



The New York City Tech Ecosystem

Generating Economic Opportunities for All New Yorkers

Acknowledgements

PREPARED BY



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The Association for a Better New York is dedicated to improving the quality of life for those that live and work in New York City and for those that visit. Special thanks to Jennifer Hensley, Eftihia Thomopoulos, and Jordan Isenstadt for their involvement in the study.



Citi, the leading global bank, has approximately 200 million customer accounts and does business in more than 1,000 cities across 160 countries. Citi provides consumers, corporations, governments and institutions with a broad range of financial products and services, including consumer banking and credit, corporate and investment banking, securities brokerage, transaction services, and wealth management. Thanks to Josh Moskowitz, Chitra Narasimhan, and Tyler Daluz who played integral roles in helping craft this report.



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For more information on the New York City Tech Ecosystem, visit www.nyctechconomy.com

Contents

Executive Summary	5
Section 1: The New York City Tech Ecosystem	17
Section 2: Economic & Fiscal Impact Analysis	49
Section 3: Public Policy Positions	55
Technical Appendix	67



Executive Summary

The New York City tech ecosystem generates economic opportunities for all New Yorkers.

The New York City tech ecosystem includes 291,000 jobs that are enabled by, produce, or facilitate technology. Tech industries generate 58,000 tech jobs and 83,000 non-tech jobs, while non-tech industries generate 150,000 tech jobs. In total, New York City's tech ecosystem employs 291,000 people or 7% of the 4.27 million people working in New York City. To put this figure into context, the retail sector employs 354,000 people or 8% of total workers, while healthcare employs 665,000 people or 16% of total workers.

From 2003 to 2013, the New York City tech ecosystem added 45,000 jobs, growing faster than both total New York City employment and total U.S. employment. The New York City tech ecosystem grew from 246,000 jobs to 291,000 jobs, an increase of 18%. In comparison, over the same period, employment increased by 12% in New York City and 4% nationally.

The New York City tech ecosystem generates approximately 541,000 jobs, \$50.6 billion in annual compensation, and \$124.7 billion in annual output. Of the 541,000 total jobs, 291,000 are direct, and 250,000 jobs are generated through multiplier effects. Together they comprise 12.6% of New York City's total workforce.

The New York City tech ecosystem includes more than just highly-educated workers – up to 44% of jobs in the New York City tech ecosystem do not require a Bachelor's degree. 128,000 jobs in the tech ecosystem do not require a Bachelor's degree, with 11,600 of those being tech jobs in tech industries.

Workers in the New York City tech ecosystem earn 49% more than the average City-wide hourly wage. The hourly wage for the tech ecosystem is \$39.50, while the average City-wide wage is \$26.50.

Jobs in the New York City tech ecosystem that do not require Bachelor's degrees pay 45% more in hourly wages than jobs with the same educational requirements in other industries. Tech ecosystem jobs that do not require a Bachelor's degree pay \$27.75 per hour, while the average City-wide hourly wage for a job with the same educational attainment requirement is \$19.00 per hour.

The New York City tech ecosystem generates over \$5.6 billion in annual tax revenues to the City, representing 12.3% of the City's 2013 tax revenue. \$2.5 billion comes from property taxes, \$1.3 billion from personal income taxes, \$0.9 billion from sales and use taxes, and \$0.9 billion from corporation and business income taxes.

This study aims to understand the comprehensive size and economic and fiscal impact of the New York City tech ecosystem.

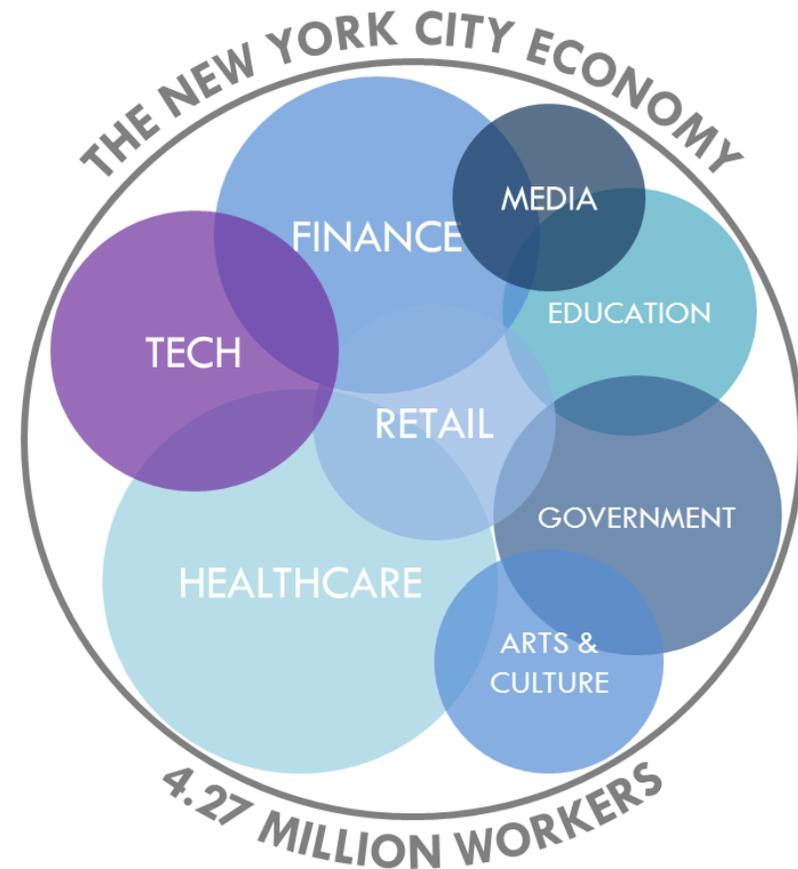
Historically, policymakers have analyzed a region's economic performance by examining its dominant industries. The analysis of an industry, defined as a collection of private firms with common products and customers, primarily considers output and aggregate demand, with secondary consideration for the functional roles necessary for each enterprise.

Yet an industry-focused evaluation fails to capture the cross-cutting economic contributions of a functional role whose success permits the broad growth of several regional industries.

In order to evaluate the economic value of common functional roles across industries, policymakers have developed a new term – an “ecosystem” – defined as a network of organizations that enable the provision of goods or services. This approach offers policymakers a new lens by which to evaluate regional economic performance in today's globally competitive economy.

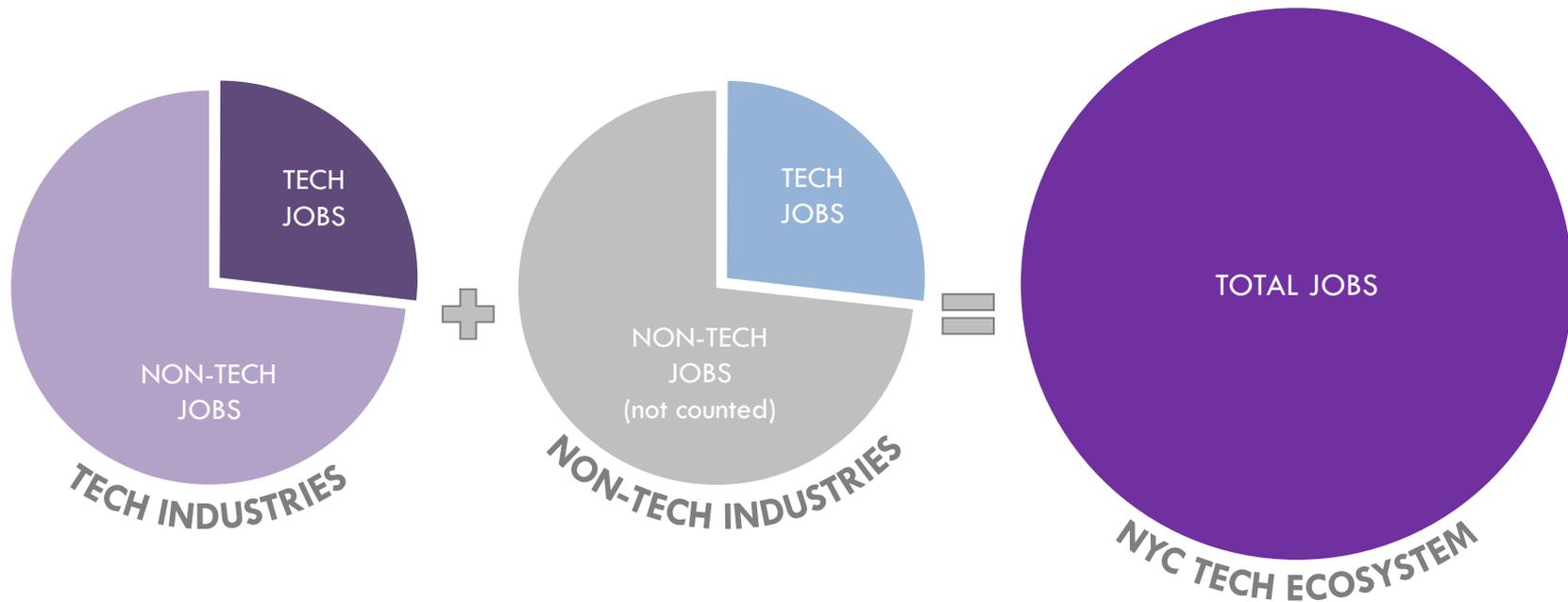
This groundbreaking study provides an in-depth evaluation of New York City's tech ecosystem's impact on the City over the past ten years and meets the following three goals:

Sources: EMSI; HR&A Advisors, Inc. Analysis



1. Define the comprehensive tech ecosystem;
2. Understand its fiscal and economic impact; and
3. Recommend public policies to foster growth.

The NYC tech ecosystem is defined by the employment within tech and non-tech industries that are distributed amongst all sectors of the NYC economy.



Where prior studies have treated tech as an independent silo, this study considers the entire economy, as tech is distributed throughout the greater New York City economy. The New York City tech ecosystem is defined by three categories of jobs that all directly enable, produce or facilitate technology: 1) tech jobs in tech industries, 2) non-tech jobs in tech industries and 3) tech jobs in non-tech industries.

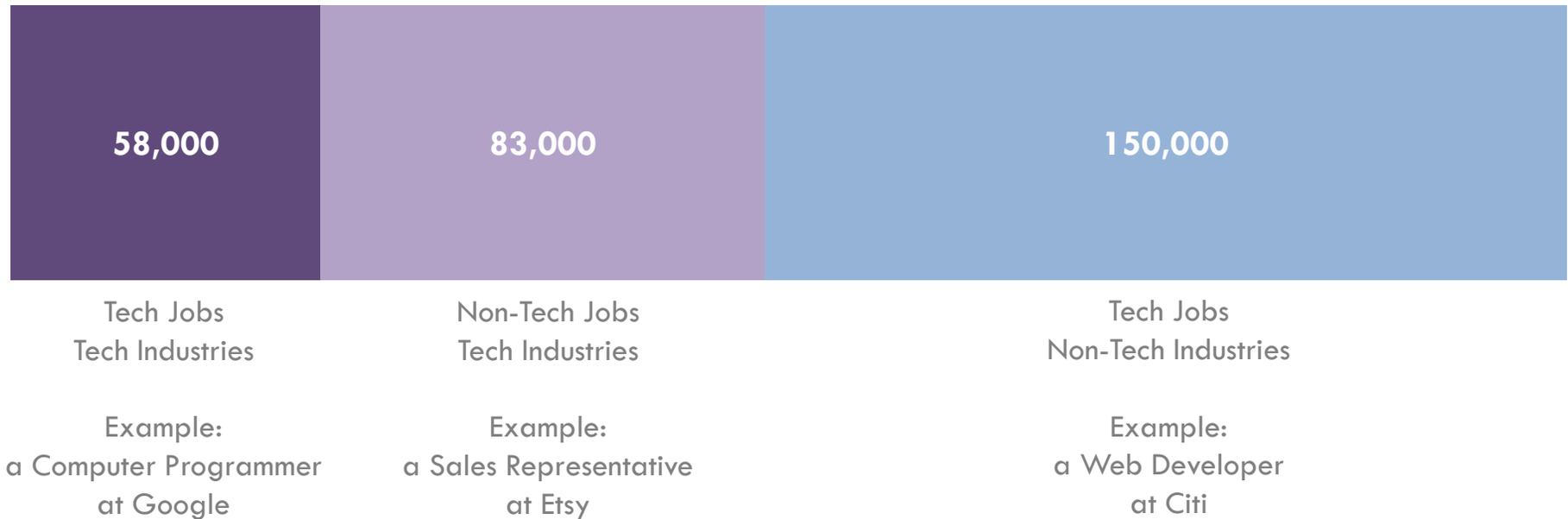
This study uniquely includes jobs not only from tech industries, but also from tech occupations in non-tech industries. The inclusion of tech occupations in non-tech industries is a significant addition to traditional methodologies and enables an accounting of tech jobs located in industries not typically considered tech-related.

Sources: EMSI; HR&A Advisors, Inc. Analysis

Executive Summary

Of the 291,000 jobs comprising the NYC tech ecosystem, over half are within non-tech industries.

