BUILDING A MORE INCLUSIVE TECH WORKFORCE

FINAL REPORT FOR NYCEDC WORKFORCE DEVELOPMENT PLANNING, 21ST CENTURY JOBS STUDY

JANUARY 2020

NYC/EDC HR&A LaGuardia Community College JFF

DRAFT FOR DISCUSSION

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ABOUT THE TEAM

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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.

Jobs for the Future (JFF) has experience working at the state, regional and national levels at the intersection of education, workforce development, technology, government, and philanthropy. JFF focuses its work on three critical areas: ensuring equity in advancement, meeting employer needs, and preparing for the future of work. Over its 35-year history, JFF has informed the strategies, policies, and activities of groups that reach over 100 million people in 42 states, including 200 school districts, 500 workforce boards, 1,200 community colleges, and leading employers across a range of industries, including the technology sector.

LaGuardia Community College brings nearly 50 years of experience delivering innovative, evidence-based, and nationally recognized workforce development programs to thousands of unemployed, underemployed, and low-income NYC residents at scale and with demonstrated employment success for graduates. Founded in 1971 in Long Island City, Queens as an open admission, cooperative education institution and part of the City University of New York, LaGuardia is a gateway to college for thousands of students – immigrant, underrepresented, low-income, first-generation college – who might not otherwise have access to higher education. Its mission – to educate and graduate one of the most diverse student populations in the country to become critical thinkers and socially responsible citizens who help to shape a rapidly evolving society – reflects its commitment to learning, diversity, innovation, and opportunity. With close to 3,500 students enrolled in tech-related courses each year, LaGuardia is one of NYC's largest providers of affordable and high-quality technology education.

COVID-19 IMPACTS

While this study was completed in January 2020, prior to the outbreak of COVID-19, the findings detailed in this report are as relevant as ever. COVID-19 has highlighted the deep-rooted racial disparities and inequities in this country, affecting Black and Latinx populations disproportionately higher across cities, including New York City. Recent Black Lives Matter protests following the deaths of George Floyd, Ahmaud Arbery, Breonna Taylor and others further reflect the dire need to confront systemic racism and injustice.

The COVID-19 pandemic has also accelerated the adoption of digital and remote work, and as a result demonstrated how crucial and urgent it is for today's workforce to have tech skills and digital literacy. As New Yorkers increasingly seek opportunities within the City's tech ecosystem, it is imperative that we collectively build an inclusive tech workforce that removes barriers, expands access to skills training, and provides opportunities to meaningful pathways for historically underrepresented populations.

September 2020

INTRODUCTION

BUILDING A MORE INCLUSIVE TECH WORKFORCE

Over the past decade, New York City has become a leading global tech hub. The New York City tech ecosystem* is now the second largest in the country, second only to Silicon Valley, and is a major engine of regional economic growth. Tech ecosystem employment, which as of 2018 totals 355,000 jobs, represents 7% of the city's jobs and accounts for 13% of the city's employment growth since 2008. The tech ecosystem is integral to New York City's other core industries, including finance, media, advertising, and healthcare. Nearly half (46%) of all tech jobs are found in non-tech industries. The world's largest tech companies have taken note, as Google, Facebook, Netflix, and Amazon announced plans just this year to occupy more than 4.5 million square feet of commercial space in Manhattan and Brooklyn (equivalent to two Empire State Buildings), complementing a dynamic startup scene that continues to expand across the five boroughs.

Despite this dynamism, New York City's tech ecosystem workforce is not representative of our city's diversity. Black and Latinx New Yorkers and women are severely underrepresented among the tech workforce. Disparities are starkest within tech occupations, particularly for tech jobs within tech industries, where only 17% of workers are Black or Latinx and only 23% are women – compared to 37% and 50% across the city's overall workforce respectively. An increasing share of tech ecosystem jobs are available only to candidates with a four-year degree, despite evidence that degrees are not required to fill many tech roles. This lack of inclusion represents a stark opportunity gap – whereas the surging tech economy has the potential to provide economic opportunity and mobility for thousands of New Yorkers from all backgrounds, it is not currently living up to that potential.

**New York City's tech ecosystem is defined on page 9 of this report.*

As tech plays an increasingly central role in economic, social, and civic life, there is an urgent and critical need for greater representation in tech. The participation of historically underrepresented groups in the creation and management of technology is critical to ensuring that technology is developed justly by reflecting the lives that it will impact, and New York City – as a global tech hub and a global symbol of diversity and inclusion – has a responsibility to lead the creation of an inclusive tech ecosystem. Finally, the perception that tech companies are elite and benefit only the few has begun to incite a backlash that can impact the viability of tech products and pose a risk to economic growth.

This report examines the scale and causes of underrepresentation in tech, identifies promising job pathways, and seeks to elevate strategies to create a more inclusive tech workforce. This report is part of a broader effort by the New York City Economic Development Corporation (NYCEDC) to study Workforce Development Planning for 21st Century Jobs and builds on the past and current efforts of both NYCEDC and the NYC Tech Talent Pipeline, which collaborates with employers and training providers to provide equitable tech career pathways for New Yorkers. This report operates from the premise that, despite significant efforts by the City, employers, and training providers, too many New Yorkers still face challenges accessing quality job opportunities in the tech ecosystem due to systemic barriers and practices, and that significant action is needed to match the scale of this challenge. It recommends strategies to improve collaboration to capture the tech ecosystem's full potential and connect underrepresented New Yorkers with 21st-century jobs.

APPROACH: QUANTITATIVE & QUALITATIVE ANALYSIS

This report seeks to understand the misalignment between the diversity of New York City's population and of the tech workforce through quantitative and qualitative research. Specifically, research undertaken by HR&A Advisors, LaGuardia Community College (LAGCC), and Jobs for the Future (JFF) included the following:

- **An analysis of labor market data:** HR&A and JFF assessed the New York City tech ecosystem, including total employment and employment by industry and occupation, wage and educational attainment trends, job requirements including minimum skills and experience, and demographic trends. Primary sources for this analysis were Economic Modeling Systems, Inc. (EMSI) and Burning Glass, which aggregate federal employment data and proprietary job listings. *Industry and occupation codes can be found in the Technical Appendix.**
- **Interviews with tech ecosystem employers:** JFF, HR&A, and LAGCC spoke with 12 employers of tech talent in New York City, including small, mid-sized, and large employers in tech and non-tech industries *(listed in the technical appendix)*. These interviews sought to ground-truth labor market findings, explore employer attitudes toward talent recruitment and diversity, and source successful models and challenges for greater diversity.

**Throughout this report, we use three measures of educational attainment: 1) "Average Educational Attainment" represents the educational level most often needed to enter an occupation at a national level. This is reported by EMSI based on data from the U.S. Bureau of Labor Statistics; 2) "Job Postings Requirements" refers to educational requirements listed in job postings collected by Burning Glass; 3) "Job Holders With a Bachelor's" refers to actual employed workers with an educational attainment of a bachelor's or higher, reported by the U.S. Bureau of Labor Statistics for specific occupations at a national level.*

- **A survey of students and alumni of tech training programs:** LAGCC of the City University of New York surveyed current students and alumni from its numerous tech degree and non-degree programs to understand students' motivations for pursuing training, their career outcomes, challenges and successes they experienced, and suggestions for improved access to tech jobs. The survey collected responses from 76 current students and 50 alumni.

Underrepresented Populations in Tech

Creating an inclusive tech workforce has been a goal of the City of New York for numerous years, reflected in strategies to develop targeted training and recruitment programs and partner with local colleges and employers. The City's efforts have focused on a range of historically underrepresented groups, including Black and Latinx New Yorkers, women, low-income individuals, public assistance recipients, under-employed young people, individuals with disabilities, individuals identifying as LGBTQ, veterans, NYCHA residents, homeless individuals, and formerly incarcerated individuals. This report focuses on the challenges of racial and gender diversity in the tech workforce for two reasons: 1) the availability of robust data on worker demographics and a lack of data tying workforce characteristics to other populations of interest; and 2) the high degree of intersection between historic inequalities for racial minorities and women and the marginalization of other vulnerable populations.

KEY FINDINGS

1 New York City's tech ecosystem has grown across an increasingly broad mix of industries and occupations, creating the potential for expanded economic opportunity.

2 Despite this potential, the tech ecosystem remains highly unrepresentative of NYC's diverse population. This requires a reexamination of common hiring practices and new approaches to creating inclusive career pathways.

New York City's tech ecosystem has grown across an increasingly broad mix of industries and occupations, creating the potential for expanded economic opportunity.

- Accelerated growth in the tech ecosystem is increasing economic opportunities around both tech jobs across industries and non-tech jobs in tech industries.
- Strong wages across the tech ecosystem continue to present higher earning opportunities than in the New York City economy overall for individuals with varying levels of educational attainment.
- Opportunity areas for creating more inclusive tech ecosystem employment span high-tech and non-tech jobs, including Data Analyst and Network Specialist roles as well as Sales, Marketing, Human Resources, and Content positions.

ABOUT NEW YORK CITY'S TECH ECOSYSTEM

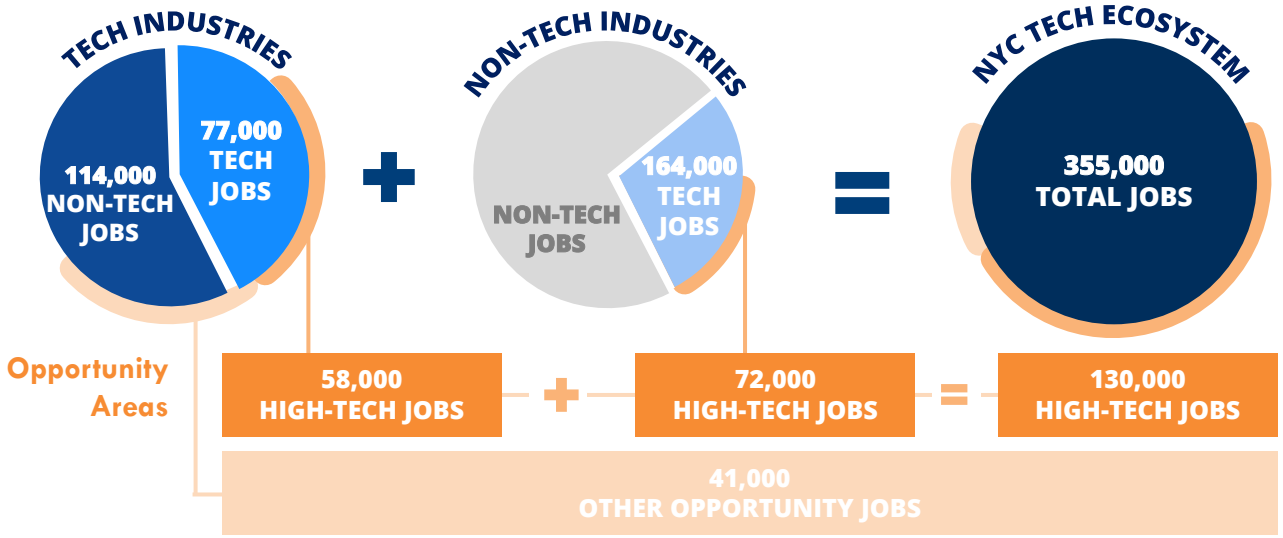
An economic "ecosystem" is a network of organizations that enables the provision of goods or services. **New York City's tech ecosystem jobs are distributed throughout tech and non-tech industries and occupations**, incorporating a broad range of jobs that rely on tech and require tech talent. Tech ecosystem jobs fall into three broad categories:

1) **Tech Occupations in Tech Industries**—for example, a software engineer at Google
2) **Non-Tech Occupations in Tech Industries**—for example, a human resources manager at Facebook
3) **Tech Occupations in Non-Tech Industries**—for example, a network security specialist at JPMorgan Chase or any number of finance, healthcare, professional services, government, and other firms

In 2018, the New York City's tech ecosystem consisted of 355,000 jobs. Across tech industries, there were 77,000 tech workers and 114,000 non-tech workers within tech industries.[1] The non-tech industry held 164,000 additional tech jobs. Together, these 355,000 jobs represent 7% of New York City's total workforce.

In addition, this report periodically focuses on two job sub-categories that have emerged as opportunity areas for economic mobility based on their growth and accessibility: **high-tech jobs** and **other opportunity jobs**.

NEW YORK CITY'S TECH ECOYSTEM IN 2018*



Opportunity high-tech jobs *directly* create or manage digital products, systems, and services. These jobs are at the forefront of tech innovation and typically require highly technical skills, including knowledge of coding languages and network architecture, as well as a bachelor's degree. In 2018, New York City was home to 130,000 opportunity high-tech jobs, comprising nearly half of the City's tech ecosystem. Opportunity high-tech jobs span several sub-categories, including Developers, Data & Systems Analysts, and Network Specialists.

Other Opportunity jobs are primarily non-tech jobs within the tech industry that are core to business operations and provide strong opportunities for career mobility opportunities. These 18 fast-growing occupations span several sub-categories – Sales and Customer Service, Marketing, Human Resources, and Creative Content – and as of 2018 represent 41,000 total jobs.[2]

**Image not to scale*

[1] *A full list of industries is included in the appendix; Source: HR&A analysis of EMSI data*

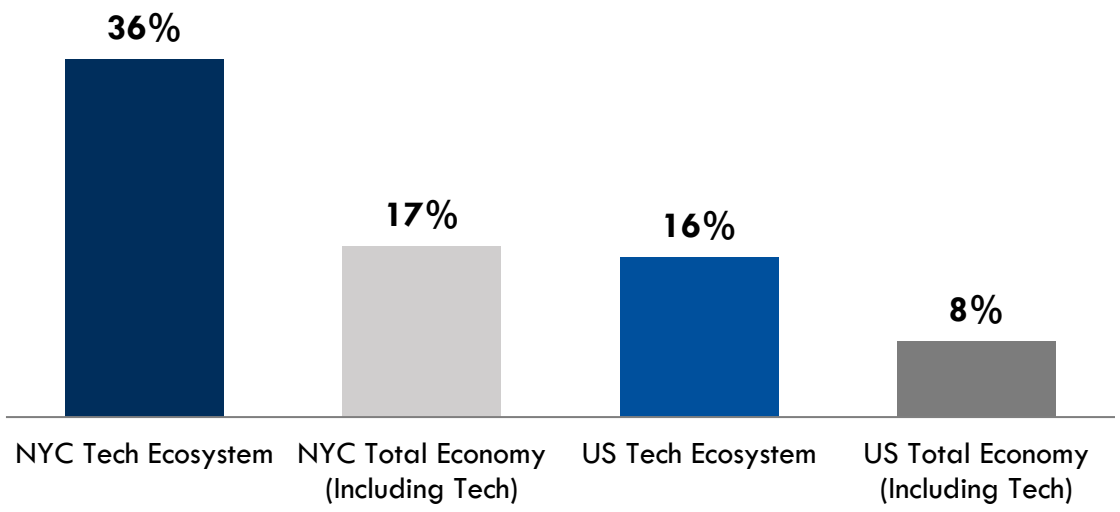
[2] *Two tech occupations – Advertising Sales Agents and Multimedia Artists & Animators – stood out as opportunity areas and were included in the Sales and Creative Content categories.*

New York City's tech ecosystem is thriving, employing 355K New Yorkers, generating 94K jobs over the last decade, and driving steadily increasing wages.

