<thead>
<tr>
<th>OUTCOMES</th>
<th>METRICS</th>
<th>CURRENT ECOSYSTEM MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ECOSYSTEM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workforce Diversity</td>
<td>% of jobs held by gender, race/ethnicity</td>
<td>Publicly available data, not widely reported in ecosystem context</td>
</tr>
<tr>
<td></td>
<td>% of jobs held by educational attainment level</td>
<td>Gaps in tracking and reporting</td>
</tr>
<tr>
<td></td>
<td>% of jobs held by nationality, immigration status, veteran status</td>
<td></td>
</tr>
<tr>
<td>Ease of Hiring</td>
<td>Duration of job postings per role</td>
<td>Publicly available data, not widely reported in ecosystem context</td>
</tr>
<tr>
<td></td>
<td>Openings vs. new hires</td>
<td>Widely tracked but not reported</td>
</tr>
<tr>
<td></td>
<td>Cost per recruit</td>
<td></td>
</tr>
<tr>
<td>Employer Hiring Behavior</td>
<td>% of jobs by occupation requiring a bachelor's</td>
<td>Gaps in tracking and reporting</td>
</tr>
<tr>
<td></td>
<td>Number of internships and apprenticeships by occupation</td>
<td>Widely tracked but not reported</td>
</tr>
<tr>
<td></td>
<td>Employer perceptions of “newly skilled” labor supply</td>
<td>Gaps in tracking and reporting</td>
</tr>
</tbody>
</table>
**Case Study: Amplifying Outcomes through Enhanced Ecosystem Collaboration**

**Per Scholas**

*Close collaboration and information-sharing has been critical to Per Scholas’ success creating inclusive pathways for underrepresented populations.*

**Overview:** Founded in the South Bronx in 1995, Per Scholas is a nonprofit that provides tuition-free technology training to unemployed or underemployed adults for careers as IT professionals.

**Approach to Collaboration:** Per Scholas leverages significant collaboration with other ecosystem actors in each of the cities where it operates to amplify its outcomes, including in New York City. The organization collaborates with employers to design industry- and job-specific courses that are responsive to real-world talent needs. To ensure that program participants are prepared to succeed in its programs, Per Scholas engages with a network of partners to provide services including financial coaching, childcare services, unemployment insurance, and other benefits. Per Scholas also works with bridge programs to ensure that program participants have the foundational learning to benefit from high-tech learning opportunities, including collaborations with community-based organizations such as The Door to raise reading and math performance to levels needed to succeed in IT support classes.
Recommendations
# Opportunities to Enhance New York City’s High-Tech Ecosystem

A **diverse high-tech talent pool served by integrated, lifelong learning opportunities** is critical to ensuring New York City’s workforce is more competitive and equitable.

**Civic Hall will work in partnership with ecosystem actors to close the high-tech opportunity gap.**

<table>
<thead>
<tr>
<th>Standardize tools</th>
<th>Create infrastructure for continuous learning and reskilling that meets the demands of rapid technological change.</th>
<th>Create more inclusive on-ramps to high-tech careers by focusing on all levels of the career ladder.</th>
</tr>
</thead>
</table>
Recommendation #1

Standardize tools to support data collection, transparency, and improvements to high-tech training.

- Establish a voluntary database to track all high-tech training efforts citywide. The first step to improving New York City’s high-tech workforce ecosystem is to understand and aggregate information on the scale, reach, and focus of programs in place today. Such a database would allow the ecosystem to identify gaps in training. It would also serve as a one-stop shop for New Yorkers in search of a job.

- Develop a common platform and metrics for tracking outcomes. This platform would standardize data collected on training and hiring practices, streamline reporting, improve data quality, and increase awareness of program effectiveness. It could also reduce costs for resource-constrained providers. To ensure that learners of diverse backgrounds are served and that success metrics remain fair for all, best practices for metrics tracking should be developed that remain sensitive to the needs of individual populations.

- Create a virtual system to aggregate tools, resources, and lessons for training providers and employers. Assembling collective lessons learned would improve the quality of training programs and employer hiring/recruitment practices, reduce program development costs, increase collaboration and information sharing among partners, and help take best practices to scale.

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**PLATFORM @ CIVIC HALL**

**Goal:** Promote transparency, accessibility, and data sharing of key ecosystem information.

**Activities:** Civic Hall could create “The Civic Hall Platform,” a centralized online and open source database to collect, measure, and analyze metrics.

**Ecosystem Actors Served:**

Current and Future Workers would be able to access information about career pathways and training opportunities to understand what next steps they should take to connect with employment opportunities.

Employers would be able to readily access information on training providers focused on skills and populations relevant to their organizational needs.

Training Providers would be able to evaluate their offerings relative to their peers and the needs of employers, integrating best practices and learnings from outcomes to improve curriculum.