NYC Tech Ecosystem – 291,000 Jobs



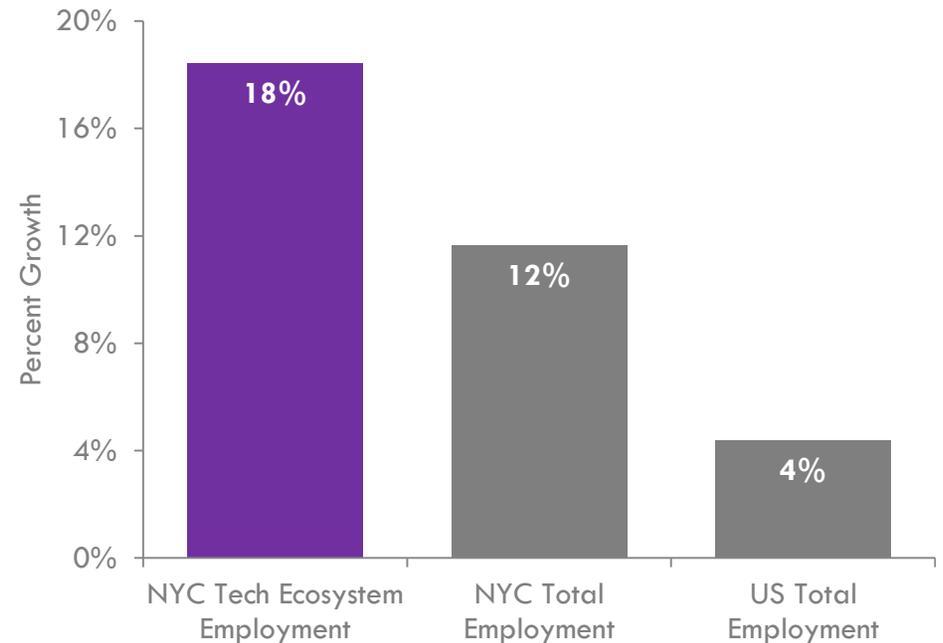
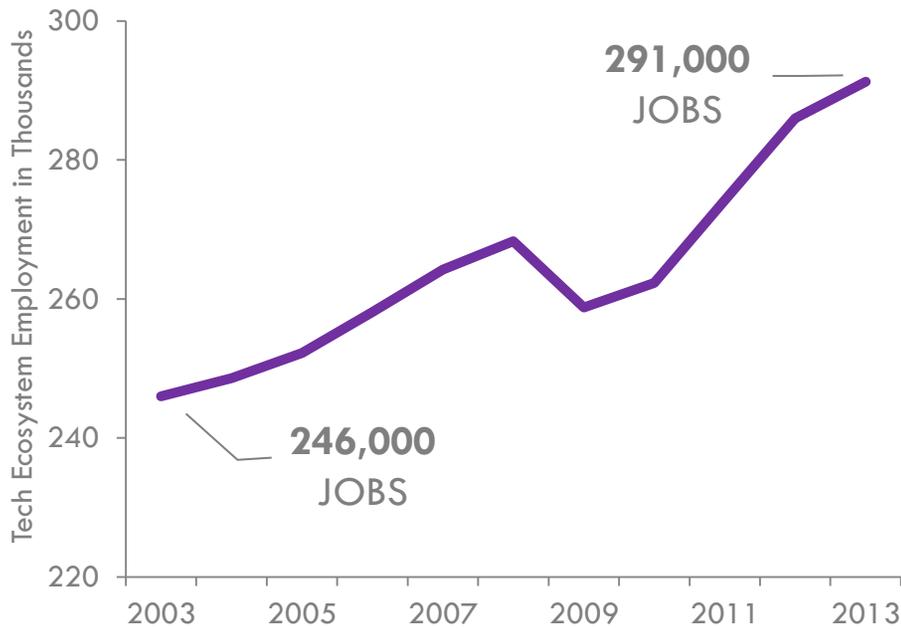
Tech jobs are embedded in all sectors of the New York City economy. There are 58,000 people working in tech occupations in tech industries (e.g. a computer programmer at Google), 83,000 people working in non-tech occupations in tech industries (e.g. a sales representative at Etsy), and 150,000 people working in tech occupations in non-tech industries (e.g. a web developer at Citi). In total, there are 291,000 total jobs within the New York City tech ecosystem.

As indicated above, 52% of New York City tech ecosystem jobs are within non-tech industries. This share includes all tech jobs within the IT departments at non-tech firms such as financial institutions, hospitals, government agencies, media companies, and other key sectors of the economy. With more than half of the New York City tech ecosystem workers employed by non-tech firms, it is clear that tech is a critical component of the entire New York City economy.

Sources: EMSI; HR&A Advisors, Inc. Analysis

Executive Summary

From 2003 to 2013, the NYC tech ecosystem added 45,000 jobs, growing faster than employment in New York City and the Nation.



Over the past 10 years, the New York City tech ecosystem grew by 45,000 jobs (18%), outpacing New York City's 12% employment growth and the Nation's 4% growth over the same time period. Although there was a slight decline in size from 2008 to 2009 due to the recession, from 2010 to 2013, the tech ecosystem grew by 11% (compared to 6% growth of the overall New York City workforce). Not only did the tech ecosystem recover from the recession – it surpassed previous growth rates and is contributing to the

expansion of the greater New York City economy today. During this period, tech jobs in tech industries grew by 17,000 jobs (41%), non-tech jobs in tech industries grew by 16,000 jobs (24%), and tech jobs in non-tech industries grew by 12,000 jobs (9%). Additionally, over the past 10 years, the tech ecosystem increased its share of the total New York City employment from 6% to 7%, demonstrating its growing impact on, influence over, and integration within other City-wide economic ecosystems.

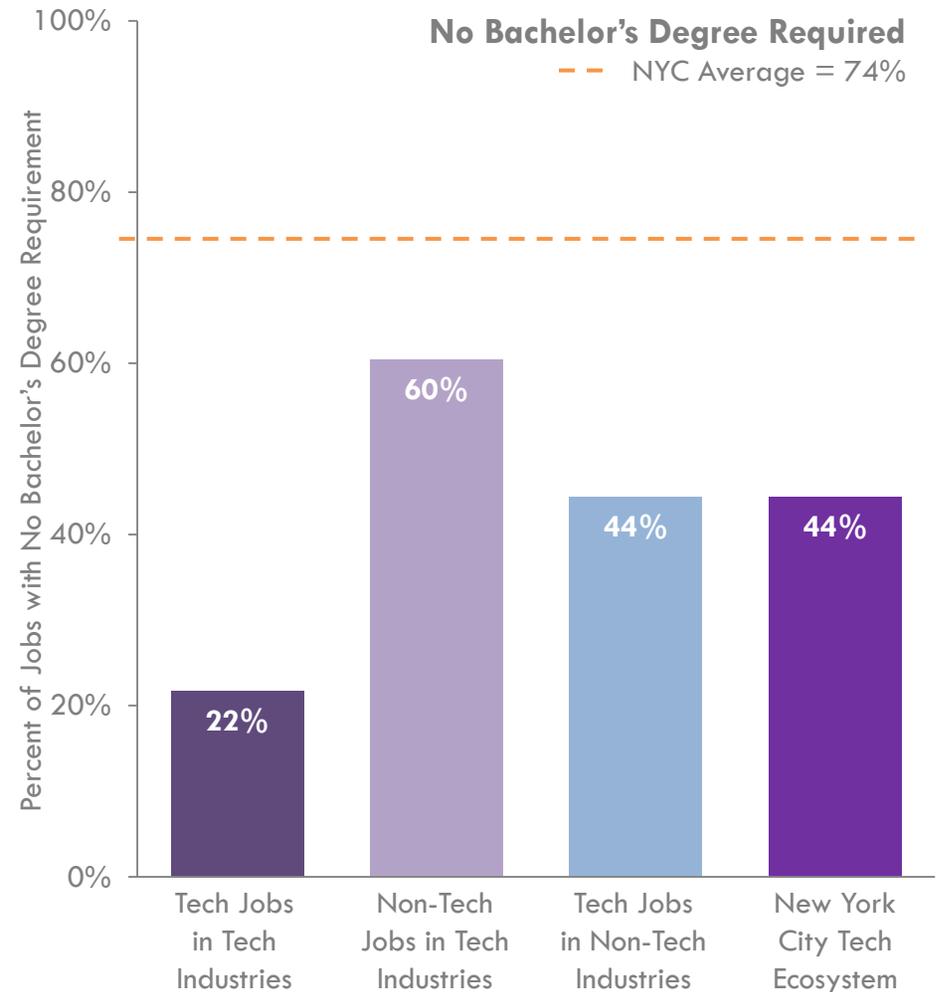
Sources: EMSI; HR&A Advisors, Inc. Analysis

The NYC tech ecosystem includes more than just highly-educated workers – up to 44% of jobs in the NYC tech ecosystem do not require a Bachelor's degrees.

As expected, tech creates opportunities for people with higher education. However, many tech jobs are available for those who do not possess or desire to pursue a Bachelor's degree. In fact, up to 44% of jobs in the New York City tech ecosystem, or 128,000 jobs, are accessible to people without a Bachelor's degree.

Over 60% or 90,000 non-tech jobs in tech industries do not require a Bachelor's degree and are providing the largest share of opportunities for people with lower levels of educational attainment. Drilling down to the occupational level, four of the five most common non-tech occupations in tech industries do not require a college education. For example, over 113,000 office support staff are employed in New York City. This occupation comprises 3,100, or 3.7%, of all non-tech jobs in tech industries and 1.1% of total jobs in the New York City tech ecosystem.

Furthermore, many tech ecosystem jobs only require short-term or long-term on-the-job training. By removing the barrier of a college degree, opportunities in the tech ecosystem can potentially empower the 2.89 million New Yorkers ages 25 to 64 who do not hold Bachelor's degrees.



Sources: EMSI; HR&A Advisors, Inc. Analysis; O*NET Online website; American Community Survey 5-Year, 2008-2012

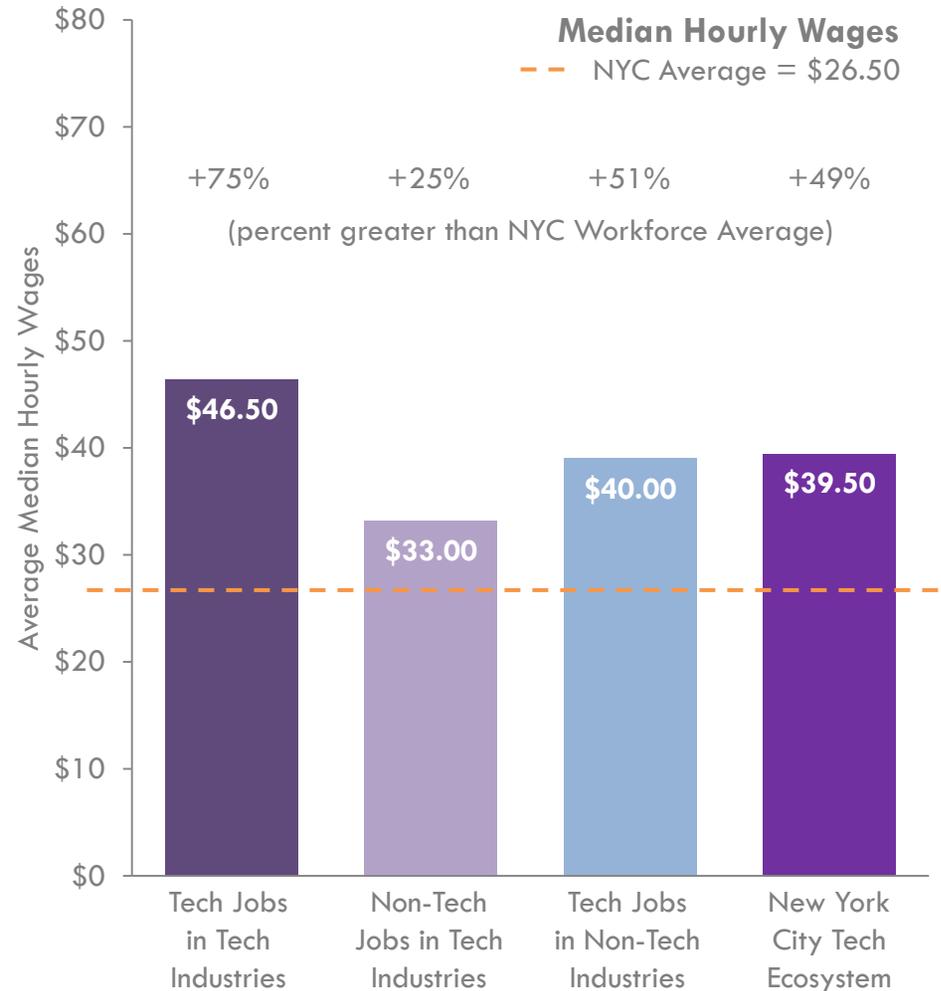
Workers in the NYC tech ecosystem earn 49% more than the average NYC hourly wage.