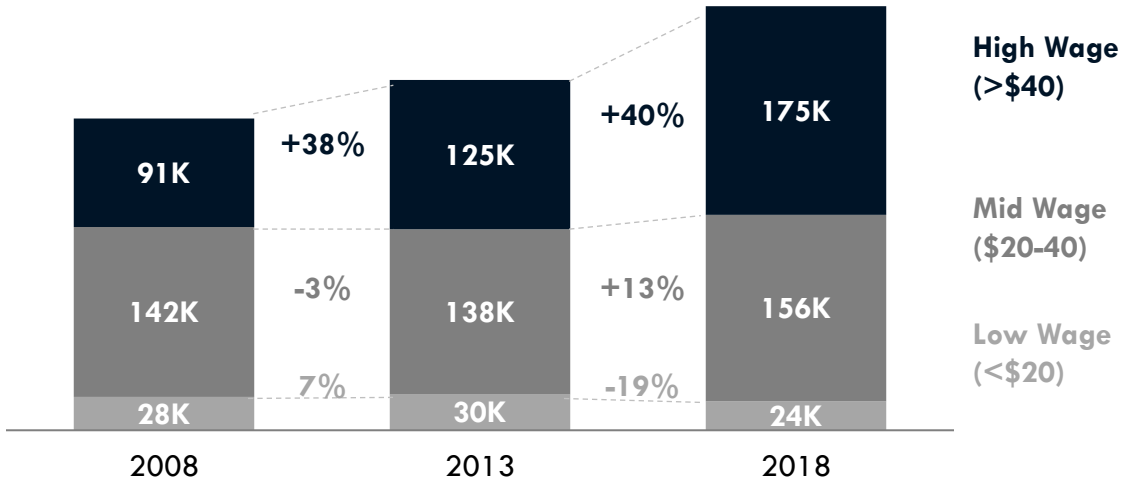
New York City continues to be a thriving home for tech, providing **355,000** jobs as of 2018. These jobs represent a 36% increase from 2008, or an addition of **94,000** jobs in one decade. This growth rate is **2X faster** than the NYC overall economy, **2X** faster than the U.S. tech ecosystem overall, and **4.5X faster** than the overall U.S. economy. Tech has become a central component of the city's increasingly diverse and resilient economy – following the recession, the tech ecosystem recovered more quickly than the economy overall.

High wage jobs across the tech ecosystem have grown significantly. Nearly half of ecosystem jobs today, and nearly 90% of ecosystem jobs created since 2008, pay a high wage of $40+/hour. Meanwhile, total jobs paying less than $20/hour have declined since 2008. Wage data by occupation suggests that these jobs were not lost but instead now pay higher wages. The growth of high wage jobs and decline of low wage jobs also applies to jobs that typically do not require a bachelor's degree.

TECH JOB GROWTH 2008-2018



TECH ECOSYSTEM JOBS BY MEDIAN HOURLY WAGE (2008 – 2018)



Source: HR&A analysis of EMSI data

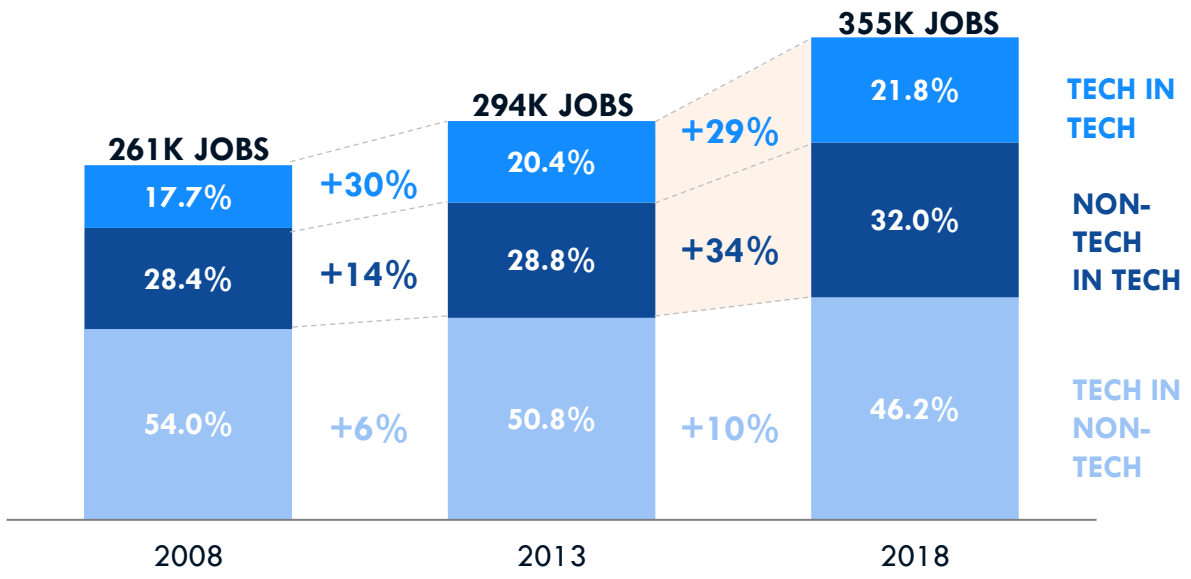
Employment opportunities are growing across all job categories, especially in tech and non-tech jobs within tech industries.

Growth within the tech ecosystem over the last 10 years has been driven primarily by tech sectors. Between 2008-2018, New York City's tech and non-tech occupations within tech industries grew by 5.4% and 4.3% year over year, respectively. By comparison, tech occupations within non-tech industries grew at an average rate of 1.5% during the same period, on par with overall New York City employment. While tech jobs have historically been spread across numerous industries, they are increasingly concentrated within tech industries, which now support a majority of tech jobs – 54% in 2018 compared with 46% in 2008.

As homegrown startups mature and global firms continue to expand in NYC, non-tech jobs at tech companies have grown at an even faster pace than tech jobs over the last five years. Non-tech in tech jobs grew by 34% since 2013, adding 39,500 jobs. This recent growth in non-tech jobs points to the strength of NYC's existing talent base and the maturity of tech firms growing in the city. Because NYC is a global hub for marketing and creative talent, and a major market for tech products and services, global tech firms have grown their sales, marketing, and content footprints in NYC. Additionally, many homegrown tech firms are "second-generation" startups; because their founders have gone through prior growth cycles, they understand the importance of sales, HR, and marketing teams to a company's ability to succeed and scale.

"Tech industry sub-sectors have focused on NYC industries — fintech grew out of the financial industries, adtech grew out of advertising, healthtech grew out of health care."
– NYC-based software company

TECH ECOSYSTEM DISTRIBUTION & GROWTH



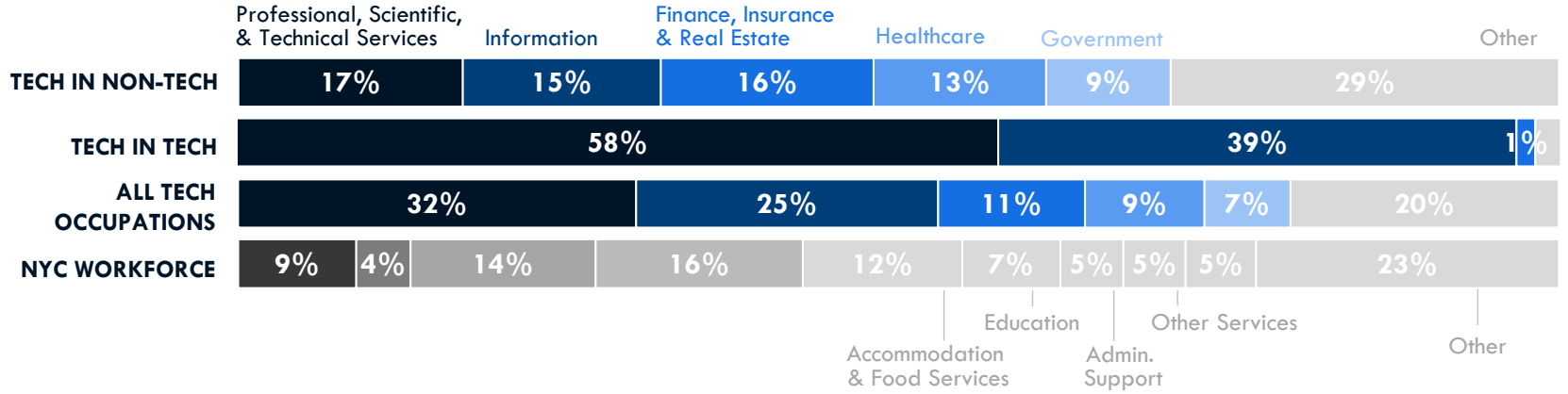
Source: HR&A analysis of EMSI data; Interviews of employers of tech talent

Tech jobs span a wide range of industries core to New York City's economy, providing diverse employment options and work environments outside of traditional tech firms.

A large array of tech opportunities exist outside of traditional tech firms. Unlike tech in tech jobs that are primarily held in professional services and information industries, tech in non-tech jobs span a wide range of industries relatively evenly. Specifically, finance, healthcare, and government stand out as large drivers of tech jobs, representing 38% of tech in non-tech jobs.

Non-tech industries can be broken down further into industry sub-sectors. As of 2018, the non-tech sub-sectors with the highest concentration of tech jobs include advertising and public relations (professional services), hospitals (health care), film and media (information), and corporate management (professional services) – all sectors that are central to New York City's current and future economy. As technology continues to transform the way we work, demand for tech jobs will continue to grow across these key industry sectors.

SHARE OF JOBS BY INDUSTRY (2018)



Industry	Non-Tech Industry Sub-Sectors with Most Tech Employment	2018 Tech Jobs	2008-2018 % Growth	Share of NYC Tech Jobs
Prof. Services	Advertising, Public Relations, and Related Services	13,700	24%	5.7%
Healthcare	General Medical and Surgical Hospitals	13,700	3%	5.7%
Information	Motion Picture and Video Industries	9,500	45%	4.0%
Prof. Services	Management of Companies and Enterprises	9,600	34%	4.0%
Government	Local Government, Education and Hospitals	6,500	19%	2.7%
Information	Radio and Television Broadcasting	6,400	4%	2.7%
Prof. Services	Securities and Commodity Contracts Intermediation and Brokerage	6,100	(31%)	2.5%
Prof. Services	Management, Scientific, and Technical Consulting Services	5,900	79%	2.5%
Information	Newspaper, Periodical, Book, and Directory Publishers	5,800	(20%)	2.4%
Government	Local Government, Excluding Education and Hospitals	5,600	26%	2.3%

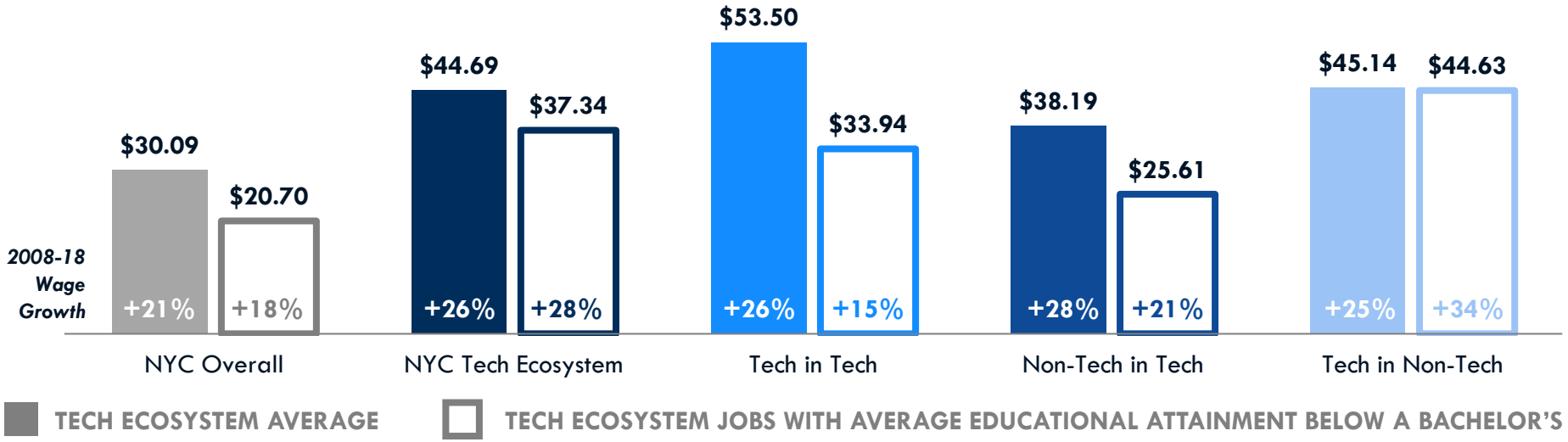
Source: HR&A analysis of EMSI data

Strong wages across the tech ecosystem continue to create higher earning opportunities than the economy overall for individuals of varying education levels.