Funders & Supporters would be able to connect with training providers and other supporters to better allocate resources.
Recommendation #2
Create infrastructure for continuous learning and reskilling that meets the demands of rapid technological change.

- **Increase access to continuous learning to maintain a competitive talent pool for high-tech jobs.** Highly technical talent is critical to New York City’s competitiveness, and to creating teams that can, in turn, hire more entry-level high-tech talent. Increasing the availability of continuous learning programs for recent college graduates and mid-career professionals can better align emerging skills needs with highly skilled New York talent. For example, providers such as CUNY and COOP are collaborating with major employers to develop training that builds upon traditional degrees and are directly responsive to the needs of emerging technologies.

- **Expand high-tech literacy training for non-tech workers.** As high-tech skills become core to a broad set of formerly non-technical jobs, literacy in basic high-tech skills such as data analysis and light coding improves opportunities for career advancement and eases adaptation to new technologies. Workers armed with high-tech skills may also identify ways to improve productivity and coordinate with in-house workers who want to learn new skills. To facilitate this opportunity, employers can provide their staff with training credits to complete targeted courses, similar to models established by General Assembly.

- **Consider skills compatibility when targeting reskilling to non-tech workers.** Automation and other technological changes will make certain jobs obsolete in the coming decade. Some of the skills required for at-risk jobs (such as tax and insurance professionals) have applicability to high-tech roles, and by screening these employees for potential high-tech training, employers can help limit disruption and provide new long-term career opportunities. Facilitating partnerships between firms with a high concentration of at-risk jobs and training providers can test new models for reskilling, as can partnering with the producers of technology driving economy-wide changes in skills needs.

### LEARNING HUB @ CIVIC HALL

**Goal:** Provide the infrastructure to support continuous learning at all stages of the career pathway.

**Activities:** Civic Hall’s 15 classrooms could serve a range of continuous learning needs and could serve as a home base for high-tech training providers and employers.

**Ecosystem Actors Served:**

- Current and Future Workers would be able to access training opportunities at all stages of their careers, both to advance in existing careers and to learn new skills to change careers.
- Employers would be able to provide upskilling and reskilling opportunities for existing employees.
- Training Providers would be able to expand upon existing programs, working closely with employers.
Recommendation #3
Create more inclusive on-ramps to high-tech careers by focusing on all rungs of the career ladder.

- **Enhance physical and virtual networks for high-tech talent from underrepresented groups.** Social capital and the lack of existing professional relationships remain major barriers to improving the gender and racial diversity of the high-tech workforce. Investing in existing and new networks for underrepresented talent can help improve access to mentors and employers, provide support for job searches and career advancement, and develop a visible critical mass of high-tech talent from all backgrounds.

- **Invest in internship and apprenticeship models that provide long-term training and evaluation for candidates not emerging from four-year programs.** Employers and labor data suggest an overreliance on four-year degrees in hiring. Extended trainings programs provide opportunities for jobseekers without traditional backgrounds to demonstrate skills and give employers a low-risk way to assess “non-traditional” candidates. Employers report that graduates of such pipeline programs have lower turnover rates than “traditionally trained” talent.

- **Enhance training pathways into industries not traditionally thought of as “tech.”** Firms in non-tech industries typically have a harder time attracting high-tech talent and are more willing to consider talent not emerging from four-year programs. These industries, including government, healthcare, and professional services, make up more than half of high-tech jobs and pay comparably high wages. Partnerships between these employers and training providers, especially those targeting under-represented populations, could establish accessible on-ramps at scale.

- **Increase training for high-growth jobs with lower barriers to entry.** High-tech jobs including data analysts and network specialists are typically more accessible to candidates without four-year degrees, particularly those emerging from specialized training programs such as bootcamps. Creating enhanced awareness of training opportunities for entry level roles in these occupations can serve as the foundation for high-tech careers with opportunities for advancement.

**COMMUNITY @ CIVIC HALL**

**Goal:** Promote new ecosystem connections to create more accessible entry points for all New Yorkers to high-tech employment opportunities.

**Activities:** Civic Hall could create an inclusive front door to tech opportunities that connects tech learners, community organizations, and employers through events, workshops, and mentorship.

**Ecosystem Actors Served:**

*Current and Future Workers* would be able to easily access information about career and training opportunities and access talent networks and mentors.

*Employers* would be able to engage directly with potential future workers and providers to promote less widely known career paths and collaborate on training.

*Training Providers* would be able to connect students more easily with talent networks and support services.
Methodology & Acknowledgements
This report focuses on jobs that require high-tech skills. HR&A developed a list of core high-tech occupations that builds upon the definition the firm developed for the 2014 New York City Tech Ecosystem Study in conjunction with industry experts, identifying a subset of occupations that require high-tech skills.