As of 2013, the average New York City median hourly wage was \$26.50. Tech ecosystem jobs pay above the City-wide average. In fact, tech ecosystem workers are paid 49% more than the City-wide average of \$26.50. In comparison to this average, tech workers in tech firms earn 75% more, tech workers in non-tech firms earn 51% more, and non-tech workers in tech firms earn 25% more.

New Yorkers working in manufacturing earn a median hourly wage of \$24.00, which is 39% less than the tech ecosystem. Retail employees in New York City earn less at \$17.25 an hour – 56% less than the tech ecosystem. Workers in accommodation and food services make the least at \$14.00 an hour – 65% less than tech ecosystem wages.

The most common tech occupation in tech industries is the applications developer. Almost 12,000 applications developers are employed at tech firms, making \$52.75 an hour, which is 33% more than the tech ecosystem average and 99% greater than the City-wide average. These 12,000 jobs are within an occupation that would not exist without the rise of ubiquitous computing, the internet, and mobile communication technologies.

Sources: EMSI; HR&A Advisors, Inc. Analysis; O*NET Online website



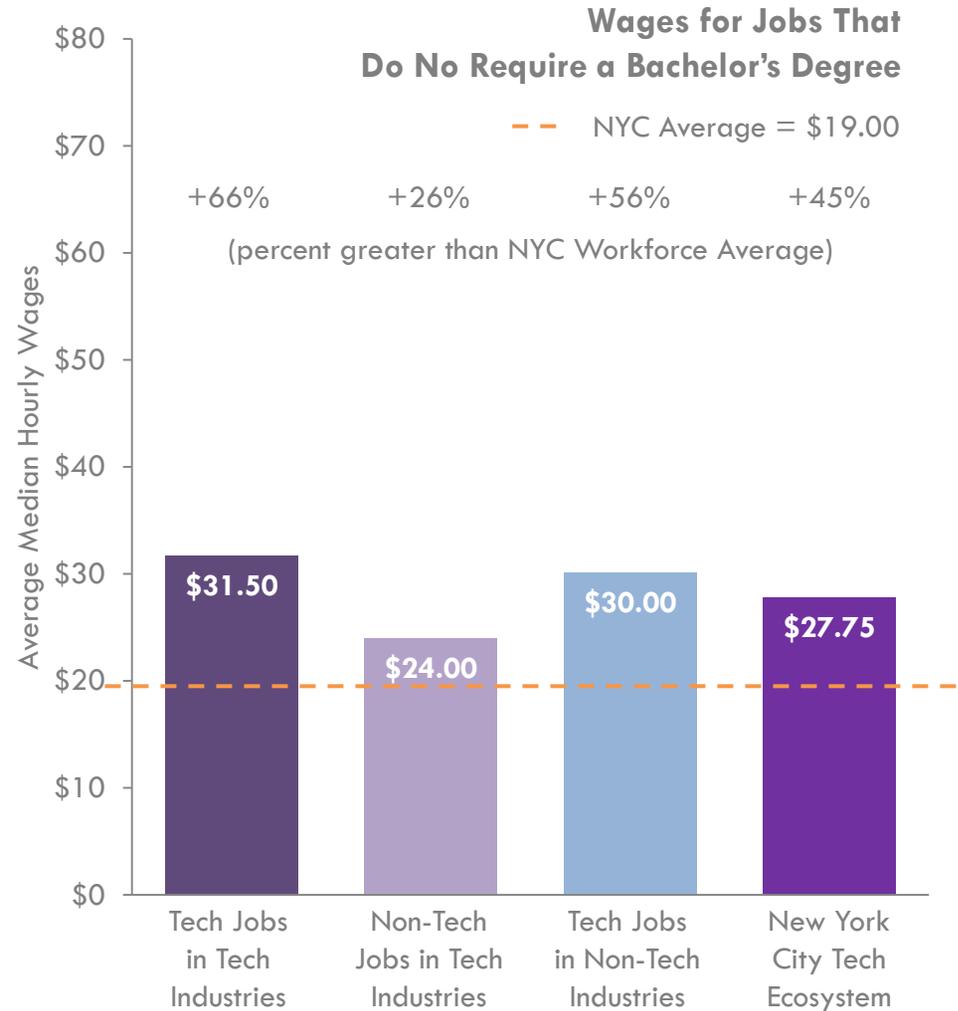
Jobs in the NYC tech ecosystem that do not require Bachelor's degrees pay 45% higher hourly wages than jobs with the same educational requirements.

For New York City tech ecosystem workers, wages are significantly higher than the average NYC median wage for jobs that do not require a Bachelor's degree. Tech jobs in tech industries that do not require Bachelor's degrees pay more than other jobs in New York City with similar educational requirements.

Representing over 5,600 jobs, sales representative is the most common non-tech occupation within tech industries that does not require a Bachelor's degree. In fact the position only requires short-term on-the-job training. While sales representatives earn a median hourly wage of \$33.60 across all industries, sales representatives comprise 7% of all non-tech jobs in tech industries and 2% of all tech ecosystem jobs, providing more higher-wage opportunities for workers with lower educational attainments.

In comparison, the most common occupation City-wide is the retail salesperson with 126,000 workers (3% of City-wide employment). In 2013, retail salespeople earned a median hourly wage of \$11.00 which, although higher than minimum wage, is well below the City-wide average and significantly below the New York City tech ecosystem average hourly wage.

Sources: EMSI; HR&A Advisors, Inc. Analysis; O*NET Online website



Executive Summary

The NYC tech ecosystem generates approximately 541,000 total jobs, which comprises 12.6% of total NYC employment.

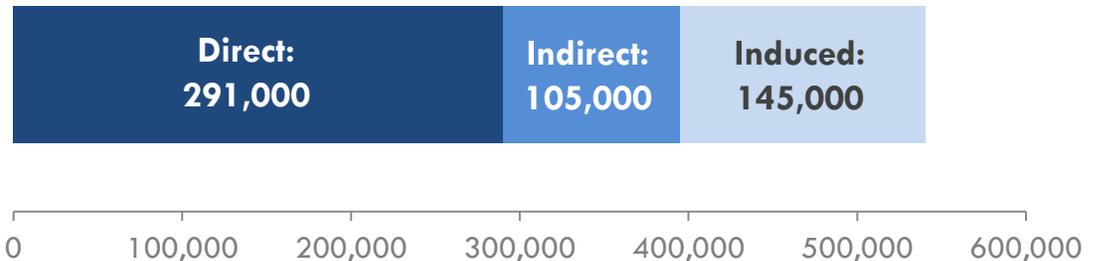
The economic impact study measures the impact of existing employment in the New York City tech ecosystem in terms of employment, employee compensation, and economic output (spending) generated.

The New York City tech ecosystem is responsible for 541,000 total jobs, equal to 12.6% of City-wide employment. 291,000 of these jobs are directly employed by the New York City tech ecosystem. The remaining 250,000 jobs are generated through the multiplier impacts of the direct NYC tech ecosystem employment.

Because jobs in the tech ecosystem are disproportionately found in high-wage industries like finance and information, their impact on the City's economy is outsized relative to the number of jobs. Considering both direct and multiplier effects, the New York City tech ecosystem generates \$50.6 billion in employee compensation, or 13.1% of all compensation in the City. The \$124.7 billion in output generated by the New York City tech ecosystem represents 13.8% of total output in the City.*

*See Technical Appendix for more information; Sources: EMSI; IMPLAN; HR&A Advisors, Inc. Analysis

541,000 Total Jobs Generated



\$50.6 Billion Total Compensation Generated



\$124.7 Billion Total Output (Spending) Generated



The NYC tech ecosystem generates over \$5.6 billion in annual tax revenues to New York City.

The New York City tech ecosystem generates \$5.6 billion in annual tax revenues to New York City, representing approximately 12.3% of the City's total Fiscal Year 2013 tax revenue of \$45.7 billion. This revenue derives from a variety of City taxes and is critical to funding vital City services like education, fire, and police.

\$2.5 billion of this annual tax revenue owes to property taxes on real estate (from both commercial and residential). Significant amounts of City revenue are also generated via personal income tax (\$1.3 billion), sales and use tax (\$0.9 billion), and corporation and business taxes (\$0.9 billion) receipts that owe to economic activity associated with the tech ecosystem.*



*See Technical Appendix for more information

Sources: EMSI; NYC Comptroller's Comprehensive Annual Financial Report; IMPLAN; HR&A Advisors, Inc. Analysis

HR&A suggests public policy considerations for the continued growth of the NYC tech ecosystem.

EDUCATION & WORKFORCE

- Create continuing education and workforce development programs that provide training for the required skills of growing tech occupations.
- Continue to support the technical programs of existing NYC-based universities and educational institutions.
- Expand efforts to incorporate computer literacy and other technical curricula into the New York City primary education system.

REAL ESTATE & INFRASTRUCTURE

- Create and expand tech hubs that centralize goods, supportive services and other resources critical to tech firms.
- Provide low-cost, flexible spaces for startups and business incubation, including critical step-up space to support new companies as they grow.
- Invest in state of the art infrastructure to enable the productivity of tech firms and workers across New York City.

ATTRACTION & RETENTION

- Promote New York City as a thriving, international hub of commerce and innovation that fosters opportunities for companies and workers.
- Centralize and coordinate New York City's existing and impactful tech-oriented programs and services.
- Maintain support for livable city initiatives that enhance New York City's attractiveness to tech ecosystem workers building their careers and lives.

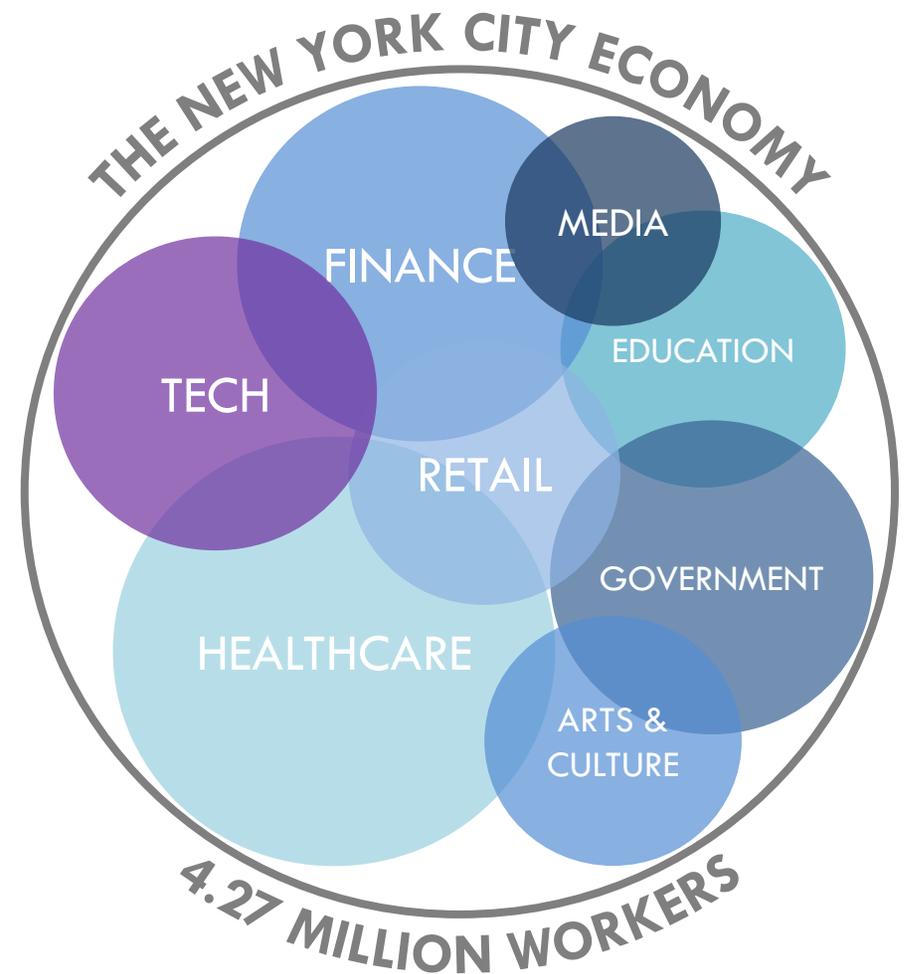
SECTION 1

Definition & Composition

The New York City economy is comprised of dynamic, overlapping ecosystems.

As of 2013, there were 4.27 million people working in New York City, where New York City is defined as the region comprised of the Bronx, Kings, New York, Queens, and Richmond counties. Of the 4.27 million, 3.39 million people were employed by the private sector, 566,000 were employed by the government, and 316,000 were self-employed. These workers are spread across the diverse range of industry sectors that comprise the entire New York City economy including: finance (employing 325,000 people), retail (employing 354,000 people) and healthcare (employing 665,000 people).