Strong wages across New York City's tech ecosystem create the potential for tech to support economic mobility. Ecosystem workers earn a **median wage of $45/hour** – 50% more than the NYC median of $30. Across the ecosystem, the highest wages are concentrated in tech jobs (both in tech and non-tech industries), although non-tech jobs within tech industries still pay 25% more than the NYC median.

Notably, tech ecosystem jobs with average educational attainment below a bachelor's degree also pay well. When compared with other industries, workers without a bachelor's in tech earn approximately 80% more than in NYC overall. Tech jobs in non-tech sectors provide a particularly compelling opportunity: within those sectors (which include finance, healthcare, and government) pay is nearly even for workers with or without a bachelor's degree, and wages for workers without a bachelor's have grown at nearly double the citywide rate since 2008. The same trend has not carried over to tech jobs within tech industries, an indicator that the bachelor's degree may hold more weight within tech companies than in the economy overall – a topic discussed further in the next chapter.

MEDIAN HOURLY WAGE COMPARISON WITH AND WITHOUT A BACHELOR'S DEGREE (2018)



*Across all **opportunity high-tech jobs,** median hourly wages are $58.74 and $38.54 for those with and without a bachelor's degree, respectively, slightly higher than for tech in tech jobs.*

*For **other opportunity jobs,** median hourly wages are $35.45 and $28.29 for those with and without a bachelor's, comparable to overall non-tech jobs in tech.*

Source: HR&A analysis of EMSI data. Average educational attainment represents the education level most often needed to enter an occupation at a national level, as reported by EMSI from U.S. Bureau of Labor Statistics data.

Occupations offering the most promise for economic mobility in high-tech include developers, data analysts, and network specialists.

Across high-tech jobs, **Developers** – including professionals who design and code systems software, applications, and websites – represent the largest and fastest-growing occupation. It is also the role most often associated with the surge in NYC tech jobs, as global companies such as Google, Facebook, and Amazon, as well as local startups like Yext and Flatiron Health expand. Yet high-tech jobs span a broad range of occupations that each offer large and growing career opportunities, including **Data & Systems Analysts**, who build data infrastructure and glean data insights to support business decisions; and **Network Specialists**, who install, configure, and manage wired and cloud-based networks.[1]

While high-tech jobs generally require higher levels of education than tech ecosystem jobs overall, there are several promising entry points, even within occupational categories. Unlike software application developers, where 84% of job holders have bachelor's degrees, only 68% of web developers hold a bachelor's degree; both occupations have more than doubled in total jobs since 2008. Within the Network Specialist category, only 55% of Computer Network Support Specialists and Network & Computer Systems Administrators hold a bachelor's, while both occupations pay hourly wages higher than the NYC average. These occupations also have considerably higher career stability compared with other middle-skilled jobs.[2]

Overall, high-tech jobs offer high wages relative to educational experience and strong potential for career and earning growth – both important factors for economic mobility. The average Computer Systems Analyst and Database Administrator, for example, earns $50-54/hour, well above NYC's median wage. After several years of experience, these professionals become eligible for advancement to Computer and Information Systems Manager and a wage increase of 74% to $94/hour on average.

HIGHEST-OPPORTUNITY HIGH-TECH JOB CATEGORIES

DEVELOPERS	**58K** TOTAL JOBS 2018	**46%** JOB GROWTH 2008-2018	**$55.37** MEDIAN HOURLY WAGE	**79%** JOB HOLDERS W/ A BACHELOR'S
DATA & SYSTEMS ANALYSTS	**44K** TOTAL JOBS 2018	**34%** JOB GROWTH 2008-2018	**$68.43** MEDIAN HOURLY WAGE	**72%** JOB HOLDERS W/ A BACHELOR'S
NETWORK SPECIALISTS	**29K** TOTAL JOBS 2018	**36%** JOB GROWTH 2008-2018	**$50.68** MEDIAN HOURLY WAGE	**54%** JOB HOLDERS W/ A BACHELOR'S

Note: "Job Holders' With a B.A." refers to actual employed workers with an educational attainment of a bachelor's or higher, reported by the U.S. Bureau of Labor Statistics for specific occupations at a national level.

[1] *A detailed list of occupations and codes can be found in the appendix of this report.*
[2] *JFF, "When Can It Launch a Career?" report, 2019*
Source: HR&A analysis of EMSI and Burning Glass data. Total jobs may not add up due to rounding.

While high-tech occupations each require distinct technical skills, certain foundational hard and soft skills can prepare trainees for a range of roles.

While high-tech skills are continuously and quickly evolving, Python, Java, and SQL remain foundational programming languages for many high-tech jobs today. Although Developers and Data Analysts have different functions, these jobs have overlapping skills requirements: job postings for both listed all three languages as top hard skills needed, with Java and SQL among the top three sought-after skills. With ever-evolving technology, required skills will continue to match future needs, reinforcing the need to align training with workplace skills.

Many high-tech employers look for similar soft skills across job functions. Problem solving and communication skills, including teamwork and written communication, are critical for many high-tech jobs, as employers look for candidates who can not only complete a task but also articulate the methods and outcomes of a task.

> **"Writing ability and communication skills – even in tech roles – are really important. Individuals need to be detailed in describing the work they've done."**
> - Software company

REQUIRED HARD & SOFT SKILLS FOR HIGH-TECH JOBS

Developers

Hard Skills	Job Posting Frequency
Java	39%
JavaScript	30%
SQL	29%
Software Development	20%
Python	19%
Software Engineering	18%
Linux	13%
Microsoft C#	11%
C++	10%
Object-Oriented Analysis and Design	9%

Data & Systems Analysts

Hard Skills	Job Posting Frequency
SQL	34%
Python	19%
Java	18%
Oracle	15%
Extraction Transformation/Loading	11%
Project Management	10%
Database Administration	8%
Big Data	8%
Data Warehousing	8%
Apache Hadoop	8%

Network Specialists

Hard Skills	Job Posting Frequency
Information Security	22%
Linux	18%
Python	15%
System Administration	12%
Cisco	10%
Network Engineering	9%
Network Security	8%
Project Management	7%
Microsoft Active Directory	6%
Information Systems	6%

All High-Tech Jobs

Soft Skills	Job Posting Frequency
Communication Skills	31%
Teamwork / Collaboration	23%
Problem Solving	18%
Troubleshooting	14%
Writing	14%
Planning	10%
Research	10%
Creativity	8%
Detail-Oriented	8%
Written Communication	4%

CODING LANGUAGE OPERATING SYSTEMS MANAGEMENT COMMUNICATION ANALYTICAL

Source: HR&A/JFF analysis of Burning Glass Data; Interviews of employers of tech talent

As non-tech jobs continue to expand in New York City, other opportunity jobs in Sales, Marketing, HR, and Content roles offer strong opportunities.

Non-tech jobs within tech companies have fueled the growth of New York City's tech sector over the last five years. Today, they make up more than 60% of all jobs in tech industries. Among the largest and fastest growing non-tech occupations are **Sales & Customer Service, Marketing, Human Resources,** and **Creative Content.** These four other opportunity occupations collectively represent 35% of all non-tech jobs.[1]

In general, other opportunity jobs have a lower educational barrier to entry than high-tech jobs, while still paying higher-than-average wages. Sales representatives earn between $30-34/hour depending on industry sector and fewer than half of job holders have a bachelor's degree. Similarly, advertising sales agents earn $35/hour and the typical educational attainment level is a high school diploma. This occupation has also grown 5.7X since 2008, reflecting the boom in online advertising and the strength of the advertising industry in New York City. HR roles also provide a foot in the door to tech, given that almost 40% of current workers do not hold a bachelor's degree. Overall, the four other opportunity categories pay 25-40% above the NYC median wage, even for jobs where less than half of job holders have a bachelor's degree.

Non-tech roles also offer career mobility opportunities. Employers singled out HR, marketing, content, and various analytics positions as providing an accessible pathway to tech firms for people with four-year non-tech degrees, allowing them to advance within teams or across functions to increase pay. While these may not be high-tech jobs, employers shared examples of marketing and analytics employees transferring into product design and product management roles.

OTHER HIGH-OPPORTUNITY JOB CATEGORIES

	TOTAL JOBS 2018	JOB GROWTH 2008-2018	MEDIAN HOURLY WAGE	JOB HOLDERS WITH A B.A.
SALES & CUSTOMER SERVICE[2]	25K	86%	$35.32	39%
MARKETING	8K	231%	$34.67	75%
HUMAN RESOURCES	3K	156%	$35.17	63%
CREATIVE CONTENT	5K	161%	$37.53	77%

"Non-tech jobs will continue to fuel the tech industry. Tech companies can't grow without that foundational support system."
– Healthtech Company

Source: HR&A analysis of EMSI data; Interviews of employers of tech talent

[1] This calculation includes the two tech occupations – Advertising Sales Agent and Multimedia Artist & Animator – included in other opportunity jobs. See appendix for a more detailed breakdown.

[2] Within this category, 25% of customer service representatives hold a bachelor's degree while 51% of sales representatives hold a bachelor's degree.

Transferable skills and experience gained in other opportunity jobs provide career mobility opportunities across industries, especially for non-tech workers in tech.

In addition to their importance at tech firms, other opportunity jobs are prevalent across other NYC growth industries, including film, media, consulting, and other professional services. Given this, gaining foundational non-tech skills and experience not only prepares jobseekers for opportunities within the tech economy but also for long-term mobility across industry sectors, where there are currently 82,600 such positions in non-tech industries. Non-tech workers within the tech industry may be especially competitive for other jobs as the demand for tech skills (including basic programming languages) and familiarity with tech programs (such as Salesforce and social media platforms) becomes increasingly desirable for non-tech occupations across industries. Finally, the skills overlap between non-tech jobs in tech and non-tech industries may provide an opportunity for incumbent non-tech workers from industries that are contracting to transition to the growing tech economy, which generally offers higher wages and longer-term job mobility.

Non-Tech Industries with the Most "Other Opportunity" Jobs	2018 Jobs	2008-2018 % Growth	Other Opportunity Jobs as Share of Total Jobs
Motion Picture and Video Industries	15,500	87%	29%
Management, Scientific, and Technical Consulting Services	24,700	71%	40%
Business Support Services	5,400	44%	39%
Radio and Television Broadcasting	7,800	42%	37%
Drugs and Druggists' Sundries Merchant Wholesalers	1,800	30%	33%
Professional and Commercial Equipment and Supplies Merchant Wholesalers	3,800	16%	33%
Cable and Other Subscription Programming	2,800	15%	37%
Furniture and Home Furnishing Merchant Wholesalers	1,600	7%	27%
Newspaper, Periodical, Book, and Directory Publishers	15,300	-13%	41%
Wholesale Electronic Markets and Agents and Brokers	3,900	-32%	45%
TOTAL	**82,600**	**29%**	

Digital Skills Growing in Demand for Other Opportunity Occupations:

- **Technical Programming** (Python)
- **Software Platforms** (Salesforce, SAP)
- **Social Media & Digital Marketing** (Instagram)

Source: HR&A Analysis of EMSI and Burning Glass data

Despite strong potential for expanded economic opportunity, the tech ecosystem remains highly unrepresentative of NYC's diverse population, requiring a reexamination of common hiring practices and new approaches to creating inclusive career pathways.

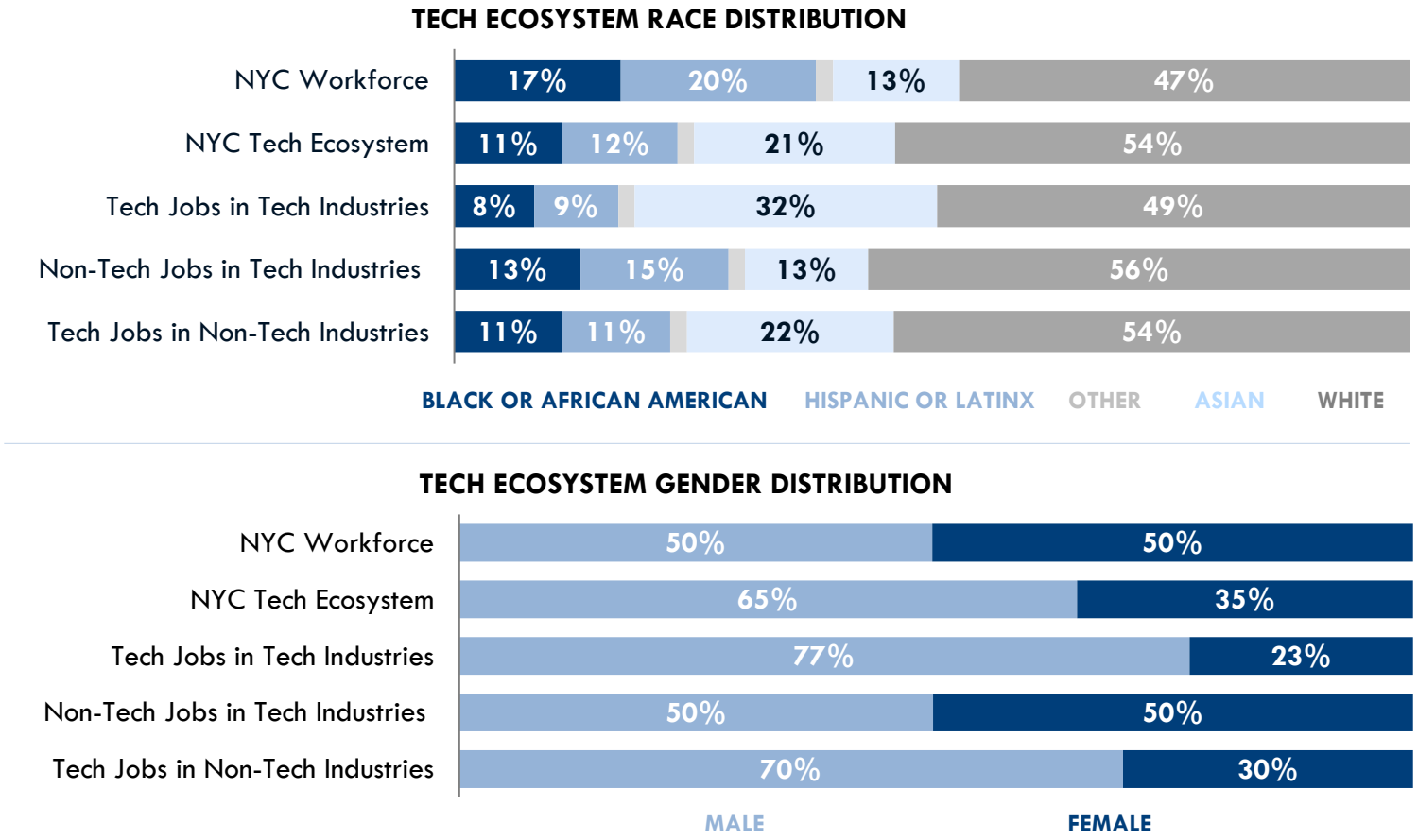
- New York City's tech ecosystem workforce is not representative of New York City's diversity.
- Higher than average educational barriers to entry further limit accessibility into tech for many New Yorkers.
- While employers recognize the importance of diversity to their long-term growth and have been testing strategies to broaden access to tech, structural and behavioral challenges persist, including:
  - Recruiting and hiring practices limit talent pools by favoring selective programs and screening by degree.
  - Requirements for work-based experiences and professional skills disadvantage underrepresented candidates who face greater barriers to accessing such opportunities.
  - A self-reinforcing perception that tech is not diverse hinders retention of underrepresented talent.