HR&A first conducted an analysis of labor market and economic data using this definition. HR&A and Civic Hall then subsequently convened thought leaders drawn from major employers and training provider organizations in the New York City high-tech skills ecosystem to review findings and provide additional qualitative insights into the ecosystem.

More than 90 employers and high-tech training providers contributed to the content of this report and Civic Hall’s planning process, providing critical insights that supported the report’s findings.
Thanks & Acknowledgments

Ali Marano, Global Head of Tech for Social Good, JPMorgan Chase
Andi Azzolina, Director of Shared Development Services, JetBlue
Andrew Cochran, Director, Planning Labs, Department of City Planning
Angie Kamath, Dean, City University of New York
Ashish Bawa, High-Tech Engineer Practice Head, Cognizant
Barbara Chang, Executive Vice President, Here to Here
Gaspar Caro, Partnership Director, Lower East Side Employment Network
Hagos Mehretab, Senior Vice President, Two Sigma
Hassan Adekoya, Chief Information Officer, Department of City Planning
Helen Kogan, New York Executive Director & Matt Velez, Director of Strategic Partnerships, NPW
Joey Ortiz, Executive Director, New York City Employment and Training Coalition (NYCETC)
John Paul Farmer, Chief Technology Officer, City of New York
Jon Spooner, Co-Founder, Stacks + Joules
Jonathan Bowles, Executive Director, Center for an Urban Future
Julie Samuels, Executive Director, TechNYC
Kalani Leifer, Executive Director, COOP
Kate Beck Sutler, Director of Workforce, Brooklyn Navy Yard Development Corporation
Kevin Josephs, High-Tech Literacy Lead Instructor, Queens Public Library
Laudine Vallarta, Global Head of Talent Acquisition, Etsy
Lauren Anderson, Director of Strategy, Tech Talent Pipeline (TTP)
Michele McInnes, Senior Advisor, Department of City Planning
Priya Ramanthan, Senior Director, National Expansion, Per Scholas
Stacy Woodruff, Managing Director Workforce Field Building Hub, Workforce Professionals Training Institute (WPTI)
Stephanie Ginos, Director of Client Technology Platform Operations & John Russo, Diversity and Inclusion, EY
Susan Scheer, Executive Director, Institute for Career Development
Tom Ogletree, Director of Social Impact, General Assembly
Tech Ecosystem Industries & Occupations

High-Tech Occupations:
- Computer and Information Systems Managers
- Computer and Information Research Scientists
- Computer Systems Analysts
- Information Security Analysts
- Computer Programmers
- Software Developers, Applications
- Software Developers, Systems Software
- Web Developers
- Database Administrators
- Network and Computer Systems Administrators
- Computer Network Architects
- Computer User Support Specialists
- Computer Network Support Specialists
- Computer Occupations, All Other
- Computer Hardware Engineers
- Industrial Engineering Technicians
- Multimedia Artists and Animators
- Audio and Video Equipment Technicians
- Broadcast Technicians
- Sound Engineering Technicians
- Film and Video Editors
- Clinical Laboratory Technologists and Technicians
- Cardiovascular Technologists and Technicians
- Diagnostic Medical Sonographers
- Nuclear Medicine Technologists
- Radiologic Technologists
- Magnetic Resonance Imaging Technologists
- Surgical Technologists
- Advertising Sales Agents
- Computer, Automated Teller, and Office Machine Repairers
- Telecommunications Equipment Installers and Repairers, Except Line Installers
- Avionics Technicians
- Electrical and Electronics Installers and Repairers, Transportation Equipment
- Electrical and Electronics Repairers, Commercial and Industrial Equipment
- Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
- Electronic Equipment Installers and Repairers, Motor Vehicles
- Electronic Home Entertainment Equipment Installers

All Other Tech Occupations:
- Aerospace Engineers
- Biomedical Engineers
- Chemical Engineers
- Industrial Engineers
- Sales Engineers
- Electrical and Electronics Drafters
- Aerospace Engineering and Operations Technicians
- Electrical and Electronics Engineering Technicians
- Electro-Mechanical Technicians
- Operations Research Analysts
- Statisticians
- Cartographers and Photogrammetrists
- Electrical Engineers
- Electronics Engineers, Except Computer

Tech Industries:
- Computer and Peripheral Equipment Manufacturing
- Communications Equipment Manufacturing
- Semiconductor and Other Electronic Component Manufacturing
- Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
- Aerospace Product and Parts Manufacturing
- Electronic Shopping and Mail-Order Houses
- Software Publishers
- Wired and Wireless Telecommunications Carriers
- Satellite Communications
- Other Telecommunications
- Data Processing, Hosting, and Related Services
- Other Information Services
- Computer Systems Design and Related Services
- Scientific Research and Development Services

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