Tech appears across these sectors and needs to be evaluated as an economic “ecosystem” - a network of organizations that enable the provision of goods or services rather than an isolated, independent industry. For example the computer systems administrator employed by a hospital’s information technology department is directly employed by the healthcare sector but also needs to be considered in evaluating the complete tech ecosystem.



Definition and Composition

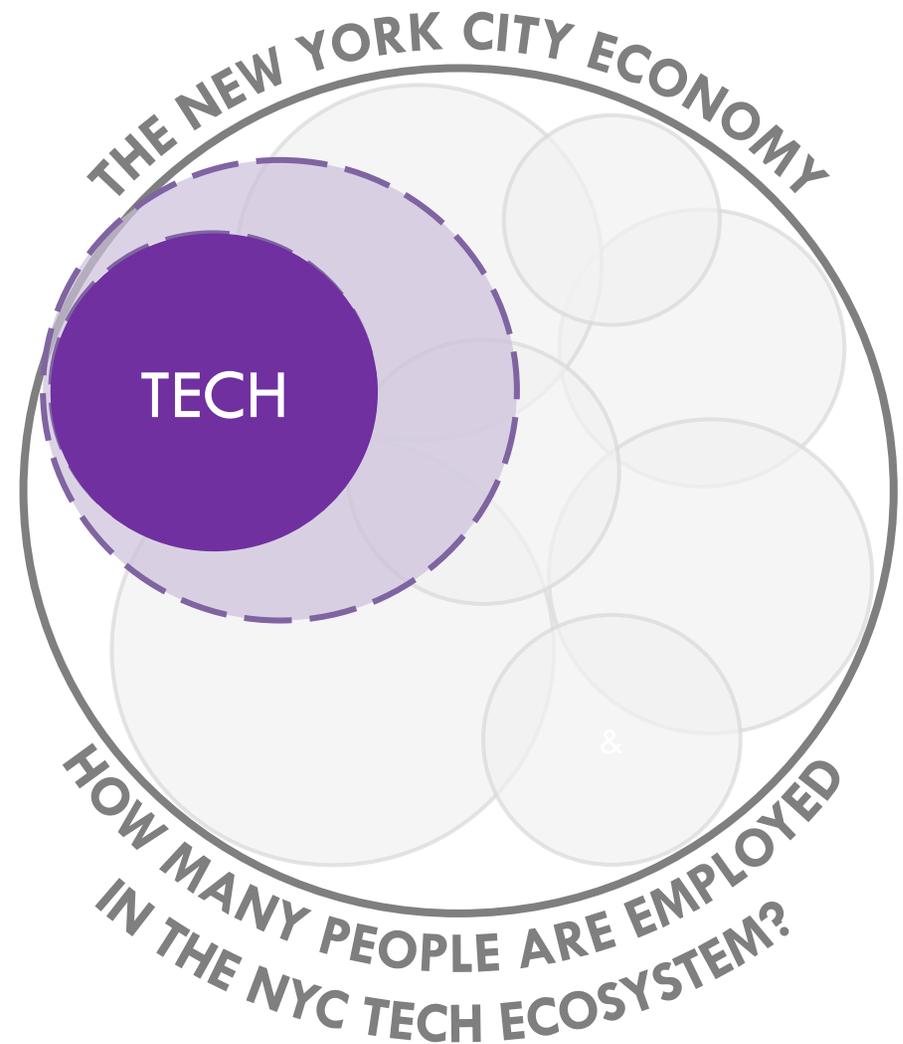
This study evaluates the comprehensive definition of the NYC tech ecosystem to understand its impact and significance to the overall economy.

New York City's tech ecosystem is a topic that is widely discussed and debated. The City of New York invested millions of dollars towards efforts to diversify the economy, especially through the support of technology initiatives. In addition, several studies were recently published that approximate the current size and future potential of the New York City tech ecosystem.

Understanding the size and impact of tech is crucial given its cross-cutting economic contributions allows for broad growth of several regional industries. This study provides an in-depth look at the New York City tech ecosystem's impact on the City over the past ten years, and aims to meet the following three goals:

1. Define the comprehensive tech ecosystem;
2. Understand its fiscal and economic impact; and
3. Recommend public policies to foster growth.

Furthermore, the methodology introduced in this study is independent of characteristics unique to New York City and can be replicated for other geographic regions given the availability of comparable datasets.



Definition and Composition

Several studies have attempted to evaluate the NYC tech ecosystem using a variety of methods and metrics.

Prior studies have predominantly relied on industry definitions alone to define tech in New York City, while other reports use anecdotal evidence such as venture capital deals and total exits, to point to the growth of the New York City tech ecosystem.

This study uniquely includes all jobs from tech industries and well as tech occupations in non-tech industries. Including tech occupations is a significant addition to traditional methodologies and enables the accounting of tech jobs located in traditionally defined non-tech industries. Where prior studies have treated the tech industry as an independent silo, this study considers the entire ecosystem, and tech's distribution and impact on the overall economy.

In addition, this study incorporates labor market data that captures the self-employed, a category of workers often excluded or overlooked in other studies that rely on standard data from the Quarterly Census of Employment and Wages. Given the recent successes of the peer economy and other cottage industries resulting from advances in technology, it is critical to include this cohort in a comprehensive evaluation of the New York City tech ecosystem.

Organization	Publication Title & Key Findings	Estimated Tech Jobs	Year
NYCEDC	*Information provided internally	132,000	2013
Bloomberg Technology Summit	“Building a Digital City” NYC’s share of the US private sector employment is the highest in 20 years due to tech	262,000 - 348,000	2013
Center for an Urban Future	“New Tech City” Tech startups and VC deals in NYC have increased over the past 5 years	52,900 (IT jobs only)	2012
Partnership for New York City	“NYC Jobs Blueprint” NYC’s high-tech is the fastest growing sector in terms of economic output	98,000	2013

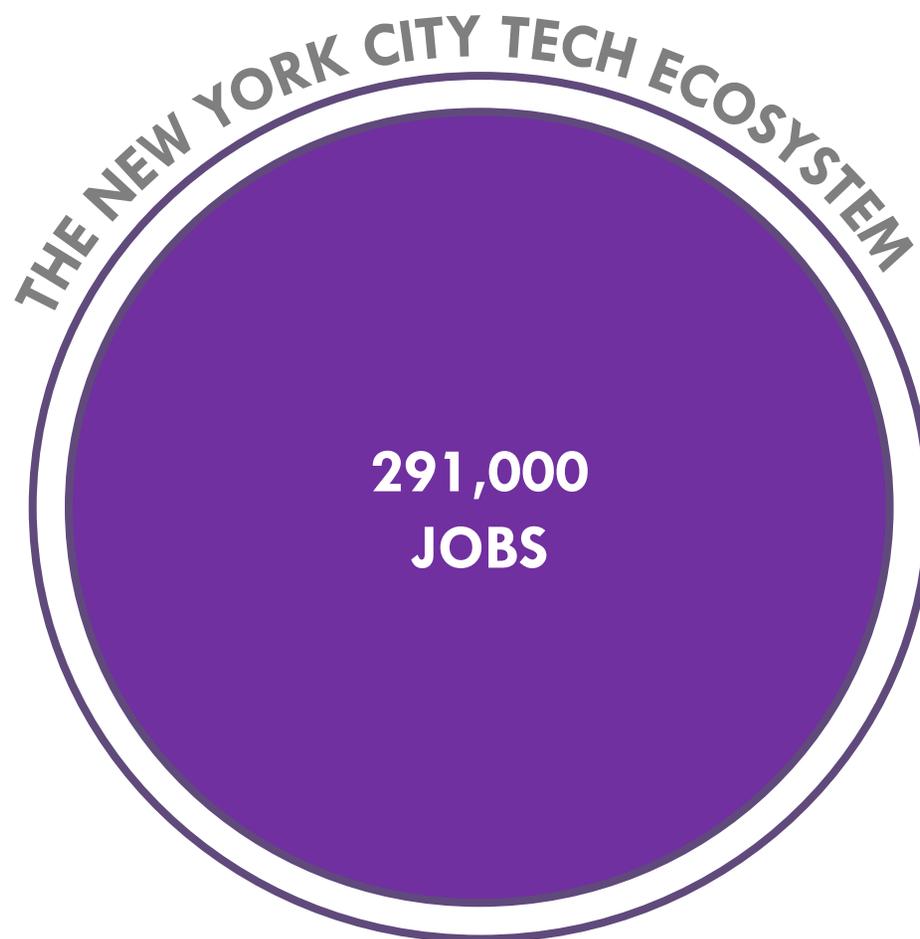
Definition and Composition

The workforce that comprises NYC's tech ecosystem is both diverse and expansive.

The New York City tech ecosystem comprises 7% of the 4.27 million people working in New York City. The 291,000 jobs comprising the tech ecosystem include workers in New York City government, the private sector, and those who are self-employed.

The New York City tech ecosystem is not limited to tech firms but is spread across three domains: tech jobs in tech industries, non-tech jobs in tech industries and tech jobs in non-tech industries. These 291,000 jobs demonstrate the resilience of the NYC economy over the last decade and quantify the City's transformation into one of the world's preeminent tech hubs. Most importantly, this number represents a diverse demographic of people with various educational backgrounds from all five New York City boroughs.

The following pages describe the methodology to determine the comprehensive size of the New York City tech ecosystem, explores its industry and occupational compositions, compares its performance to Bay Area tech ecosystems, and dives into wage, demographic, and education levels characteristics.



Sources: EMSI; HR&A Advisors, Inc. Analysis

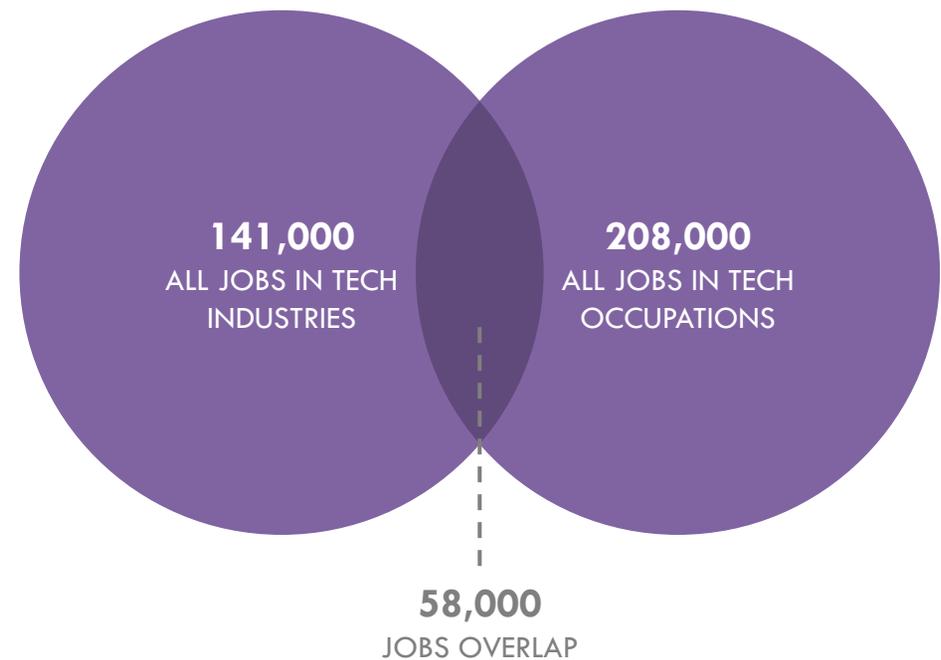
Definition and Composition

The NYC tech ecosystem is comprised of all jobs in tech industries and jobs from tech occupations in non-tech industries.