New York City's tech ecosystem workforce is not representative of the City's diversity.

NYC's tech ecosystem continues to struggle with a deep diversity challenge, with Black and Latinx New Yorkers and women severely underrepresented among the tech workforce. Only 23% of tech ecosystem workers are Black or Latinx (vs. 37% citywide) and only 35% are female (vs. 50% citywide).

Disparities are starkest within tech occupations, particularly for tech jobs within tech industries, where only 17% of workers are Black or Latinx and only 23% are women. In both cases, the percentages are roughly half of the respective citywide averages. (See the following page for a detailed look at representation across high-tech professions.)

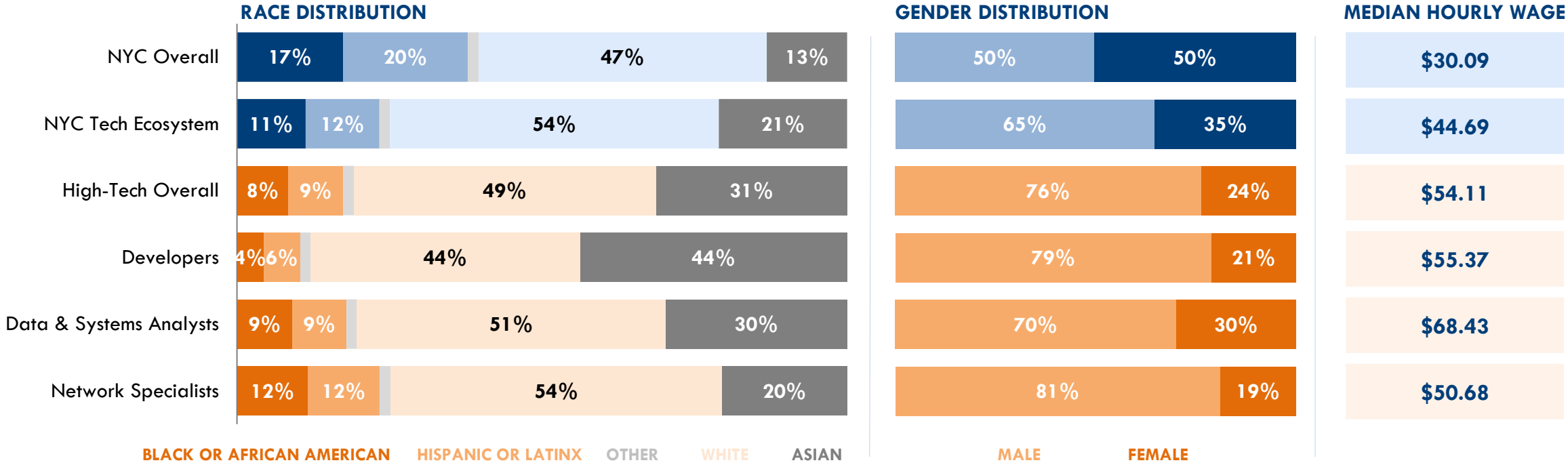
While non-tech jobs have an even gender distribution, they remain unrepresentative in terms of race, albeit less so than tech jobs. Only 28% of non-tech workers within tech industries are Black or Latinx compared to 39% in all other industries. Among the four opportunity occupations, Creative Content and Sales & Marketing face the greatest diversity challenge, with 77% and 64% of jobs held by white workers, respectively.



Note: Opportunity high-tech jobs are especially unrepresentative in terms of race and gender when compared to tech in tech jobs. Representation for other opportunity jobs mirrors non-tech in tech jobs. These trends are explored in greater detail on the following page. While racial distribution data was not available in prior studies, gender distribution has worsened slightly between 2013 and 2018 – males made up 60% of tech industries and 71% of tech occupations in 2013 vs. 63% and 71% in 2018. Source: HR&A Analysis of EMSI data.

High-tech jobs are especially unrepresentative, with developer roles facing the greatest diversity challenge.

Among high-tech jobs, underrepresentation is acute across all occupations but the severity of it varies by function. Racial and gender disparities are starkest among Developers, the largest, fastest-growing, and one of the highest-paying high-tech professions. Strikingly few Developers – only 10% – are Black or Latinx. While Network Specialists are relatively more racially diverse at 24% Black or Latinx, women make up only 20% of these jobs, the lowest across all high-tech occupational groups. Given that these opportunities provide some of the most promising entry-level jobs and significant career-growth opportunities within tech, this lack of representation only exacerbates historic and systemic wealth and earnings disparities citywide.



Source: HR&A Analysis of EMSI data

Higher-than-average degree requirements place certain jobs in the tech ecosystem out of reach for many New Yorkers, despite evidence that degrees are often nonessential.

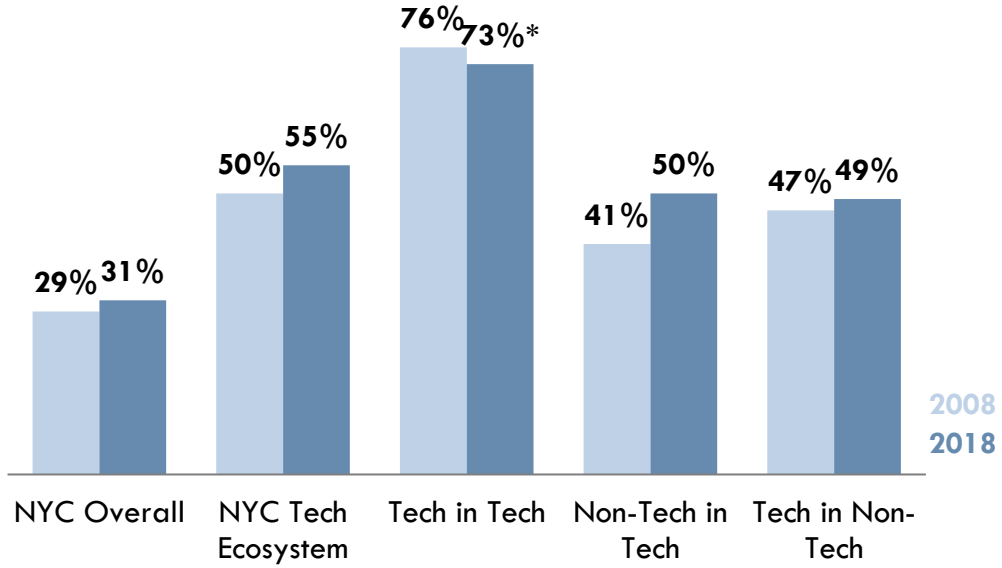
Despite a large number of jobs in the tech ecosystem that do not require a bachelor's degree, and higher-than-average pay among those jobs, tech ecosystem jobs are still more likely to be filled by workers with high educational attainment than NYC jobs overall, creating a barrier to entry for many New Yorkers seeking upward economic mobility. 55% of jobs in the tech ecosystem have an average educational attainment of a bachelor's or higher (up from 50% in 2008), versus 31% of jobs overall. By comparison, only 47% of NYC workers ages 18-34 have a bachelor's degree or higher, meaning that the majority of the emerging workforce is cut off from the majority of tech ecosystem jobs.

The barrier is especially high for tech jobs within tech industries, where nearly three-quarters of jobs have an average educational attainment of a bachelor's or higher. This is largely due to the significant share of high-tech jobs – where 90% of jobs have an average educational attainment above a bachelor's degree – in tech in tech. High-tech jobs make up 89% of tech in tech jobs, while only representing 55% of tech in non-tech jobs. The higher proportion of Developers and other advanced computer science jobs in tech industries contributes to the vast difference in educational attainment across industries.

For non-tech jobs within tech industries, about half have an average educational attainment above a bachelor's degree, although that share has increased by nearly 10 percentage points in the last decade. This rise could point to a growing reliance by employers on bachelor's degrees in screening candidates. In many cases degrees act as proxies for a candidate's professionalism and soft skills, as discussed later in this report. Other opportunity jobs have similar educational barriers to the tech ecosystem overall – 57% of jobs have an average educational attainment above a bachelor's – though several roles, such as in sales, customer service, and HR, allow greater accessibility.

Source: HR&A Analysis of EMSI data; Interviews of employers of tech talent

SHARE OF JOBS WITH AVERAGE EDUCATIONAL ATTAINMENT ABOVE A BACHELOR'S DEGREE (2008-2018)



Note: Average educational attainment represents the education level most often needed to enter an occupation at a national level, rather than the typical education of current workers in the occupation. EMSI reports average educational attainment based on data from the U.S. Bureau of Labor Statistics.

**This decline is largely due to the increased share of Web Developer & Computer User Support Specialist jobs within Tech in Tech jobs; both occupations have an average educational attainment level below a bachelor's degree.*

Employers recognize the importance of diversity and meeting equity goals to their long-term growth and competitiveness.

Most employers interviewed for this study were broadly aware of the scale of underrepresentation of Black, Latinx, and female New Yorkers in tech and recognized the importance of diversity both to their mission and to their long-term growth and success.

Employers cited the lack of racial and gender diversity on their engineering teams as a threat to product quality, in that team homogeneity could stunt creativity and risk blind spots in product design that could limit appeal to potential users. These concerns are reflected by recent challenges with tech products that are perceived to reinforce historic inequalities, such as algorithms used by lenders to make credit decisions and health care companies to inform access to care – a growing risk as tech and artificial intelligence are integrated into more and more aspects of civic life.

Another concern raised by employers was the reputational risk associated with having a lack of diversity and being perceived to be elite or exclusive. This holds especially true for companies that market to broad audiences and in major markets with diverse populations, like New York City, where rapid economic growth (driven in part by tech) has also prompted concerns about gentrification and displacement. Employers discussed how poor perception can impact both future business growth and the ability to attract quality talent, who increasingly value diverse workplaces.

Companies have seen tangible benefits to inclusive hiring practices, including higher employee retention. 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 catered to underserved populations. Retention rates doubled, from the typical industry tenure of 18-24 months to 45 months, helping reduce costs associated with turnover and training of new staff.

"It's important to bring in a diverse range of perspectives so that we're reflective of our customers."
- E-commerce company

**"A lot of people think tech companies just don't care about diversity.
But tech companies do care, we just don't know how to solve this problem yet."**
- Mid-sized cloud-based company

"We become a more successful company because of diversity. Not from a profit standpoint, but from what we're contributing to the world."
- Tech design company

Source: Interviews of employers of tech talent

Yet deep-rooted challenges prevent substantial changes to creating more inclusive access and greater representation in tech.

Current recruiting and hiring practices limit talent pools by favoring selective programs and screening by degree.

- Employers focus recruiting on selective four-year programs and internal networks, reinforcing the existing makeup of tech teams
- Employers over-rely on bachelor's degrees to screen candidates regardless of skill

Requirements for work-based experiences and professional skills disadvantage underrepresented candidates.

- Candidates from underrepresented groups face greater barriers to completing internships and accessing professional experiences
- Bachelor's degrees often become proxies for soft skills

A self-reinforcing perception that tech limits diversity further hinders retention of underrepresented talent.

- Existing lack of diversity in tech creates a "chicken and egg" challenge for recruiting and retention
- Lack of support systems and a homogenous tech workplace culture drives turnover, especially among underrepresented talent

For high-tech jobs, employers rely on selective four-year programs and high-stakes interviewing to recruit the 'best of the best,' creating a narrow talent pipeline.

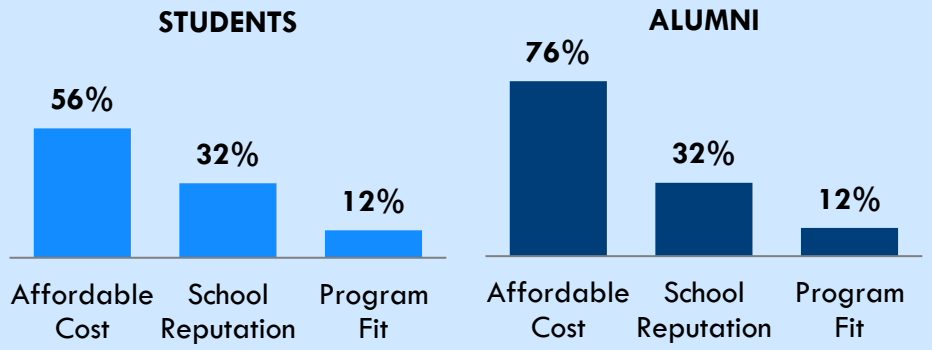
Low-income populations, students of color, and first-generation college students have historically been disadvantaged when it comes to college access and completion. Among students surveyed from LaGuardia Community College, more than half cited affordability as a major reason for their enrollment. Moreover, other financial considerations such as travel expenses, software costs, and childcare often also get in the way of completing programs. This contributes not only to occupational segregation, but to furthering social and racial disparities as well.[1]

These inequalities are further perpetuated as top tech firms vie for the best engineering talent from selective schools across the country. Numerous tech employers described a highly competitive recruiting environment that has driven employers to focus on recruiting at select four-year colleges with top-tier computer science programs, even when they acknowledged that top talent exists outside of these networks. Most firms do not have a presence at public four-year programs or less selective private programs, which typically have more diverse enrollment, but also larger student populations that make it harder for employers to screen for top talent. Smaller employers, in particular, noted that they lack resources to develop relationships at more schools. This approach adopts the racial, gender, and other disparities that exist at selective schools and has a perpetuating impact as many firms rely on their existing teams to help recruit talent for future jobs.