Tech industries enable or produce technology. North American Industry Classification System (NAICS) codes as defined by the U.S. Census Bureau are used to categorize all industries. In this scheme, where Software Publishing is an industry class, Google is a firm that falls under that industry classification. The 15 tech industries included in our definition support 141,000 jobs; these jobs are comprised of both tech and non-tech occupations.*

Tech occupations produce, facilitate, or exist because of technology. Standard Occupational Classification (SOC) codes as defined by the Bureau of Labor Statistics are used to categorize all occupations. A computer programmer is classified under Computer Programming and assumed to be a tech occupation whether the person is employed by a tech industry firm or a non-tech industry firm. The 48 tech occupations included in our definition support 208,000 jobs in NYC.*

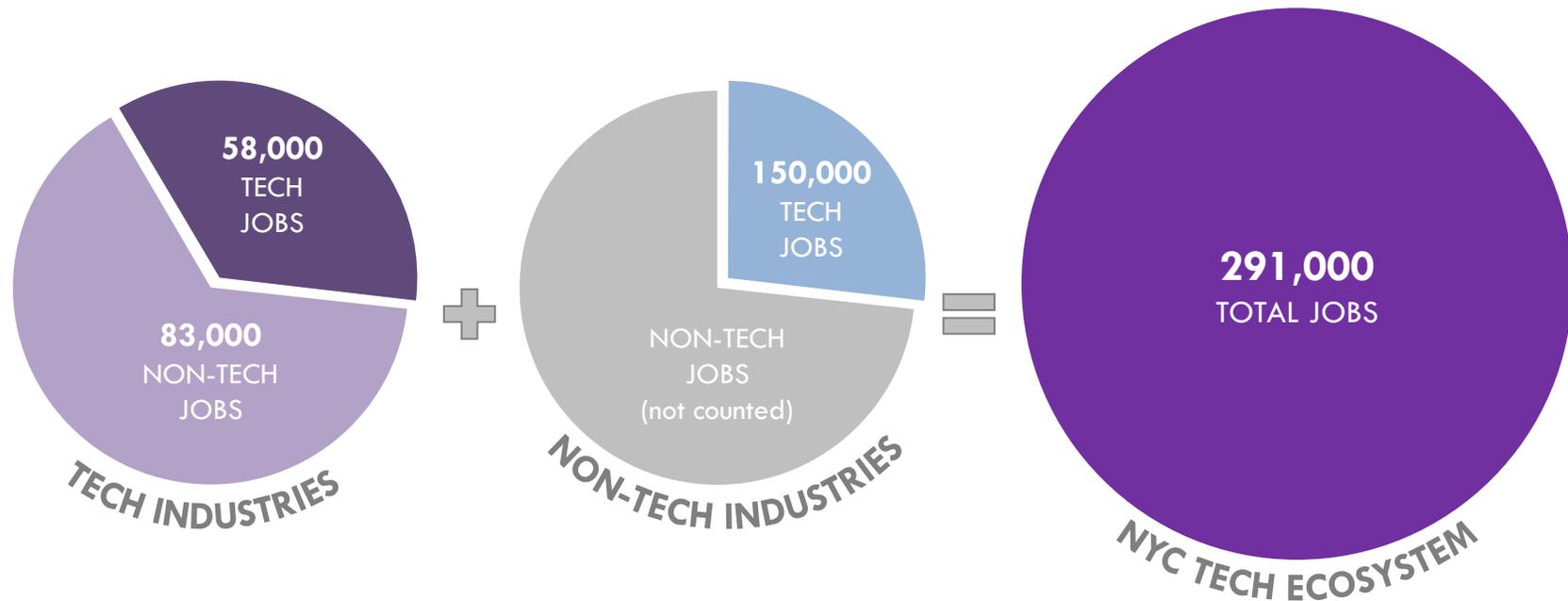
Between these two domains, an overlap of 58,000 jobs exists. These jobs are tech occupations within tech industries. A computer programmer at Google is an example of a tech job within a tech firm.



*See Technical Appendix for full listing of Tech Industries and Tech Occupations; Sources: EMSI; HR&A Advisors, Inc. Analysis

Definition and Composition

The NYC tech ecosystem is defined by the employment within tech and non-tech industries that is distributed amongst all sectors of the NYC economy.



The New York City tech ecosystem is defined by three categories of jobs that all directly enable, produce or facilitate technology. Jobs comprising the tech ecosystem fall into the following categories: 1) tech jobs in tech industries, 2) non-tech jobs in tech industries and 3) tech jobs in non-tech industries. There are 58,000 people working in tech occupations in tech industries (e.g. a computer programmer at Google), 83,000 people working in non-

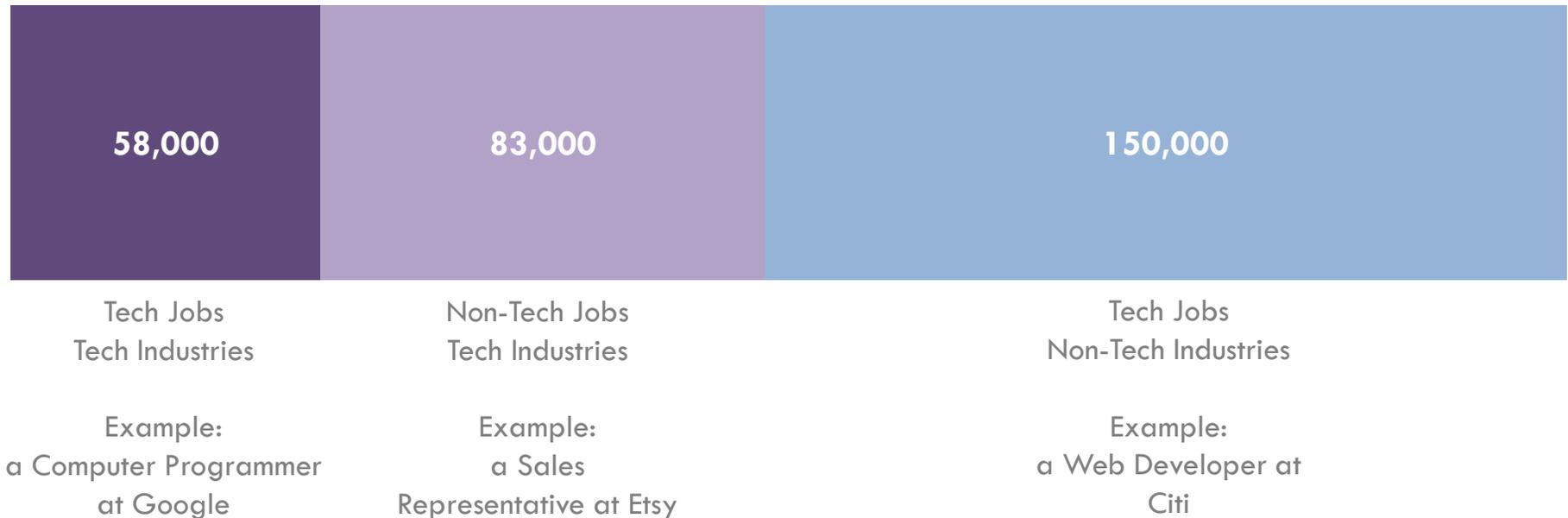
tech occupations in tech industries (e.g. a sales representative at Etsy) and 150,000 people working in tech occupations in non-tech industries (e.g. a web developer at Citi). Added together there are 291,000 people working in the New York City tech ecosystem which represents 7% of all people working in New York City.

Sources: EMSI; HR&A Advisors, Inc. Analysis

Definition and Composition

Over half of the jobs in the NYC tech ecosystem are found in non-tech industries.

NYC Tech Ecosystem – 291,000 Jobs



Tech jobs play a vital role in all sectors of the New York City economy. As indicated above, 52% of the City's tech ecosystem jobs are within non-tech industries, including all tech jobs within the IT departments at non-tech firms such as financial institutions, hospitals, government agencies, media companies, and other key sectors of the economy. With more than half of the City's tech ecosystem workers employed by non-tech firms, it is clear that tech is a critical

component of the entire City economy. The finance, insurance, healthcare, and real estate industries comprise the foundation of the City's robust economy. Manufacturing, although in decline, still wields a considerable amount of influence over the economy. Tech appears in each of these industries and plays a significant role in New York's continued success in these sectors by enabling firms to adapt their businesses to the ever-changing market conditions.

Sources: EMSI; HR&A Advisors, Inc. Analysis

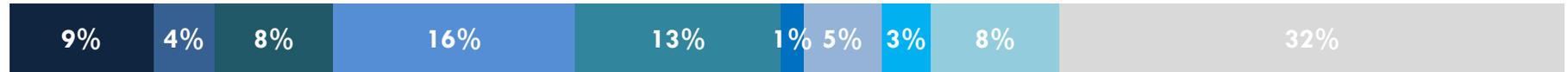
Definition and Composition

Almost two-thirds of the NYC tech ecosystem jobs are within professional services, information, finance and insurance industry sectors.

NYC Tech Ecosystem – 291,000 Jobs



NYC Economy – 4.27 Million Jobs



- Professional, Scientific, & Technical Services
- Information
- Finance & Insurance
- Health Care & Social Assistance
- Government
- Management of Companies
- Educational Services
- Wholesale Trade
- Retail Trade
- Other

Of the 4.27 million people working in New York City, 21% work in the economic drivers of Professional Services, Information, Finance and Insurance supersectors; whereas 63% of the 291,000 workers in the NYC tech ecosystem work in these sectors. The tech ecosystem’s dominance of these key sectors demonstrates the vital role technology plays in supporting the business and operations of firms within these traditionally strong sectors of the NYC economy.

The “Other” industry supersectors grouped together in the figure above include the following 12 NAICS classifications: Accommodation and Food Services, Administrative, Support, and Waste Management Services, Transportation and Warehousing, Real Estate and Rental, Arts and Entertainment, Manufacturing, Construction, Utilities, Agriculture, Mining, Other Services, and Unclassified Industries.

Sources: EMSI; HR&A Advisors, Inc. Analysis

Tech jobs in tech industries spur the creation of non-tech jobs in tech industries.

Tech Jobs in Tech Industries – 58,000 Jobs



Non-Tech Jobs in Tech Industries – 83,000 Jobs



■ Professional, Scientific, and Technical Services ■ Information ■ Retail Trade ■ Manufacturing

Over 95% of New York City’s tech industry jobs are found in two supersectors: Professional, Scientific, and Technical Services; and Information. Within these two supersectors, the Computer Systems Design and Related Services industry supports the largest share of New York City tech ecosystem jobs, representing 12.7% of total tech ecosystem jobs or approximately 60,000 jobs.

Due to the multiplier effect, tech jobs in tech industries can support the creation of non-tech jobs across a range of sectors. There are approximately 2.0 non-tech jobs for every tech job in Information; for Retail, there are 7.8 non-tech jobs for every tech job. As tech jobs in these sectors increase, a greater number of non-tech jobs follow, which suggests that tech can catalyze job creation and economic growth for all workers.

Sources: EMSI; HR&A Advisors, Inc. Analysis

Definition and Composition

Tech occupations are now embedded in financial services companies like Citi as these firms modernize operations and innovate new products and services.

The finance and insurance supersector supports 8% of New York City jobs, and 12% of all jobs in New York City's tech ecosystem. Companies in this supersector employ tech workers to streamline their business operations and develop new products and services for an increasingly digital consumer base.

Headquartered in Manhattan, Citi has the world's largest proprietary financial services network, connecting 250,000 staff and 11,000 locations across 160 countries worldwide. Citi directly employs nearly 17,000 people in New York City, of which 1,860 are estimated to work within the tech ecosystem under this study's definition. Tech occupations within the firm include systems architects, project managers, developers, testers, system administrators and information-security specialists. People in these tech positions provide extensive technical support to Citi's worldwide network, protect and strengthen information security, and play an integral role in the development of new products. In addition to employing tech workers directly, financial services firms like Citi also support tech workers outside of their companies by engaging external vendors and investing in and incubating tech startups based in New York City to help them develop new digital products and services.

Citi strives to be *the* digital bank, and makes considerable efforts to invest in technology to support its expansion of consumer-side banking services. For example, in February 2014, Citi unveiled its new mobile app for banking and credit card users. Teams from Ohio to India worked on the development and deployment of the app for Citi, but its creative and strategic base was in NYC, where the head of Internet and Mobile Banking for Citi and her team are



NAICS: 5221	\$70.2 B
Depository Credit Intermediation	Annual Revenue Estimates

16,870	1,860	11%
Employees in NYC	Employees in Tech Occupations	Share of Tech Occupations

Sources: SEC 2013 Form 10-K, 'Citigroup'; "New York City's Biggest Employers", Business Insider (2012)

Definition and Composition

Tech occupations are now embedded in financial services companies like Citi as these firms modernize operations and innovate new products and services.

headquartered. New York-based product managers led the creation of the app, and Citi engaged dozens of other New York-based tech employees at outside entities to help design the application. Similar examples exist for other recent innovations at Citi, including the development of its award-winning tablet app, a new ATM experience, and a new consumer website. Citi's technology teams also develop software to provide consistent and innovative solutions for its institutional clients. For example, Citi's e-commerce application, Citi Velocity, allows for better and more efficient trading experiences on desktops as well as mobile channels, which offers more solutions to its clients.

As consumer banking continues to embrace technology, financial services firms like Citi and its competitors will increasingly need a talented technology workforce. To ensure that New York City can meet this demand, it is critical for the City to invest in and implement policies to attract and maintain these workers across the economy.



NAICS: 5221 Depository Credit Intermediation	\$70.2 B Annual Revenue Estimates	
16,870 Employees in NYC	1,860 Employees in Tech Occupations	11% Share of Tech Occupations

Sources: SEC 2013 Form 10-K, 'Citigroup'; "New York City's Biggest Employers", Business Insider (2012)

Definition and Composition

NYC tech startups like Etsy are adapting traditional service sectors to the digital economy.

Tech now plays a major role in all sectors of the NYC economy, including retail. The Electronic Shopping and Mail-Order Houses industry, which includes e-commerce companies like Etsy, is one of the top-performing tech industries in NYC. Brooklyn-based Etsy, which launched in 2005, has transformed the retail market by lowering barriers to entry for artisanal manufacturers and creating new opportunities for them to reach consumers.

As of 2013, approximately 20,700 out of over one million total Etsy sellers are distributed throughout NYC's five boroughs (compared to 15,000 yellow cabs in Manhattan). A recent survey of Etsy sellers across the nation suggests that nearly half are independent workers, and nearly 90% are female. Over the last year alone, these sellers generated over \$1.35 billion in sales.

Etsy's New York office employs 375 people. Based on this study's definition, approximately 165 of these Brooklyn-based workers perform tech functions. While Etsy is a tech firm, 56% of its employees work in non-tech occupations. These workers may lead seller education programs, provide customer service, or enforce site policies, among other responsibilities.

Additionally, Etsy has spurred the creation of other tech and non-tech jobs by making key analytics freely available through its API. Profitable mobile applications like Stitchlabs, an inventory management tool for Etsy sellers, and Virb, a web development tool that integrates with a seller's Etsy shop, leverage Etsy's data to offer additional services to the Etsy community.



NAICS: 4541 Electronic Shopping and Mail-Order Houses	\$500 M Annual Revenue Estimates	
375 Employees in NYC	165 Employees in Tech Occupations	44% Share of Tech Occupations

Sources: "Busted by the Crafts Cops", *The Wall Street Journal* (2012); "Redefining Entrepreneurship" Etsy Sellers Survey, 2013; Wikipedia, 'Etsy'

Definition and Composition

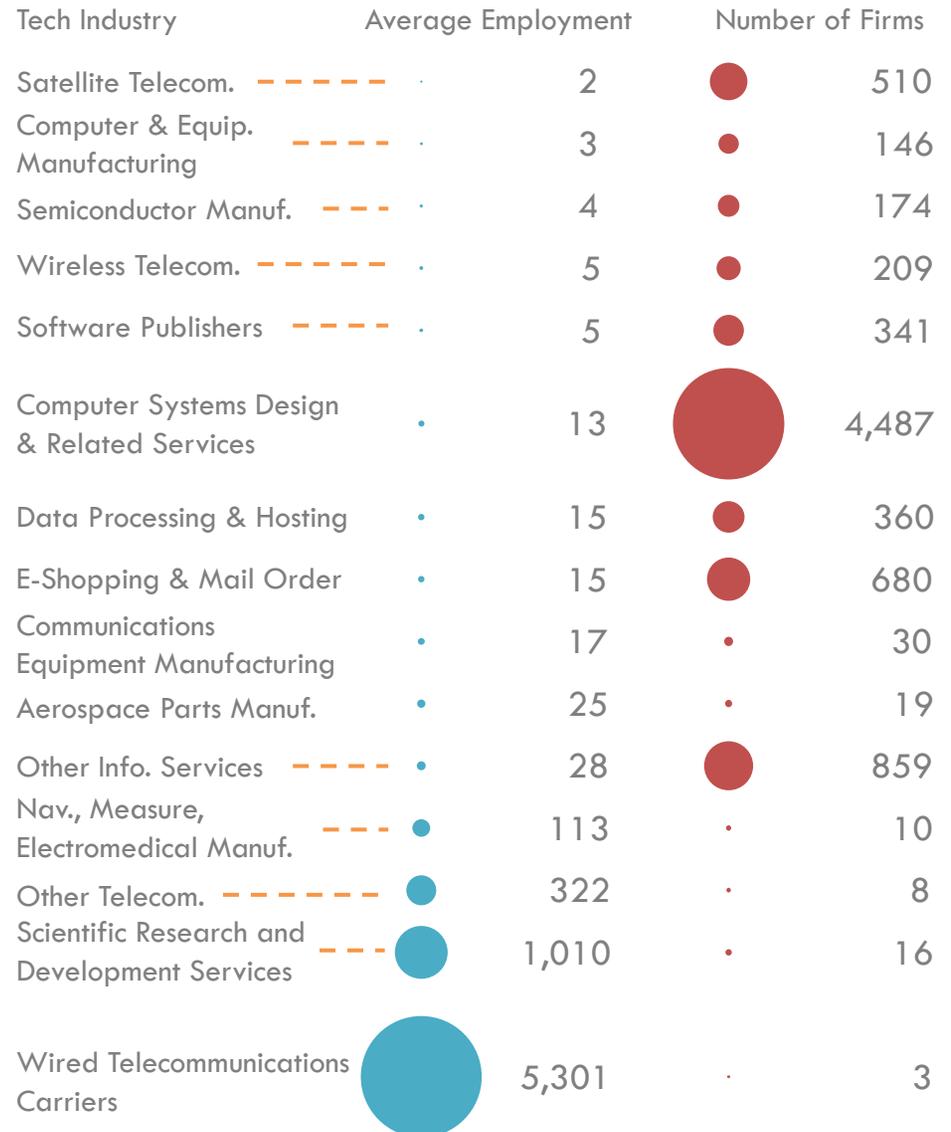
New York City tech firms are mostly small businesses that are productive employment generators.

New York City is home to approximately 251,000 firms; 7,850 (3%) of those firms are within tech industries. On average, each firm employs around 18 people; however, if monopolies such as the large communication service providers are treated as outliers and excluded from the analysis, tech firms employ approximately 16 people per firm. This is closer to the City-wide average of 17 employees per firm.

The Computer Systems Design and Related Services industry includes over half of all New York City tech industries firms. Tech startups typically fall into this category, with a lower-than-average firm size of 13 employees per firm.

In juxtaposition, some industries dominated by a handful of firms have significantly higher employment per firm. For example, three firms dominate the Wired Telecommunications Carriers industry with an average employment of 5,300 people each.

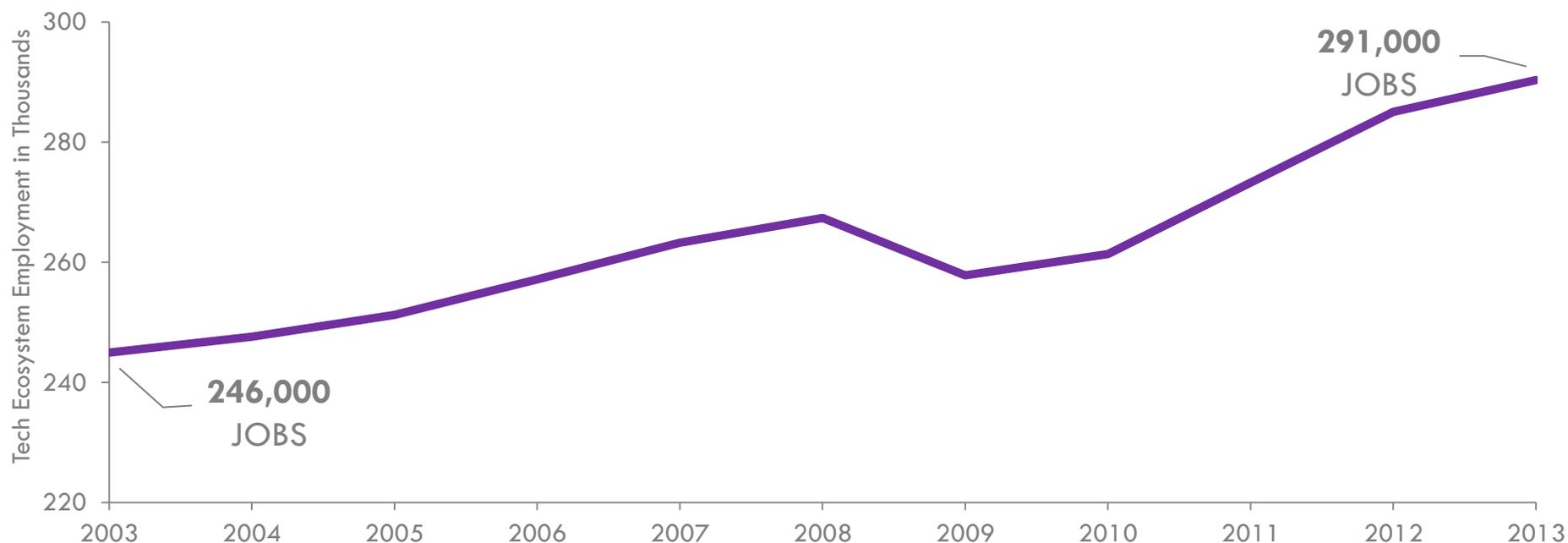
However, with all but 4 categories having an average employment that is less than 30 people, it is clear that tech is comprised of many small businesses that are productive employment generators.



Sources: EMSI; HR&A Advisors, Inc. Analysis

Definition and Composition

From 2003 to 2013, the NYC tech ecosystem added 45,000 jobs.



Over the past 10 years, the New York City tech ecosystem grew from 246,000 jobs to 291,000 jobs, an addition of 45,000 jobs. From 2003 to 2007, the country was in the midst of robust economic growth. During this period, the tech ecosystem grew by 9% and added over 22,000 jobs. Although overall tech employment slightly contracted during 2008 and 2009, from 2010 to 2013, the tech ecosystem grew by 11%, outpacing the City's 6% growth rate, during

the same time period. In comparison, the finance and insurance supersector only grew by 1% during this decade, adding only 3,100 jobs to its workforce. Not only did New York City's tech ecosystem recover from the recession, it surpassed previous growth rates and is contributing to the growth of the overall New York City economy.

Sources: EMSI; HR&A Advisors, Inc. Analysis

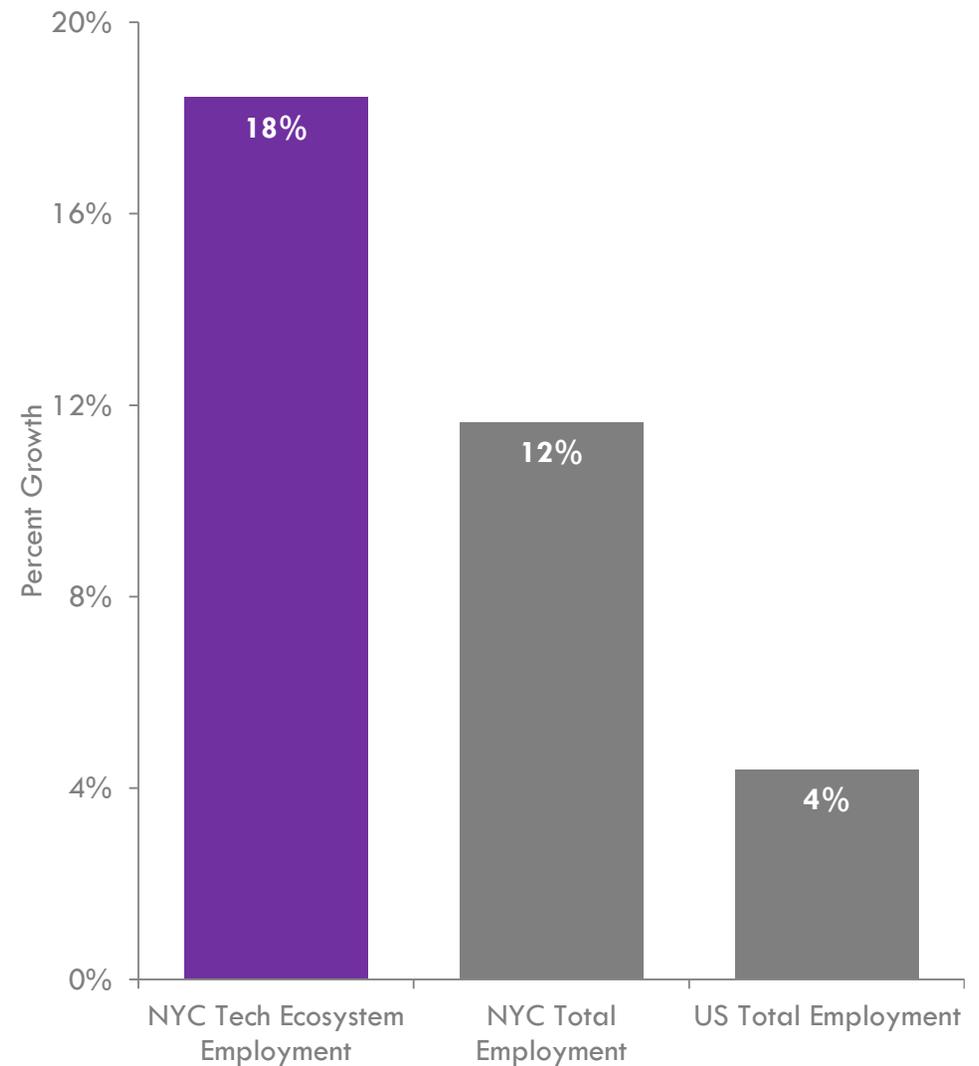
Definition and Composition

From 2003 to 2013, the NYC tech ecosystem grew faster than employment in both New York City and the Nation.

The New York City tech ecosystem grew by 18% during the past 10 years, outpacing New York City's 12% employment growth and the Nation's 4% growth over the same time period.

The outperformance of the New York City tech ecosystem is due in part to the digital transformation of the New York City economy. As companies use technology to adapt their businesses to satisfy the growing demand for accessible, instantaneous services, jobs within the New York City tech ecosystem increase. For example, occupations such as application development and computer programming are experiencing high growth as the need to offer web and mobile applications of a firm's services increases.