Relatedly, several employers pointed to common interviewing methods that further hinder candidates not emerging from top programs. To screen for technical and problem-solving abilities, many tech firms pose conceptual interview questions and conduct whiteboard-style coding interviews (in which interviewees are asked to code on the spot). While these techniques are not inherently unfair, employers acknowledged that graduates of top-tier programs often have the resources and capacity to prepare. In contrast, students from low-income or historically disadvantaged backgrounds face greater obstacles to adequately prepare for interviews, given that time for training may often compete with family or other obligations. In the recent survey of LaGuardia students and alumni, 24% of respondents cited lack of interview skills as a major challenge to employment.

"For people with non-traditional backgrounds, landing your first job is the most difficult. Companies often focus on university recruiting – targeting the best of the best at Ivy League or four-year computer science programs – and it's unfair for non-traditional talent to compete with them."
– Mid-sized Cloud-based Company

More than 50% of student & alumni respondents cited cost as a major reason for enrolling at LaGuardia Community College:



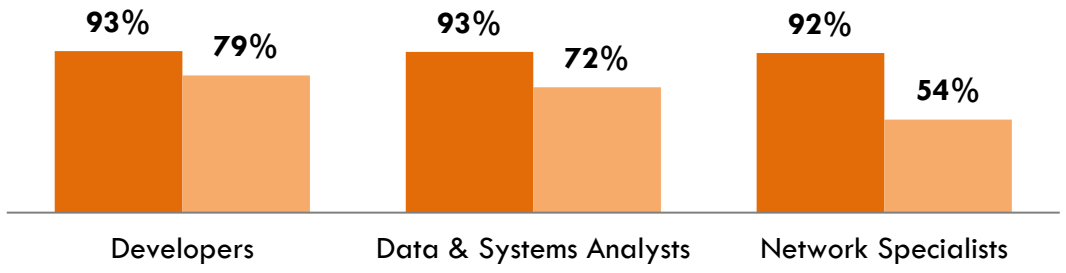
[1] *Thomas Bailey, "Rethinking the 'cafeteria' approach to community college," The Washington Post, 2015;*
Source: LAGCC Student Survey; Interviews of employers of tech talent

Across all jobs, an overreliance on bachelor's degrees among ecosystem employers continues to stifle accessibility into tech.

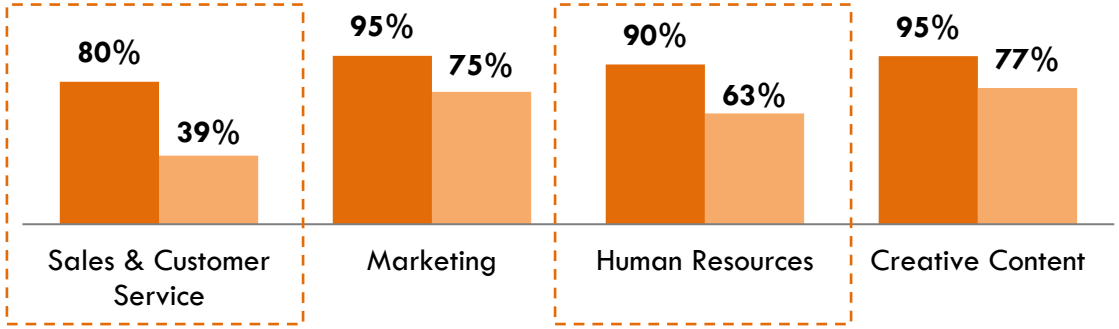
There is a significant gap between job posting requirements and the educational attainment of actual workers across high-tech and other opportunity occupational roles. In all cases, the share of job postings open to those with a bachelor's is significantly higher than the share of existing workers with a degree. While this phenomenon is common across occupations, several stand out: among Network Specialist, HR, and Sales jobs, 92%, 90%, and 80% of 2018 job postings required a bachelor's, respectively, though only 54%, 63%, and 39% of employees in those roles have a bachelor's today. This credential inflation shuts out jobseekers who may have the requisite skills and experience to succeed in a well-paying position but are not considered because they do not have a four-year degree.[1] This not only prevents potentially qualified non-degree candidates from applying; it also deprives employers of talent to fill open positions. The impact of credential inflation is far-reaching: according to the U.S. Department of Education, 58% of today's high school sophomores will not earn a four-year degree; growing bachelor's requirements leave this majority with increasingly fewer job opportunities.

"There has been a definite preference in hiring a four-year candidate. The rationale is less about the credential itself and more about the trust and confidence in the candidate to complete a project without a ton of additional training."
- Major Tech Consulting Company

HIGH-TECH JOB POSTINGS REQUIREMENT VS. JOB HOLDERS WITH BACHELOR'S



OTHER OPPORTUNITY JOB POSTINGS REQUIREMENT VS. JOB HOLDERS WITH BACHELOR'S DEGREES



JOB POSTINGS WITH A REQUIREMENT FOR A BACHELOR'S **JOB HOLDERS WITH A BACHELOR'S OR HIGHER**

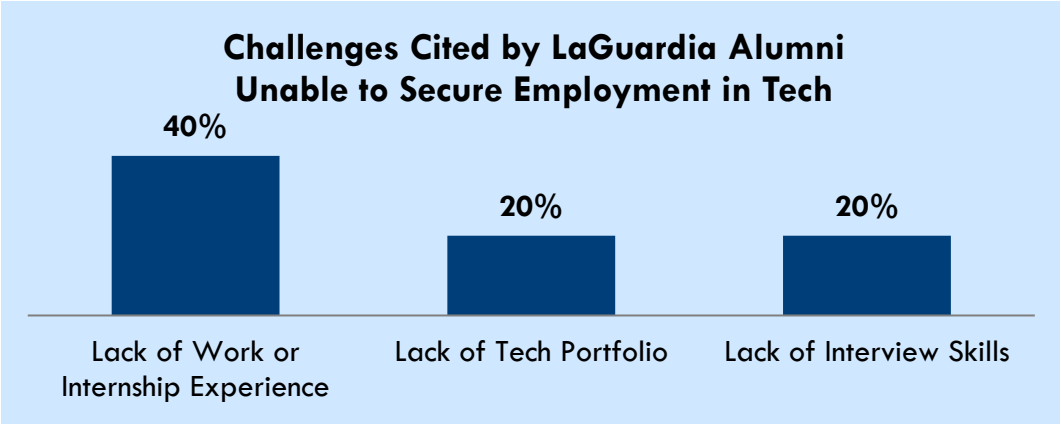
[1] *Burning Glass "Moving the Goalposts: How Demand for a Bachelor's Degree is Reshaping the Workforce" report*
Source: HR&A Analysis of EMSI Data; Interviews of employees of tech talent. "Job Postings Requirements" refers to educational requirements listed in job postings data collected by Burning Glass; "Job Holders' With a Bachelor's" refers to actual employed workers with an educational attainment of a bachelor's or higher, reported by the U.S. Bureau of Labor Statistics at a national level.

Tech employers look for skills learned through work-based experiences, disadvantaging candidates who face barriers to accessing such opportunities.

In addition to technical proficiency, employers place great importance on skills associated with past work-based experience, especially for tech roles. While more than 80% of entry-level tech ecosystem jobs technically do not require work experience (on par with NYC overall), numerous tech employers noted that they look for past work, internship or other project experience to screen for required hard and soft skills and demonstrate a passion for tech. In addition to technical skills, these include communication, problem-solving, receiving and giving feedback, asking questions professionally, working in teams, writing, research, and organization. Indeed, a survey by the *National Association of Colleges and Employers* found that students with paid internship experiences received full-time job offers at a higher rate: 65% vs. 35%.[1] The value of relevant project experience is especially important for roles where bachelor's degrees may not be required, such as web developers, data analysts, and network specialists.

Broadly speaking, candidates from underrepresented groups face higher barriers to secure work-based experience, placing them at a disadvantage for tech jobs. In the recent survey of LaGuardia students and alumni, 40% of respondents who had completed a tech program but not attained a job in tech cited lack of work or internship experience as a primary challenge and 20% cited the lack of a portfolio. Common challenges include the need to work one or more jobs, the need to take care of a loved one, housing insecurity, and travel expenses – all of which make it difficult to complete an internship or other program to develop professional skills.

"Tech companies value internship experience. Having worked in a professional setting goes a long way in determining success, like knowing how to navigate politics, accept and give feedback, and ask questions."
– Mid-size Healthtech Company

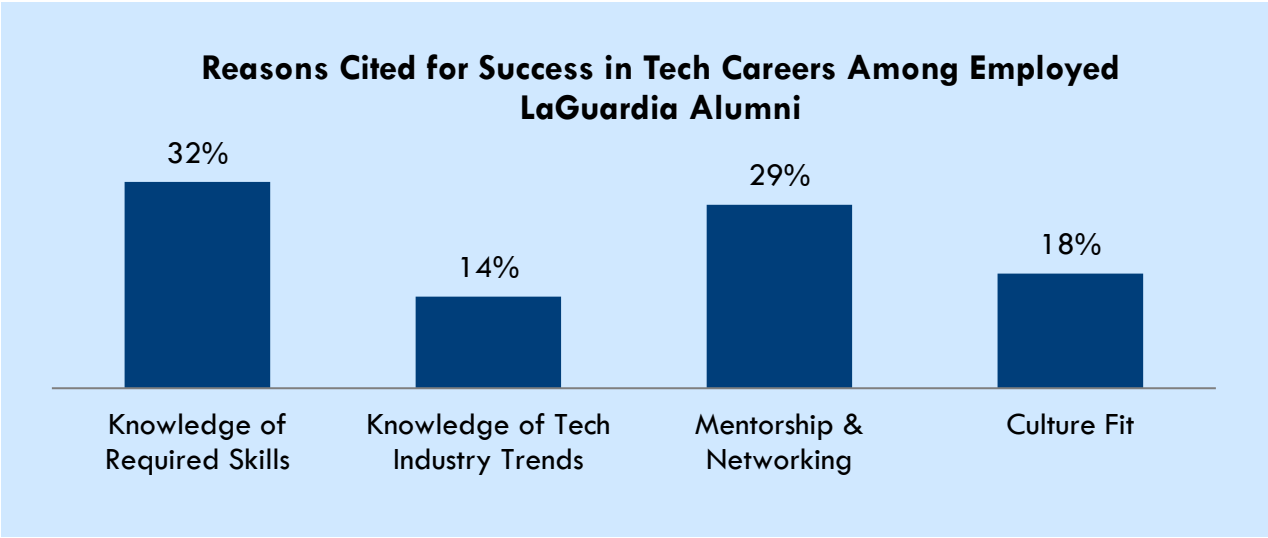


Tech Ecosystem Top Soft Skills	Frequency in 2018 Non-Tech Job Postings	Frequency in 2018 Tech Job Postings
Communication Skills	45%	31%
Teamwork / Collaboration	25%	23%
Organizational Skills	21%	4%
Creativity	21%	8%
Detail-Oriented	20%	8%
Research	20%	10%
Writing	19%	14%
Problem Solving	16%	18%
Planning	14%	10%

[1] *Jobs for the Future, "Making Work-Based Learning Work" study*
Source: HR&A Analysis of Burning Glass data; LAGCC Student Survey; Interviews of employers of tech talent

Industry relationships and mentorship are critical to career success in tech, but such resources are not equally accessible to all.

Beyond employer perceptions, job candidates not coming out of four-year programs often lack access to professional relationships and exposure that would make them more competitive. Whereas students attending bachelor's programs are often exposed to professional work settings and culture, as well as potential industry mentors, through company visits, alumni relationships, the experiences of classmates and faculty, and their broader social networks, many students attending two-year or certificate programs or accelerated training programs, such as bootcamps, may lack such exposure. In the survey of LaGuardia tech program alumni, respondents selected mentorship and culture fit as among the most important factors for securing and retaining a job in tech, citing a desire for "more exposure to people working in tech, especially for mentorship." As a result, emphasis on professional skills and project experience exacerbates the reliance on bachelor's degrees to screen talent.



[1] *The Roadmap for Racial Equity: An Imperative for Workforce Development Associates, National Skills Coalition, 2019.*
Source: LAGCC Student Survey; Interviews of employers of tech talent

Continuous investment in creating diverse and inclusive workplaces is critical to retaining and supporting underrepresented talent within the tech ecosystem.

Perceptions of a tech culture that limits diversity can be self-reinforcing. Employers from both the tech and non-tech industries indicated that an existing lack of diversity has led to a "chicken and egg" challenge wherein minority and female talent seek out employers with teams that reflect their identity, often facing limited and discouraging opportunities. The National Center for Women and Information Technology found that the number of women pursuing computer science degrees has declined by 20% over the past two decades.

For underrepresented talent who do make it through the door, workplace culture and support systems greatly affect retention and career growth. In a national study that surveyed more than 2,000 adults who left their job in a tech-related industry or function, the Kapor Center and Harris Poll discovered that existing tech workplace culture – the product of longtime homogeneity on many teams – drives turnover, specifically among underrepresented groups, and costs the industry more than $16 billion each year. According to the study, 1 in 10 women working in tech roles at tech companies experienced unwanted sexual attention – nearly twice the rate as for tech workers in non-tech industries. In addition, Black and Latinx men and women experienced stereotyping at twice the rate of white and Asian men, and LGBTQ employees were more likely to experience bullying in the form of hostility and stereotyping. Feelings of unfairness and mistreatment contributed to nearly 40% of employees' decision to leave a company.