Additionally, the tech ecosystem increased its share of people working in the New York City workforce from 6% to 7% during this time, demonstrating its growing impact on, influence over, and integration within the City-wide economy.



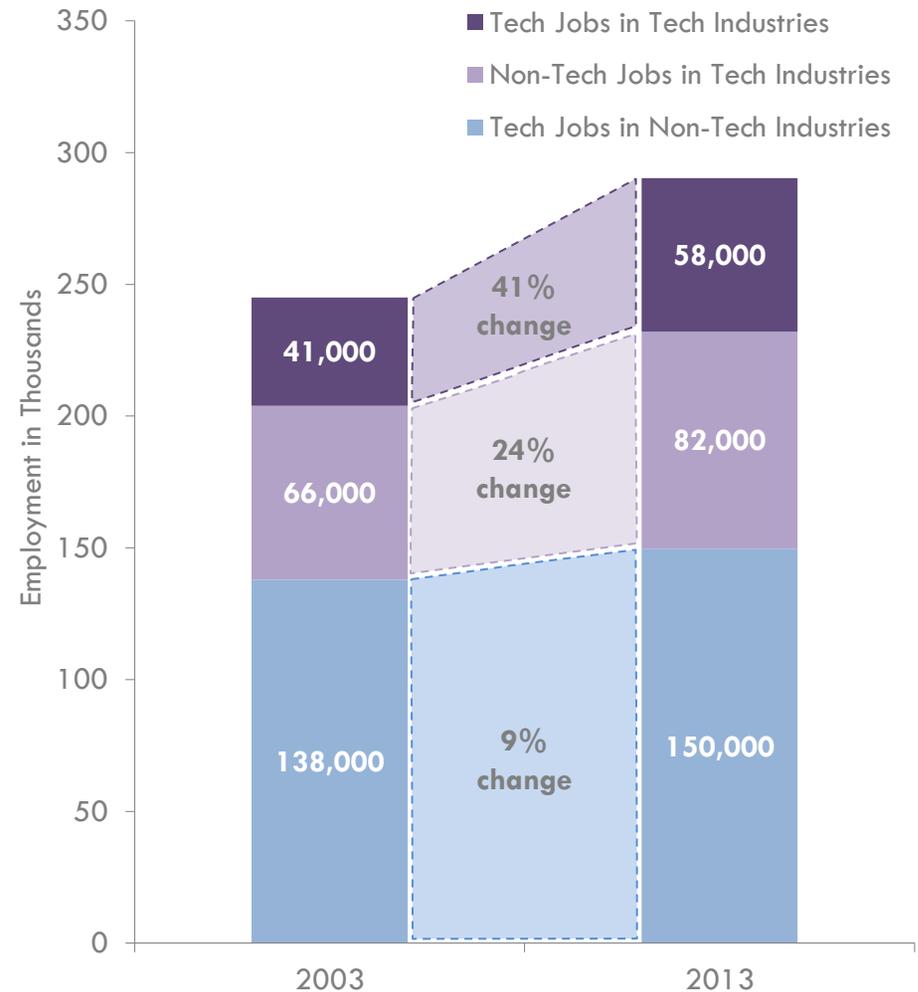
Sources: EMSI; HR&A Advisors, Inc. Analysis

Jobs within tech firms such as startups are experiencing exceptionally high growth.

During the last decade, tech jobs in tech industries grew by an impressive 41%, while their non-tech counterparts followed suit with a 24% increase. While tech industries added 33,000 jobs, surpassing the City's 12% growth rate, tech employment in non-tech firms grew at a slower, but very respectable 9%. Non-tech firms hindered by the recession and the transfer of tech jobs outside of New York City are partly accountable for this fairly slower rate. Although each category suffered losses during the recession, tech industries experienced significant post-recession growth. From 2010 to 2013 tech jobs in tech industries grew by 20%, non-tech jobs in tech industries grew by 16%, and tech jobs in non-tech industries grew by 6%.

These growth rates support the assertion that tech jobs embedded in non-tech industries emulate the growth patterns of the City-wide economy, as non-tech industries have stabilized and matured. Tech industries, most notably those associated with new economy startups, are ushering in a new era of growth, the firms within these industries are younger and more volatile. Tech industries warrant additional support in order to encourage continued growth and participation within the New York City economy.

Sources: EMSI; HR&A Advisors, Inc. Analysis



Definition and Composition

Non-tech firms have capitalized on the digital economy by creating flourishing subsidiaries, such as Major League Baseball with MLB Advanced Media.

MLB Advanced Media (MLBAM) was formed in 2000 when team owners voted unanimously to centralize the industry's digital rights into an independent tech company. Based in New York City since inception, MLBAM showcases how a traditionally non-tech industry can successfully enter the tech ecosystem and leverage the digital economy.

MLBAM manages the official league site (MLB.com) and the 30 team sites. It also has built a world-class tech infrastructure in NYC to provide live video streaming services for dozens of sports and entertainment clients, including MLB.TV, ESPN3, WWE, The Blaze, Row 44 and New York's own Tech Meetup. MLBAM also develops mobile applications, most notably *At Bat*, which has been Apple's top-grossing sports app five straight years. In 2013, *At Bat* was downloaded 10 million times.

In addition to its subscription products, MLBAM generates revenue through advertising, sponsorship, licensing, merchandise and ticketing. Almost all of the firm's total annual revenue is derived from internally-built technology products or services. Most recently, MLBAM announced agreements with Sony, to deliver back-end infrastructure for a cloud-based television service; and with WWE, to create a 24/7 streaming network television platform, called WWE Network.

An original tech tenant of Chelsea Market, MLBAM employs 700 people, of which two-thirds are estimated to work in tech occupations under this study's definition. These tech workers include network and computer systems administrators, information security analysts, and web developers, who work alongside editors, graphic designers, and content managers.

Sources: MLBAM, MLBAM.com; "MLBAM's Home Runs With Sony And WWE...", Forbes.com (2014)



NAICS: 5111 Newspaper, Periodical, Book, & Directory Publishers	\$700 M Annual Revenue Estimates	
700 Employees in NYC	450 Employees in Tech Occupations	65% Share of Tech Occupations

Definition and Composition

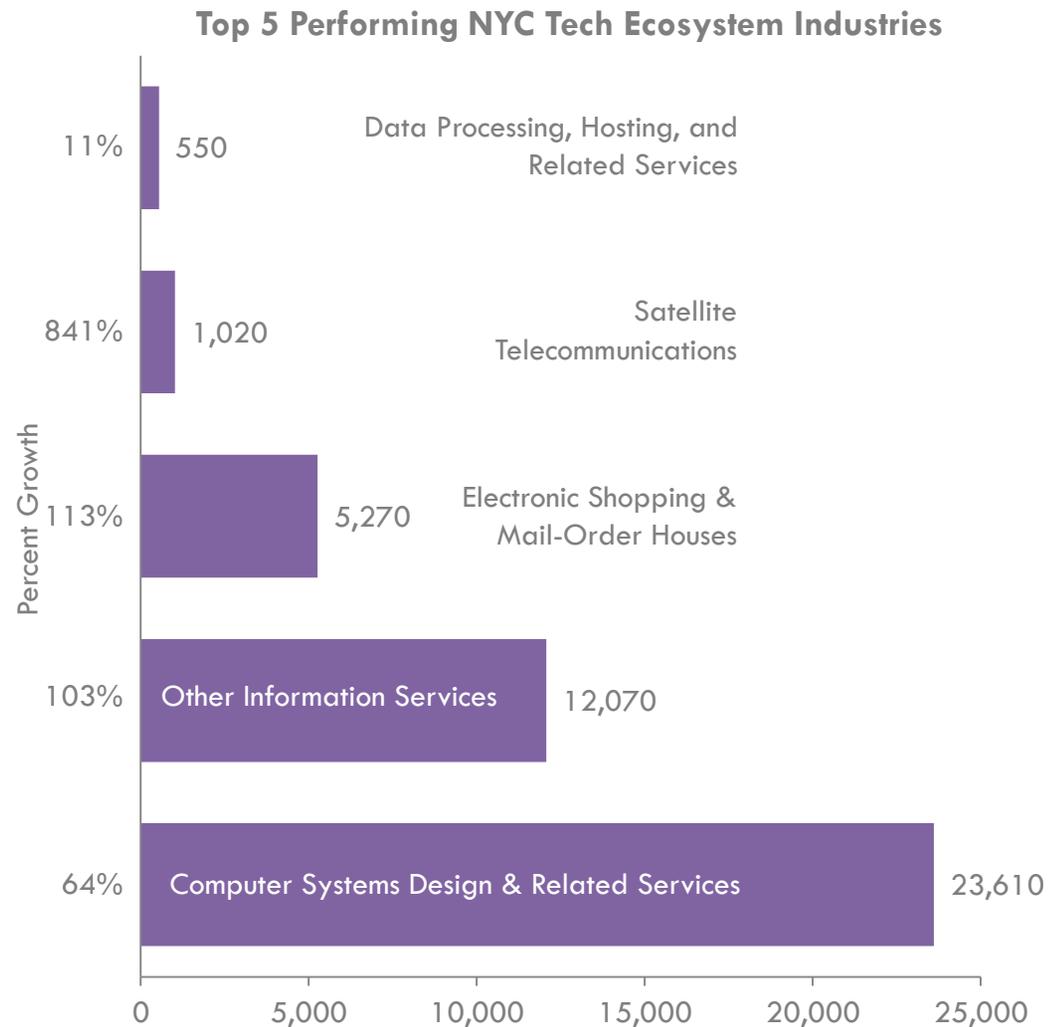
The top performing tech industries exhibit growth that is largely driven by the digital economy.

Together, the top five fastest growing tech industries added 42,500 jobs to the City's tech ecosystem over the last decade.* Although relatively limited in number of new jobs, the Satellite Telecommunications industry experienced the most notable growth, increasing employment by eight times its size. Online retailers, represented by the Electronic Shopping and Mail-Order Houses industry, doubled in size.

The digital economy is a major driver of growth in these industries. The goods and services produced by the industries exhibiting major growth during this decade directly address the needs of the digital economy. For example, the Computer Systems Design and Related Services industry gained the most jobs (almost 24,000) during this decade. Together with Other Information Services and Electronic Shopping and Mail Order Houses, these industries are where startups flourish. Whereas the Data Processing, Hosting, and Related Services and Satellite Telecommunications industries provide the infrastructure needed to support the digital economy.

**45,000 jobs were added to the tech ecosystem. Job loss in other tech industries reduces the total jobs added to tech industries to 33,000. Non-tech industries represent the additional 12,000 new jobs.*

Sources: EMSI; HR&A Advisors, Inc. Analysis



Definition and Composition

The fastest growing tech occupations produce goods or services that are hallmarks of the digital economy.

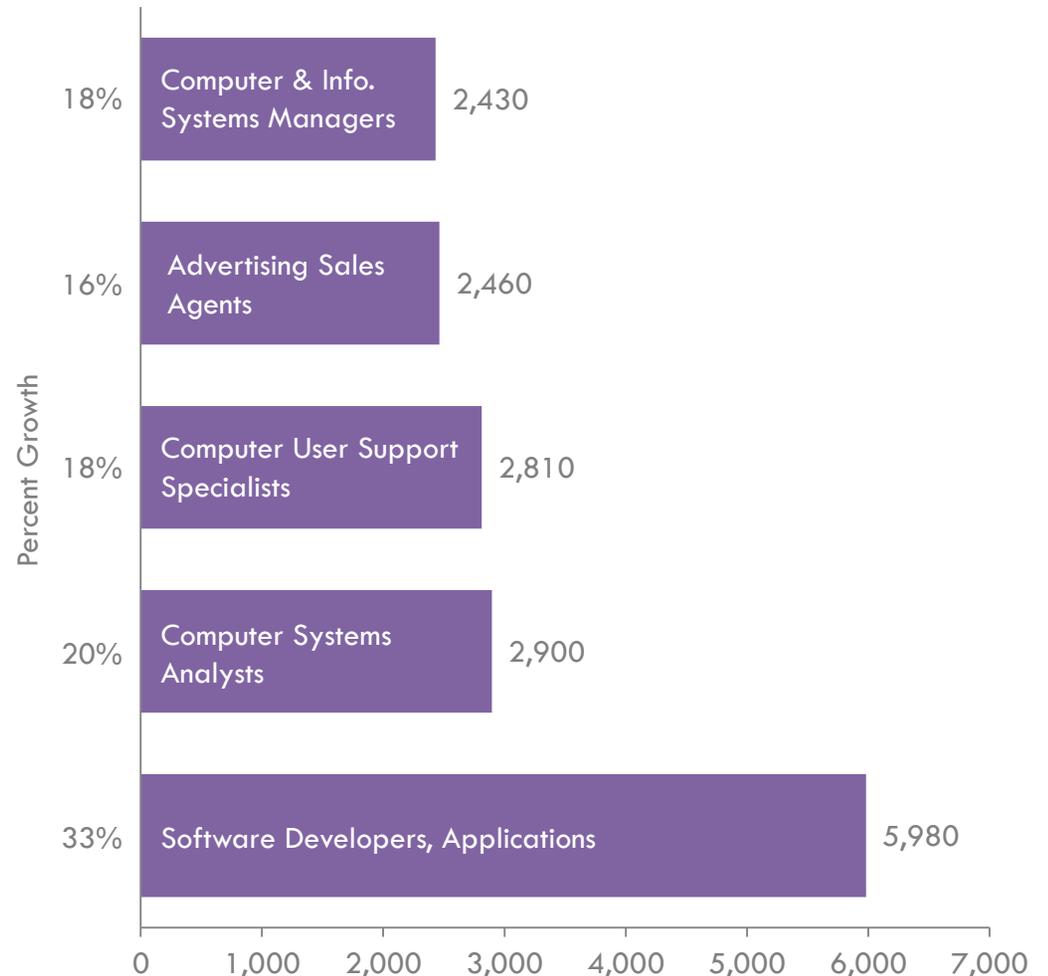
Within the last decade, the five fastest growing tech occupations contributed over 16,500 jobs to the tech ecosystem. Computer systems analysts, user support specialists, and information systems managers are occupations critical to the IT departments at non-tech companies. The growth of these occupations demonstrates transformations taking place within the staffing structures and business models of non-tech firms.