While many tech companies have adopted practices to improve diversity and inclusion, efforts do not end with recruitment. Retaining and growing underrepresented talent requires concerted efforts to reshape workplace culture and provide support and mentorship systems to help talent navigate environments that were largely designed in a more homogenous era. Employers also cited the strong tie between diversity in recruitment and the long-term desirability of tech jobs for underrepresented groups – even a well-resourced Black Employee Resource Group can only make so much impact if it represents only 5% of tech employees.

Employers interviewed for this study have adopted practices and internal support systems to improve diversity and inclusion. Examples include:

- "Pick a Colleague" Mentorship Program
- Mandatory Diversity Training
- Mandatory Unconscious Bias Training
- Company-Wide Affinity Groups or Employee Resource Groups
- Targeted Diversity Efforts for Recruiting Managers
- Full-Time Diversity Recruitment Manager

[1] *Kapor Center "Tech Leavers Study," 2017*
Source: Interview of employers of tech talent

As employers test new approaches to broaden diversity among tech, significant effort and urgency is required to tackle this critical issue at scale.

Employers interviewed for this report noted numerous approaches they have deployed to diversify their teams and broaden recruitment in recent years.

These approaches include:

- Recruiting at colleges with more diverse enrollment, such as CUNY and historically black colleges and universities, and connecting with affinity groups at target schools that represent underrepresented talent
- Partnerships with the City of New York, CUNY, and training providers to design programs for entry-level roles geared to non-degree candidates
- Removing degree requirements from job postings and interviewing individuals without a bachelor's degree for entry-level tech and non-tech occupations
- Extending internship programs to candidates emerging from accelerated training programs, such as bootcamps, who do not have a bachelor's and hiring individuals with associate's degrees
- Reexamining the use of certain interview questions and methods which can disadvantage candidates who did not attend selective degree programs

Despite these efforts and broad recognition of the scope of the problem, significant barriers remain to taking solutions to scale. Even employers who are seeking to improve diversity noted that their recruiting protocols are set up to identify top talent from programs that offer specific training and preparation, and that branching out to other schools or training programs requires more time- and resource-intensive screening methods and new relationships, all of which comes at a cost. Citing the fast pace and competitive nature of the tech industry, employers stressed the need for any new recruiting strategies to minimize hiring risk and on-the-job training time, particularly in instances where candidates do not have significant professional experience. Small and medium-size employers cited additional challenges, noting that they often lack brand awareness among tech jobseekers and therefore have fewer incoming candidates from underrepresented groups. Meanwhile, they do not have the staff or resources to expand recruiting to a broader list of schools or develop relationships with bootcamps or other training programs.

Building on the substantial efforts to date of employers, training partners, and the City of New York, additional work is needed to match the scale of this critical issue and with increasing urgency.

Source: Interview of employers of tech talent

RECOMMENDATIONS

Key interventions by the City can help employers, training providers, and jobseekers create a more diverse and inclusive NYC tech workforce.

CITY

EMPLOYERS

TRAINING PROVIDERS

STUDENTS

BROADEN AWARENESS
of students and job seekers to the full range of career opportunities in tech and the skills and practices needed to succeed

ACCELERATE ACCESS
into the tech ecosystem for underrepresented talent by encouraging employers to shift how they recruit and what they require, and providing resources to underrepresented talent

BROADEN AWARENESS of all types of tech careers

CHALLENGE

People often think of software developers when they think of tech, but there are numerous career tracks in the tech ecosystem that offer opportunities for New Yorkers.

RECOMMENDATION

Promote awareness and training in all high-tech and other opportunity occupations.

As important as software developers are to NYC's economy, they are one of more than two dozen occupations in the tech ecosystem that provide high-earning career mobility opportunities. Students and other New Yorkers seeking job opportunities would benefit from an expansion of existing City efforts to broaden awareness of and provide targeted training opportunities addressing the full range of career options within the tech ecosystem. Strategies may include:

- Tapping into and expanding NYC Tech Talent Pipeline's network of 400+ employers to identify talent needs and explore pathways for other opportunity careers such as sales and HR and high-tech roles within non-tech fields such as healthcare and media more thoroughly. This effort would build on TTP's recent success with the Data Analyst Training Accelerator (DATA), a free, 18-week immersive training program for data and marketing analytics developed based on industry feedback *(see callout at right)*.
- Developing training modules for career advisors who primarily serve underrepresented talent, such as Workforce1 coaches, public school career counselors, and community-based organization employees to share labor market insights, recruiting intelligence, and a survey of available training programs that demonstrate the range of tech pathways. This effort would complement TTP's work focused on CUNY schools, including CUNY 2X Tech program and the Tech-in-Residence Corps, which build partnerships with employers to shape CUNY tech curricula *(see callout at right)*.
- At the K-12 level, adding a module in the CS4All curriculum about the breadth of careers in tech to build awareness at the beginning of the career ladder.

SPOTLIGHT: NYC TECH TALENT PIPELINE

The NYC Tech Talent Pipeline initiative has partnered with more than 400 employers to elevate best practices in sourcing and recruiting talent, including a more diverse tech workforce. Leveraging this network, its programs to grow awareness and access around the tech ecosystem include:

Data Analyst Training Accelerator (DATA): Developed in response to feedback from some of the city's largest tech employers, DATA at Galvanize is a free, full-time, 18-week, in-person immersive data analytics training program. The program is designed to equip unemployed and underemployed New Yorkers with the in-demand skills necessary to launch careers in data and marketing analysis. Participants learn advanced Excel, SQL, Python, and digital marketing-related analytics, as well as career advancement and interview skills. The program is tuition-free for qualified New Yorkers.

CUNY 2X Tech: CUNY 2X Tech is a new initiative to double by 2022 the number of CUNY students graduating annually with a tech-related bachelor's degree who are prepared to launch careers in the NYC tech ecosystem. As part of the Mayor's 100,000 jobs plan, $24 million has been committed to CUNY 2X Tech, which works with 8 of the system's 11 senior colleges and hundreds of employers in NYC to better align the classroom experience with industry needs and expand access to quality tech careers.

Tech-in-Residence Corps: 50+ companies currently serve in the Tech in Residence Corps, which places tech professionals into CUNY classrooms to teach real-world skills that provide students with the foundation they need to launch careers in tech.

NYC Tech Innovators: Since 2017, the program has recognized employers each year supporting local talent and initiatives that help to grow an inclusive tech ecosystem in NYC.

BROADEN AWARENESS of tech ecosystem practices

CHALLENGE

Students from underrepresented groups typically have less exposure to the soft skills and professional practices that aid success in tech.

RECOMMENDATION

Expand City programs and build additional partnerships to expose all talent to tech ecosystem practices and greater mentorship opportunities.

When it comes to hard skills for specific tech roles, schools and bootcamps have generally developed strong partnerships with employers to understand needs. Yet employers broadly cited a challenge with candidates – especially those without a four-year degree – not having the requisite professional skills to perform well on day one. Setting up students for success when they come through non-traditional programs requires a full awareness on the part of training providers of not just hard skills, but what it takes to succeed both in tech job interviews and in the workplace.

Strategies may include:

- Scaling up TTP's Tech Skills Workshops, which offer modules on topics such as whiteboarding and tech-based problem-solving that are designed in concert with employers.
- Encouraging individual tech workers to volunteer time to provide mentorship and career support including mock interviews and other real-world lessons, to underrepresented talent, including through participation in TTP's Tech-in-Residence Corps.
- Developing a "tech prep checklist" that outlines activities jobseekers should take to demonstrate skills competence and professionalism, such as creating a LinkedIn profile, developing a Github profile, studying common interviewing techniques, attending industry events and trade shows, and exploring existing online reference materials, how-to guides, and coaching resources. This could be incorporated into the CUNY 2X Tech initiative or implemented widely across training programs.

ACCELERATE ACCESS through employer incentives

CHALLENGE

Employers broadly see the need to change hiring practices but have not made the paradigm shift needed to address systemic challenges.

RECOMMENDATION

Align City incentives to encourage and reward employers that commit to responsible recruiting practices.

Addressing the magnitude of tech's underrepresentation challenge will require widespread employer behavior change. Motivations aside, changes in recruiting and training practices require additional cost and effort on the part of employers and can be especially risky for smaller employers and startups. The City of New York could hasten that change by leveraging its own tax and incentive structures to promote responsible recruiting practices. Similar to M/WBE and HireNYC initiatives that promote responsible contracting and local hiring for capital projects, the City could:

- Develop a rebate of the Commercial Rent Tax (CRT) for companies that adopt responsible practices, such as recruiting from CUNY or local schools/programs, creating internship or apprenticeship programs, and sharing recruiting data (see examples on the right).
- Include responsible hiring practices in City RFP processes, such as through questionnaires.
- Expand requirements for applicants to other City benefits, such as commitments to the HireNYC program required of applicants to Industrial Development Authority financing, to include participation in "how to" trainings on recruitment best practices.

While designed for tech, these programs could apply to any growing industries that suffer from a lack of representation.

NATIONAL PRECEDENTS FOR TRAINING INCENTIVE PROGRAMS

Several municipalities in the United States have developed incentive programs intended to diversify their workforces. In some cases, such as Baltimore, these programs are targeted toward diversifying specific industries, while Portland has moved to incentivize not only hiring but retention to support career advancement for targeted groups.

Baltimore, Maryland: Baltimore's Civic Works organization, which oversees the EPA-funded "B'more Green" Brownfields Environmental Job Training program, has partnered with Maryland's Department of Human Resources to offer an 80% wage subsidy for a six-month period to employers that hire B'more Green graduates.

Portland, Oregon: The Portland Economic Development Commission oversees the Oregon Enterprise Zone program, which offers businesses a three- to five-year property tax exemption in exchange for first-source hiring (i.e. giving first priority to local residents and/or graduates of specific partner programs) and employee retention agreements.

Denver, Colorado: The Denver Urban Renewal Authority's (DURA) Division of Workforce Development runs a First Source Hiring Program that provides incentives to hire residents who fall below the 80th percentile of Area Median Income (AMI) for the Denver metro region. Employers who participate in this program may be eligible for tax increment financing (a tool that captures future tax revenues from a property or business to fund capital improvements) or similar assistance from DURA.

State Tax Credit Programs: In addition, numerous states offer tax credits to businesses to cover eligible job training costs for new employees, including: 50% of costs in Kentucky; 50% of costs in Mississippi (not to exceed $2,500 per employee annually); and 30% of costs conducted through community colleges in Virginia for worker retraining efforts. Connecticut's Human Capital Tax Credit Program provides tax credits equal to 5% of the cost of human capital investments including training and childcare subsidies. In addition, the State of California Employment Training Panel provides direct financial support to employers to assist in upgrading the skills of their workers through training that leads to good paying, long-term jobs, with a focus on supporting small businesses with less than 100 employees. The ETP is funded by California employers through a special payroll tax.

ACCELERATE ACCESS by investing in training

CHALLENGE

While accelerated training programs provide a meaningful path for underrepresented talent to access tech jobs at low risk to employers, adoption is limited.

RECOMMENDATION

Expand accelerated training programs across a wide variety of tech employers.

Numerous employers cited a growing openness to, and interest in, accelerated training programs – such as apprenticeships, extended internships, and other months-long programs – that are designed to onboard and upskill graduates of bootcamps and non-four-year programs. Through such programs, employers can evaluate and train talent on the job over an extended period, giving candidates a chance to demonstrate skills and allowing employers to broaden their recruitment channels at low risk.

Building on TTP's recent publication of *Key Practices for Accelerated Tech Training* with 12 lessons for program design, and growing efforts such as ApprenticeNYC and CareerWise NY, the City can continue to promote and expand accelerated programs by:

- Studying and promoting the positive impacts of accelerated training programs on employers and jobseekers to promote uptake among skeptical potential partners. These impacts may include (for employers) percent of trainees hired full time, tenure/retention among trainees, reduced recruitment costs, and increased team diversity, and (for jobseekers) increased wages, career growth over time, skill proficiency, and happiness at work. The results could help support rationales both for employer investment and future City incentives and regulations.
- Reducing burdens for smaller employers to participate in accelerated programs, such as through support services that prepare program participants for internships and apprenticeships and provide support to participants and employers during the program. Support services can be modeled off the City's Summer Youth Employment Program (SYEP), which contracts with community-based organizations to provide such support. Training program management and support services could also be managed on behalf of multiple smaller businesses through partnerships with coworking spaces and other tech hubs such as the forthcoming Union Square Tech Hub, Company, or Brooklyn Navy Yard.
- Facilitating resource sharing by and among tech employers, trainers, and other participants in accelerated programs (including among the 400+ TTP employer network members) to promote effective program models, share lessons learned, and reduce time and costs in program design and administration.
- Promoting participation in accelerated training programs by City agencies, major health care employers, and educational institutions – all major employers of tech talent.

ACCELERATE ACCESS by supporting underserved talent

CHALLENGE

Students from underrepresented groups disproportionately face financial barriers to participating in work-based learning and other training opportunities.

RECOMMENDATION

Provide financial assistance to students and candidates to support training.

Underrepresented talent often face economic and other barriers to access internship opportunities and other real-world experiences that would make them competitive during recruitment.

To level the playing field, the City, in partnership with foundations and major employers, could pilot a program to provide cash stipends and free MetroCards to students who participate in select training programs, in exchange for commitments to take part in real-world learning experiences. Such efforts could build upon existing City programs that provide childcare, Metrocards, and food subsidies to expand the pool of potentially eligible participants. Employers could also be called upon to expand existing programs at major companies that provide paid internship opportunities that allow participants to enter skills development programs full-time.

Measuring the impact of direct financial support could help prove a case for broader implementation and greater private funding; the City could encourage employer tracking of information, including potential impacts on employee retention or reduction in retraining costs. To the extent possible, funding for the pilot should be sourced from interested employers, including potential stipends for professional projects or internships that could relieve the pressure on students to maintain jobs unrelated to their degree or training programs.

CHALLENGE

Smaller employers struggle to identify and retain top talent from outside core channels.

RECOMMENDATION

Scale proactive efforts to source, promote and continually support talent from non-traditional programs.

Smaller employers noted the difficulties they face broadening their recruitment efforts, managing partnerships with bootcamps and training providers, and taking more inclusive approaches to screening talent.

The City can continue to play an important role in connecting employers to qualified candidates that would not otherwise enter their recruitment pipeline. Strategies may include scaling up TTP's Tech Talent Team, which works with employers to source talent from its network; partnering with tech recruiting firms (which smaller companies often turn to for in-demand talent) to develop stronger pipelines from CUNY and non-four-year programs, and partnering with affinity groups for Black and Latinx and female tech talent to expand their reach. This dedicated pipeline of "best of the best" candidates would seek to replicate the existing pipeline from top-tier schools from a broader pool of New York City talent.

Continuous investment by employers in internal diversity support systems is also critical to not only retaining underrepresented talent, but also in turn help remove the "chicken and egg" challenge that hinders female and minority talent from entering the tech workforce. While setting up company affinity groups, mentorship programs or mandatory diversity training may be more challenging for smaller employers, they may benefit from creating intra-company resource groups and industry networks.

BROADEN AWARENESS: NEXT STEPS

RECOMMENDATION	KEY ACTORS	NEXT STEPS	
Promote awareness and training in all high-tech and other opportunity occupations.		**Medium Term: 6-12 Months** ▪ Develop materials/curricula to summarize the breadth of opportunities in tech and available training resources, including opportunities for tech jobs in city government ▪ Convene employers and training providers to discuss additional training opportunities in non-tech careers and non-tech industries	**Long Term: 12+ Months** ▪ Develop protocol for sharing industry insights with a broad network of career coaches ▪ Design new programs and marketing efforts
Expand City programs and build additional partnerships to expose all talent to common tech ecosystem practices and customs.		**Short Term: 6-9 Months** ▪ Partner with employers to encourage mentorship and support among existing employees ▪ Develop "tech prep checklist" materials and deployment strategy	

ACCELERATE ACCESS: NEXT STEPS

RECOMMENDATION	KEY ACTORS	NEXT STEPS	
Align City incentives to encourage and reward employers that commit to responsible recruiting practices.		**Medium Term: 6-12 Months** ▪ Evaluate current incentive portfolio for opportunities to introduce levers to encourage employer behavior change ▪ Convene employers, trainers, and industry experts to discuss potential incentive models	**Long Term: 12+ Months** ▪ Pilot an opt-in incentive program to test demand and impact
Expand accelerated training programs across a wide variety of tech employers.		**Medium term: 6-12 months** ▪ Commission study on tangible impacts of accelerated programs ▪ Convene employers and training programs to review potential opportunities to reduce participation burdens	**Long Term: 12+ Months** ▪ Develop protocol and partnerships to source and share industry best practices with a broad network of employers of tech talent ▪ Evaluate program models to reduce burdens for participation in training programs among small employers
Provide financial assistance to students and candidates to support training.		**Medium term: 6-12 months** ▪ Convene students, educators, and training providers to confirm priority participation barriers ▪ Seek commitments from one or more employers to pilot a stipend or other support service for trainees	**Long Term: 12-24 Months** ▪ Evaluate current support services portfolio for opportunities to expand upon existing programs ▪ Design new programs and protocol
Scale proactive efforts to source, promote and continually support talent from non-traditional programs.		**Short Term: 6-9 months** ▪ Evaluate opportunities to expand existing programs, such as TTP's Tech Talent Team, that connect top talent from underrepresented groups with employers ▪ Partner with organizations and intermediaries such as Here to Here and Civic Hall to promote industry best practices for supporting non-traditional talent ▪ Study tools, platforms, and approaches to promote underrepresented talent broadly among interested employers	

APPENDIX

TECHNICAL APPENDIX

LABOR MARKET DATA: TECH ECOSYSTEM INDUSTRIES

NAICS	DESCRIPTION	2018 JOBS
5415	Computer Systems Design and Related Services	69,500
5191	Other Information Services	47,300
5417	Scientific Research and Development Services	18,000
5173	Wired and Wireless Telecommunications Carriers	15,400
4541	Electronic Shopping and Mail-Order Houses	15,000
5182	Data Processing, Hosting, and Related Services	10,000
5112	Software Publishers	9,300
5179	Other Telecommunications	2,300
5174	Satellite Telecommunications	200
3341	Computer and Peripheral Equipment Manufacturing	2,100
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	700
3344	Semiconductor and Other Electronic Component Manufacturing	700
3364	Aerospace Product and Parts Manufacturing	500
3342	Communications Equipment Manufacturing	400

Source; EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: OPPORTUNITY HIGH-TECH OCCUPATIONS

CATEGORY	SOC	DESCRIPTION	2018 JOBS	2008-2018 GROWTH	2018 MEDIAN HOURLY WAGE	JOB HOLDERS WITH A BACH.	SHARE IN TECH INDUSTRY
Developers	15-1132	Software Developers, Applications	31,500	114%	$61.11	84%	59%
	15-1133	Software Developers, Systems Software	9,500	16%	$61.29	84%	55%
	15-1134	Web Developers	9,100	107%	$36.75	58%	43%
	15-1142	Computer Programmers	7,500	-39%	$46.34	72%	55%
Data & Systems Analysts	15-1121	Computer Systems Analysts	23,900	33%	$54.15	73%	41%
	11-3021	Computer and Information Systems Managers	16,000	50%	$94.14	72%	37%
	15-1141	Database Administrators	4,000	-2%	$50.94	71%	27%
Network Specialists	15-1142	Network and Computer Systems Administrators	13,500	17%	$48.42	53%	28%
	15-1152	Computer Network Support Specialists	6,700	40%	$40.98	46%	35%
	15-1143	Computer Network Architects	4,500	61%	$60.78	58%	45%
	15-1122	Information Security Analysts	3,900	95%	$63.52	66%	31%
		TOTAL	**130,100**	**39%**	**$58.74**	**79%**	**45%**

Note: "Job Holders' With a Bachelor's" refers to actual employed workers with an educational attainment of a bachelor's or higher, reported by the U.S. Bureau of Labor Statistics for specific occupations at a national level.
Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: OTHER OPPORTUNITY OCCUPATIONS

CATEGORY	SOC	DESCRIPTION	2018 JOBS	2008-2018 GROWTH	2018 MEDIAN HOURLY WAGE	JOB HOLDERS WITH A BACH.
Sales & Customer Service	41-3099	Sales Representatives, Services, All Other	10,300	119%	$34.21	49%
	43-4051	Customer Service Representatives	7,500	49%	$19.99	25%
	41-4011	Sales Representatives, Products (Technical)	2,000	18%	$47.33	47%
	41-3011	Advertising Sales Agents*	2,100	569%	$35.74	43%
	11-2022	Sales Managers	1,900	164%	$94.54	68%
	41-4012	Sales Representatives, Products (Non-Technical)	1,300	35%	$29.25	47%
Marketing	13-1161	Market Research Analysts and Marketing Specialists	5,900	258%	$37.39	79%
	19-4061	Social Science Research Assistants	2,200	175%	$27.37	32%
Human Resources	13-1071	Human Resources Specialists	1,800	177%	$35.74	59%
	13-1151	Training and Development Specialists	1,400	133%	$34.44	54%
Creative Content	27-3041	Editors	2,500	127%	$37.32	81%
	27-3043	Writers and Authors	1,000	186%	$34.60	74%
	27-2012	Producers and Directors	800	433%	$47.37	83%
	27-3022	Reporters and Correspondents	800	220%	$33.62	84%
	27-1014	Multimedia Artists and Animators*	300	34%	$32.95	43%
		TOTAL	**41,800**	**100%**	**$37.15**	**50%**

**Two tech occupations – Advertising Sales Agents and Multimedia Artists & Animators – stood out as opportunity areas and were included in Sales and Creative Content categories. This data reflects those jobs within tech industries, specifically, and are a subset of the job data in the "All Other Tech Occupations" table.*

Note: "Job Holders' With a Bachelor's" refers to actual employed workers with an educational attainment of a bachelor's or higher, reported by the U.S. Bureau of Labor Statistics for specific occupations at a national level. Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: ALL OTHER TECH OCCUPATIONS (1/2)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT	SHARE IN TECH INDUSTRY
15-1111	Computer and Information Research Scientists	700	Master's degree	51%
15-1151	Computer User Support Specialists	25,000	Some college, no degree	34%
15-1199	Computer Occupations, All Other	2,300	Bachelor's degree	37%
15-2031	Operations Research Analyst	3,350	Bachelor's Degree	16%
15-2041	Statisticians	600	Bachelor's degree	23%
17-1021	Cartographers and Photogrammetrists	100	Bachelor's degree	0%
17-2011	Aerospace Engineers	200	Bachelor's degree	20%
17-2031	Biomedical Engineers	50	Associate's degree	0%
17-2041	Chemical Engineers	50	Associate's degree	0%
17-2071	Electrical Engineers	3,550	Associate's degree	15%
17-2072	Electronics Engineers, Except Computer	1,050	Associate's degree	44%
17-2061	Computer Hardware Engineers	400	Bachelor's degree	56%
17-2112	Industrial Engineers	2,000	Associate's degree	18%
17-3012	Electrical and Electronics Drafters	550	Bachelor's degree	13%
17-3021	Aerospace Engineering and Operations Technicians	50	Postsecondary nondegree award	33%
17-3023	Electrical and Electronics Engineering Technicians	1,800	Associate's degree	19%
17-3024	Electro-Mechanical Technicians	50	Postsecondary nondegree award	0%
17-3026	Industrial Engineering Technicians	400	Bachelor's degree	17%
27-1014	Multimedia Artists and Animators	2,600	Bachelor's degree	11%
27-4011	Audio and Video Equipment Technicians	6,150	Associate's degree	3%

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: ALL OTHER TECH OCCUPATIONS (2/2)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT	SHARE IN TECH INDUSTRY
27-4012	Broadcast Technicians	4,550	Associate's degree	2%
27-4014	Sound Engineering Technicians	1,500	Associate's degree	2%
27-4032	Film and Video Editors	4,900	Associate's degree	2%
29-2018	Clinical Laboratory Technologists and Technicians	7,000	Associate's degree	1%
29-2031	Cardiovascular Technologists and Technicians	1,350	Postsecondary nondegree award	0%
29-2032	Diagnostic Medical Sonographers	2,200	High school diploma or equivalent	0%
29-2033	Nuclear Medicine Technologists	400	Some college, no degree	0%
29-2034	Radiologic Technologists	5,150	Postsecondary nondegree award	0%
29-2035	Magnetic Resonance Imaging Technologists	1,050	Associate's degree	0%
29-2055	Surgical Technologists	2,450	Postsecondary nondegree award	0%
41-3011	Advertising Sales Agents	17,800	High school diploma or equivalent	12%
41-9031	Sales Engineers	1,000	Postsecondary nondegree award	50%
49-2011	Computer, Automated Teller, and Office Machine Repairers	3,000	Postsecondary nondegree award	14%
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	4,750	High school diploma or equivalent	59%
49-2091	Avionics Technicians	550	Postsecondary nondegree award	2%
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment	200	Bachelor's degree	0%
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	400	Master's degree	7%
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	1,300	Bachelor's degree	0%
49-2096	Electronic Equipment Installers and Repairers, Motor Vehicles	250	Bachelor's degree	4%
49-2097	Electronic Home Entertainment Equipment Installers and Repairers	1,000	Bachelor's degree	7%

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (1/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
41-3099	Sales Representatives, Services, All Other	10,300	High school diploma or equivalent
43-4051	Customer Service Representatives	7,500	High school diploma or equivalent
13-1161	Market Research Analysts and Marketing Specialists	5,900	Bachelor's degree
11-1021	General and Operations Managers	5,600	Bachelor's degree
13-1111	Management Analysts	3,000	Bachelor's degree
43-9061	Office Clerks, General	2,900	High school diploma or equivalent
13-2011	Accountants and Auditors	2,900	Bachelor's degree
43-6011	Executive Secretaries and Executive Administrative Assistants	2,800	High school diploma or equivalent
49-9052	Telecommunications Line Installers and Repairers	2,750	High school diploma or equivalent
27-3041	Editors	2,500	Bachelor's degree
43-1011	First-Line Supervisors of Office and Administrative Support Workers	2,350	High school diploma or equivalent
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	2,250	High school diploma or equivalent
19-4061	Social Science Research Assistants	2,200	Bachelor's degree
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	2,000	Bachelor's degree
11-2021	Marketing Managers	1,950	Bachelor's degree
11-2022	Sales Managers	1,850	Bachelor's degree
13-2051	Financial Analysts	1,850	Bachelor's degree
13-1071	Human Resources Specialists	1,800	Bachelor's degree
25-4021	Librarians	1,600	Master's degree

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (2/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
43-3031	Bookkeeping, Accounting, and Auditing Clerks	1,600	Some college, no degree
13-1199	Business Operations Specialists, All Other	1,500	Bachelor's degree
13-1151	Training and Development Specialists	1,400	Bachelor's degree
11-9199	Managers, All Other	1,400	Bachelor's degree
41-2031	Retail Salespersons	1,400	No formal educational credential
41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	1,350	High school diploma or equivalent
41-1012	First-Line Supervisors of Non-Retail Sales Workers	1,250	High school diploma or equivalent
11-3031	Financial Managers	1,200	Bachelor's degree
25-4031	Library Technicians	1,200	Postsecondary nondegree award
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	1,100	No formal educational credential
27-1024	Graphic Designers	1,100	Bachelor's degree
43-5061	Production, Planning, and Expediting Clerks	1,100	High school diploma or equivalent
27-3043	Writers and Authors	1,000	Bachelor's degree
43-4121	Library Assistants, Clerical	1,000	High school diploma or equivalent
43-4151	Order Clerks	1,000	High school diploma or equivalent
43-5071	Shipping, Receiving, and Traffic Clerks	950	High school diploma or equivalent
43-9021	Data Entry Keyers	900	High school diploma or equivalent
27-3031	Public Relations Specialists	850	Bachelor's degree
23-1011	Lawyers	850	Doctoral or professional degree

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (3/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
13-1028	Buyers and Purchasing Agents	850	Bachelor's degree
19-1042	Medical Scientists, Except Epidemiologists	850	Doctoral or professional degree
27-2012	Producers and Directors	800	Bachelor's degree
27-3022	Reporters and Correspondents	800	Bachelor's degree
43-5081	Stock Clerks and Order Fillers	700	High school diploma or equivalent
37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	600	No formal educational credential
11-3011	Administrative Services Managers	600	Bachelor's degree
41-1011	First-Line Supervisors of Retail Sales Workers	600	High school diploma or equivalent
19-3099	Social Scientists and Related Workers, All Other	600	Bachelor's degree
11-3121	Human Resources Managers	550	Bachelor's degree
11-1011	Chief Executives	550	Bachelor's degree
19-4099	Life, Physical, and Social Science Technicians, All Other	500	Associate's degree
13-1041	Compliance Officers	500	Bachelor's degree
27-1011	Art Directors	450	Bachelor's degree
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	450	High school diploma or equivalent
43-3021	Billing and Posting Clerks	450	High school diploma or equivalent
49-9071	Maintenance and Repair Workers, General	450	High school diploma or equivalent
27-3042	Technical Writers	400	Bachelor's degree
43-4111	Interviewers, Except Eligibility and Loan	400	High school diploma or equivalent

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (4/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
43-4171	Receptionists and Information Clerks	400	High school diploma or equivalent
53-7064	Packers and Packagers, Hand	400	No formal educational credential
13-1141	Compensation, Benefits, and Job Analysis Specialists	350	Bachelor's degree
43-9011	Computer Operators	350	High school diploma or equivalent
25-9031	Instructional Coordinators	350	Master's degree
33-9032	Security Guards	350	High school diploma or equivalent
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	350	High school diploma or equivalent
11-9041	Architectural and Engineering Managers	350	Bachelor's degree
43-9199	Office and Administrative Support Workers, All Other	300	High school diploma or equivalent
43-4161	Human Resources Assistants, Except Payroll and Timekeeping	300	Associate's degree
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	300	High school diploma or equivalent
25-4011	Archivists	300	Master's degree
11-2011	Advertising and Promotions Managers	300	Bachelor's degree
25-3097	Teachers and Instructors, All Other	300	Bachelor's degree
17-2141	Mechanical Engineers	300	Bachelor's degree
11-2031	Public Relations and Fundraising Managers	300	Bachelor's degree
13-1121	Meeting, Convention, and Event Planners	300	Bachelor's degree
17-2199	Engineers, All Other	250	Bachelor's degree
41-9041	Telemarketers	250	No formal educational credential

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (5/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
43-9071	Office Machine Operators, Except Computer	250	High school diploma or equivalent
19-3011	Economists	200	Master's degree
19-4021	Biological Technicians	200	Bachelor's degree
43-3011	Bill and Account Collectors	200	High school diploma or equivalent
43-9051	Mail Clerks and Mail Machine Operators, Except Postal Service	200	High school diploma or equivalent
11-3131	Training and Development Managers	200	Bachelor's degree
21-1012	Educational, Guidance, School, and Vocational Counselors	200	Master's degree
51-2098	Assemblers and Fabricators, All Other, Including Team Assemblers	150	High school diploma or equivalent
43-5032	Dispatchers, Except Police, Fire, and Ambulance	150	High school diploma or equivalent
19-3022	Survey Researchers	150	Master's degree
11-3061	Purchasing Managers	150	Bachelor's degree
13-1081	Logisticians	150	Bachelor's degree
29-2052	Pharmacy Technicians	150	High school diploma or equivalent
43-9022	Word Processors and Typists	150	High school diploma or equivalent
51-1011	First-Line Supervisors of Production and Operating Workers	150	High school diploma or equivalent
29-1051	Pharmacists	150	Doctoral or professional degree
27-4021	Photographers	150	High school diploma or equivalent
53-3033	Light Truck or Delivery Services Drivers	150	High school diploma or equivalent
43-4071	File Clerks	150	High school diploma or equivalent

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (6/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
13-2031	Budget Analysts	150	Bachelor's degree
43-3051	Payroll and Timekeeping Clerks	150	High school diploma or equivalent
11-9121	Natural Sciences Managers	150	Bachelor's degree
41-9099	Sales and Related Workers, All Other	100	High school diploma or equivalent
19-2031	Chemists	100	Bachelor's degree
53-1048	First-line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	100	High school diploma or equivalent
19-3041	Sociologists	100	Master's degree
13-2099	Financial Specialists, All Other	100	Bachelor's degree
43-3061	Procurement Clerks	100	High school diploma or equivalent
13-1131	Fundraisers	100	Bachelor's degree
27-1022	Fashion Designers	100	Bachelor's degree
19-2099	Physical Scientists, All Other	100	Bachelor's degree
11-3051	Industrial Production Managers	100	Bachelor's degree
43-2021	Telephone Operators	100	High school diploma or equivalent
19-2041	Environmental Scientists and Specialists, Including Health	100	Bachelor's degree
41-3031	Securities, Commodities, and Financial Services Sales Agents	100	Bachelor's degree
53-7051	Industrial Truck and Tractor Operators	100	No formal educational credential
23-2011	Paralegals and Legal Assistants	100	Associate's degree
43-4199	Information and Record Clerks, All Other	100	High school diploma or equivalent

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (7/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
19-4031	Chemical Technicians	100	Associate's degree
19-2012	Physicists	100	Doctoral or professional degree
21-1093	Social and Human Service Assistants	100	High school diploma or equivalent
19-1021	Biochemists and Biophysicists	100	Doctoral or professional degree
27-3021	Broadcast News Analysts	100	Bachelor's degree
13-2041	Credit Analysts	100	Bachelor's degree
43-9081	Proofreaders and Copy Markers	100	Bachelor's degree
11-3071	Transportation, Storage, and Distribution Managers	100	High school diploma or equivalent
11-9111	Medical and Health Services Managers	100	Bachelor's degree
19-3031	Clinical, Counseling, and School Psychologists	100	Doctoral or professional degree
51-4041	Machinists	50	High school diploma or equivalent
23-2093	Title Examiners, Abstractors, and Searchers	50	High school diploma or equivalent
17-3029	Engineering Technicians, Except Drafters, All Other	50	Associate's degree
11-3111	Compensation and Benefits Managers	50	Bachelor's degree
29-1141	Registered Nurses	50	Bachelor's degree
17-2051	Civil Engineers	50	Bachelor's degree
27-1021	Commercial and Industrial Designers	50	Bachelor's degree
51-6031	Sewing Machine Operators	50	No formal educational credential
41-9091	Door-to-Door Sales Workers, News and Street Vendors, and Related Workers	50	No formal educational credential

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (8/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
43-5021	Couriers and Messengers	50	High school diploma or equivalent
27-1013	Fine Artists, Including Painters, Sculptors, and Illustrators	50	Bachelor's degree
25-4012	Curators	50	Master's degree
47-2111	Electricians	50	High school diploma or equivalent
51-9111	Packaging and Filling Machine Operators and Tenders	50	High school diploma or equivalent
51-9199	Production Workers, All Other	50	High school diploma or equivalent
21-1018	Substance Abuse, Behavioral Disorder, and Mental Health Counselors	50	Bachelor's degree
51-5112	Printing Press Operators	50	High school diploma or equivalent
13-1051	Cost Estimators	50	Bachelor's degree
41-2011	Cashiers	50	No formal educational credential
51-9151	Photographic Process Workers and Processing Machine Operators	50	High school diploma or equivalent
33-1099	First-Line Supervisors of Protective Service Workers, All Other	50	High school diploma or equivalent
27-2011	Actors	50	Some college, no degree
11-9151	Social and Community Service Managers	50	Bachelor's degree
13-1031	Claims Adjusters, Examiners, and Investigators	50	High school diploma or equivalent
27-3091	Interpreters and Translators	50	Bachelor's degree
49-9099	Installation, Maintenance, and Repair Workers, All Other	50	High school diploma or equivalent
29-1069	Physicians and Surgeons, All Other	50	Doctoral or professional degree
19-3091	Anthropologists and Archaeologists	50	Master's degree

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (9/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
13-2061	Financial Examiners	50	Bachelor's degree
37-3011	Landscaping and Groundskeeping Workers	50	No formal educational credential
21-1029	Social Workers, All Other	50	Bachelor's degree
17-3027	Mechanical Engineering Technicians	50	Associate's degree
39-3092	Costume Attendants	50	High school diploma or equivalent
21-1094	Community Health Workers	50	High school diploma or equivalent
33-9099	Protective Service Workers, All Other	50	High school diploma or equivalent
29-9011	Occupational Health and Safety Specialists	50	Bachelor's degree
19-3094	Political Scientists	50	Master's degree
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	50	High school diploma or equivalent
43-4041	Credit Authorizers, Checkers, and Clerks	50	High school diploma or equivalent
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	50	Bachelor's degree
25-9041	Teacher Assistants	50	Some college, no degree
19-1029	Biological Scientists, All Other	50	Bachelor's degree
29-2071	Medical Records and Health Information Technicians	50	Postsecondary nondegree award
51-9141	Semiconductor Processors	50	High school diploma or equivalent
21-1091	Health Educators	50	Bachelor's degree
27-4031	Camera Operators, Television, Video, and Motion Picture	50	Bachelor's degree
17-2131	Materials Engineers	50	Bachelor's degree

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (10/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
27-3099	Media and Communication Workers, All Other	50	High school diploma or equivalent
17-2161	Nuclear Engineers	50	Bachelor's degree
19-3039	Psychologists, All Other	50	Master's degree
17-3013	Mechanical Drafters	50	Associate's degree
21-1099	Community and Social Service Specialists, All Other	50	Bachelor's degree
19-4091	Environmental Science and Protection Technicians, Including Health	50	Associate's degree
37-2012	Maids and Housekeeping Cleaners	50	No formal educational credential
25-1099	Postsecondary Teachers	50	Doctoral or professional degree
23-2099	Legal Support Workers, All Other	50	Associate's degree
53-3031	Driver/Sales Workers	50	High school diploma or equivalent
13-1075	Labor Relations Specialists	50	Bachelor's degree
49-2021	Radio, Cellular, and Tower Equipment Installers and Repairs	50	Associate's degree
37-1011	First-Line Supervisors of Housekeeping and Janitorial Workers	50	High school diploma or equivalent
53-3032	Heavy and Tractor-Trailer Truck Drivers	50	Postsecondary nondegree award
13-2072	Loan Officers	50	Bachelor's degree
19-1022	Microbiologists	50	Bachelor's degree
27-1026	Merchandise Displayers and Window Trimmers	50	High school diploma or equivalent
49-3023	Automotive Service Technicians and Mechanics	50	Postsecondary nondegree award
53-7063	Machine Feeders and Offbearers	50	No formal educational credential

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (11/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
49-9041	Industrial Machinery Mechanics	50	High school diploma or equivalent
39-7018	Tour and Travel Guides	50	High school diploma or equivalent
49-2098	Security and Fire Alarm Systems Installers	50	High school diploma or equivalent
19-3093	Historians	50	Master's degree
19-2021	Atmospheric and Space Scientists	50	Bachelor's degree
41-9011	Demonstrators and Product Promoters	25	No formal educational credential
11-9039	Education Administrators, All Other	25	Bachelor's degree
51-4121	Welders, Cutters, Solderers, and Brazers	25	High school diploma or equivalent
43-6012	Legal Secretaries	25	High school diploma or equivalent
33-9021	Private Detectives and Investigators	25	High school diploma or equivalent
13-1011	Agents and Business Managers of Artists, Performers, and Athletes	25	Bachelor's degree
43-9111	Statistical Assistants	25	Bachelor's degree
51-3011	Bakers	25	No formal educational credential
51-5111	Prepress Technicians and Workers	25	Postsecondary nondegree award
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	25	High school diploma or equivalent
43-6013	Medical Secretaries	25	High school diploma or equivalent
21-1015	Rehabilitation Counselors	25	Master's degree
25-9099	Education, Training, and Library Workers, All Other	25	Bachelor's degree
43-2011	Switchboard Operators, Including Answering Service	25	High school diploma or equivalent

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

LABOR MARKET DATA: NON-TECH OCCUPATIONS IN TECH INDUSTRIES (12/12)

SOC	DESCRIPTION	2018 JOBS	AVG. EDUCATIONAL ATTAINMENT
35-2012	Cooks, Institution and Cafeteria	25	No formal educational credential
47-2061	Construction Laborers	25	No formal educational credential
43-9041	Insurance Claims and Policy Processing Clerks	25	High school diploma or equivalent
43-9031	Desktop Publishers	25	Associate's degree
43-5111	Weighers, Measurers, Checkers, and Samplers, Recordkeeping	25	High school diploma or equivalent
51-9198	Helpers--Production Workers	25	High school diploma or equivalent
15-2011	Actuaries	25	Bachelor's degree
43-4061	Eligibility Interviewers, Government Programs	25	High school diploma or equivalent
17-3031	Surveying and Mapping Technicians	25	High school diploma or equivalent
47-2073	Operating Engineers and Other Construction Equipment Operators	25	High school diploma or equivalent
27-2099	Entertainers and Performers, Sports and Related Workers, All Other	25	No formal educational credential
49-9098	Helpers--Installation, Maintenance, and Repair Workers	25	High school diploma or equivalent
39-1021	First-Line Supervisors of Personal Service Workers	25	High school diploma or equivalent
31-9096	Veterinary Assistants and Laboratory Animal Caretakers	25	High school diploma or equivalent

Source: EMSI. Totals may not add up exactly due to rounding.

TECHNICAL APPENDIX

EMPLOYERS OF TECH TALENT: INTERVIEW PARTICIPANTS

TECH COMPANIES

- Major tech company
- Medium-size e-commerce company
- Medium-size health-tech company
- Medium-size technology consulting company
- Medium-size software as a service company
- Small-size hardware accelerator
- 2 small-size hardware companies

NON-TECH COMPANIES

- Large-size professional services company
- Large-size financial services company
- Large-size media company
- Small-size talent agency