The demand for digital products is a key driver of these occupations. To foster additional growth in these high demand occupations, the City has joined with private organizations to invest in an array of new initiatives such as Cornell Tech, NYCDigital and New York Tech Meet-up to provide education, business opportunities, and support to the burgeoning tech community.

With the exception of computer hardware engineers, tech occupations are either growing or remaining at stable levels. However, with the maker movement in full steam, computer hardware engineering may experience a resurgence in New York City over the coming years. Companies like MakerBot and Shapeways, NYC-based startups specializing in 3D-printing, are pioneers of this new industrial revolution.

Sources: EMSI; HR&A Advisors, Inc. Analysis

Top 5 Performing NYC Tech Ecosystem Occupations



Definition and Composition

Some of NYC's prominent firms, including The New York Times, have altered their business models in response to the expanding digital world.

Founded in 1851, The New York Times (NYT) was produced as a print newspaper for almost 150 years. In 1996, *The New York Times on the Web*, NYT's first official website, was launched. It was followed in 2008 by the first mobile application for the iPhone and a streaming video service. Shortly thereafter, in 2011, NYT introduced paid digital subscriptions and began to charge for full access to Times digital content. In less than two years, at the end of 2013, NYT had 760,000 digital-only subscribers in addition to the hundreds of thousands of print subscribers who linked their accounts for full access to its digital content.

Digital was obviously not a part of the original line of business when The Times debuted over 160 years ago. However over the past few decades, NYT has altered its business plan and adapted the manner in which it delivers its high quality news and information to an ever-expanding number of digital platforms. While print remains a critical revenue contributor and is likely to remain so for many years, NYT expects much of its future growth to come from digital advertising and digital circulation. Although many traditional newspaper companies are struggling to adapt, The Times has led the way by adapting to new trends in tech and continuing to innovate. Because of this, The Times is well positioned to continue to thrive in the highly competitive digital marketplace.

NYT is headquartered in New York City, where it has approximately 2,080 full time, permanent employees, of whom, 460 are estimated to work within the firm's tech departments. Many of these workers are employed as applications developers, web developers, advertising sales agents and A/V equipment technicians—all occupations that are included within the NYC tech ecosystem.



NAICS: 5111
Newspaper,
Periodical, Book, &
Directory Publishers

\$1.6 B
Annual Revenue
Estimates

2,080
Employees in
NYC

460
Employees in
Tech
Occupations

22%
Share of
Tech
Occupations

Sources: SEC 2010 Form 10-K, 'The New York Times Company'; "NYT Struggles to Replace Print Ads with Digital Sales", Bloomberg.com (2013)

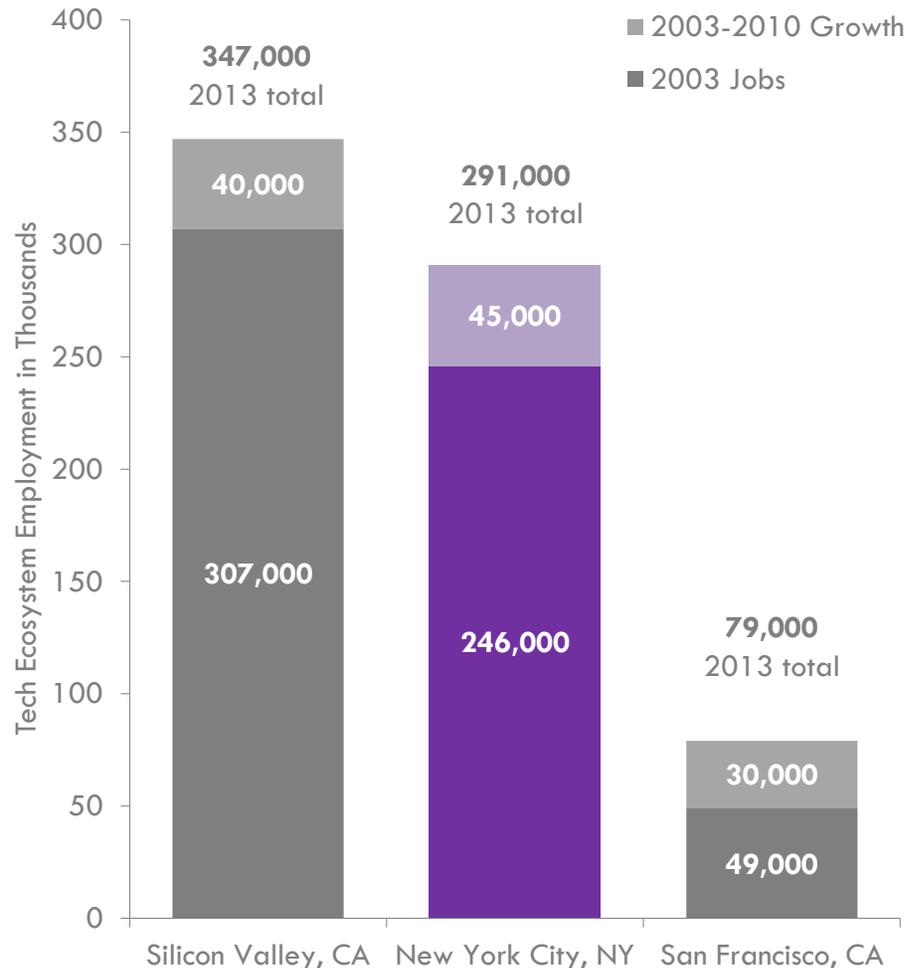
Definition and Composition

The NYC tech ecosystem, having grown significantly over a short amount of time, currently dwarfs San Francisco and contends with Silicon Valley.

HR&A estimated the total number of jobs within the Silicon Valley and San Francisco tech ecosystems by using the same methodology applied to determine the size of the New York City tech ecosystem. Based on this measure, New York City added more jobs than Silicon Valley and San Francisco. In addition, NYC's 18% increase (of 45,000 jobs) outpaced Silicon Valley's 13% increase (of 40,000 jobs) but fell short of San Francisco's rapid growth rate of 61% (30,000 additional jobs). In terms of overall employment, the NYC tech ecosystem is larger than that of San Francisco and fell only 56,000 jobs short of Silicon Valley.

NYC's economy supports 4.27 million workers and the tech ecosystem represents 7% of these workers. To compare, San Francisco's workforce is comprised of 667,000 workers; with tech ecosystem jobs comprising 12%. Silicon Valley's economy is comprised of 1.41 million workers, and its tech ecosystem represents a 25% share. Combined San Francisco and Silicon Valley's tech ecosystem represents 21% of regional employment. While there is no arguing that tech dominates the Bay Area; given the size and diversity of the NYC economy, tech has established a significant presence and impact over a short amount of time in New York City.

Sources: EMSI; HR&A Advisors, Inc. Analysis



Note: Silicon Valley includes Santa Clara and San Mateo Counties.
San Francisco includes San Francisco County.

Definition and Composition

New economy companies, like Google, are increasingly locating in NYC to tap into the City's robust digital industry.

Google's presence in New York City has significantly grown since its start in 2001 with one employee working out of a Starbucks coffee shop. With over 3,600 employees based in New York City, Google's expansion serves as the most prominent example of a leading California-based tech company growing roots in New York City.

While Google's software engineering efforts are primarily in California, the company's New York office has the second largest concentration of engineers outside of its Mountain View headquarters in the United States. Over half of the company's employees in New York City are tech engineers; the rest are in advertising and sales since the majority of Google's 2012 revenues are derived from advertising sales.

Accelerating this expansion, Google completed several acquisitions of NYC-based companies, the most notable being DoubleClick, a NYC-based online advertising company specializing in digital ad display that the company acquired for \$3.1 billion in 2008. Google also acquired Invite Media, a NYC-based demand side platform that facilitates the purchase of display ad media from online exchanges and networks.

These recent trends in acquisitions and hires demonstrate the value of the New York City tech ecosystem to Google and other new economy giants. New York City's underlying strength as a national leader in media and advertising is attracting and retaining leaders of the new digital economy.



NAICS: 5112
Software Publishers

\$50.2 B
Annual Revenue
Estimates

3,600
Employees in
NYC

2,200
Employees in
Tech
Occupations

61%
Share of
Tech
Occupations

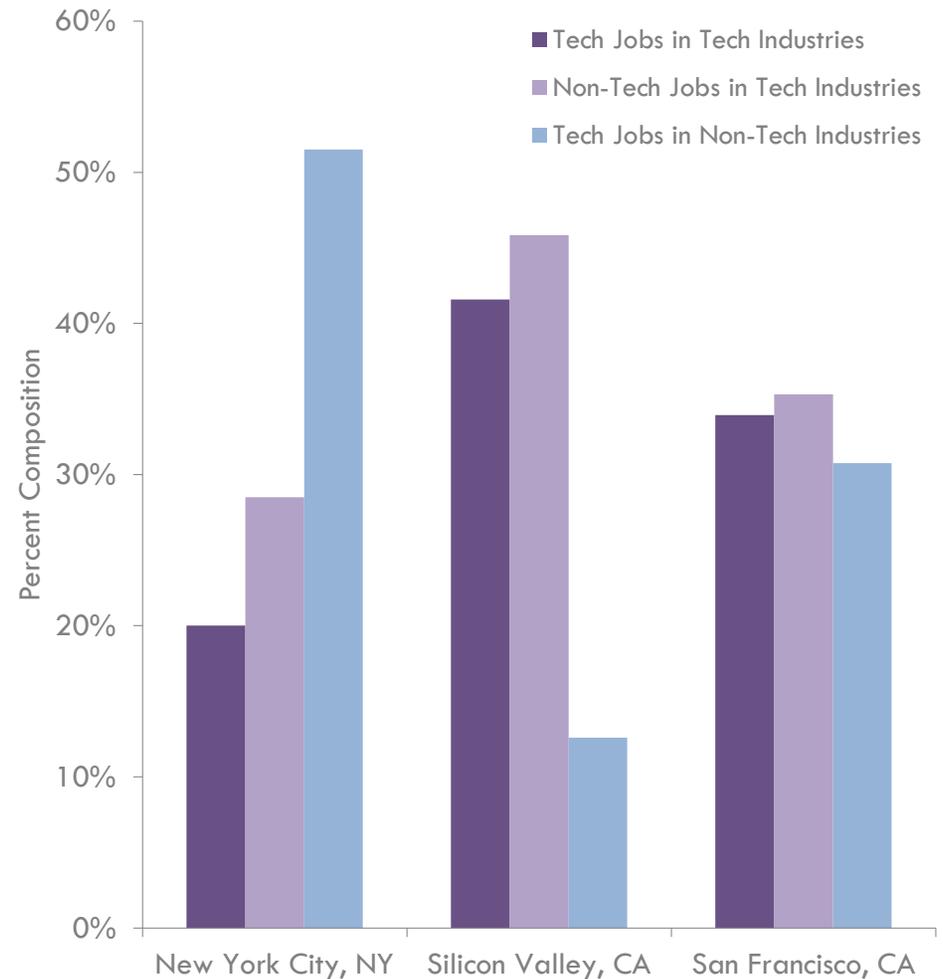
Sources: "Google Web Grows in City", *The Wall Street Journal* (2012); SEC 2012 Form 10-K, 'Google, Inc'

Definition and Composition

The NYC tech ecosystem workforce is integrated amongst and provides support to all sectors of the NYC economy.

The tech ecosystems of New York City, Silicon Valley, and San Francisco all feature unique characteristics. Silicon Valley jobs are heavily concentrated in tech industries, whereas the opposite is true for New York City. San Francisco exhibits a more equitable distribution among the three categories. New York City's tech ecosystem is more diffuse and distributed throughout the entire economy – this results in tech appearing less prominent compared to Silicon Valley, where tech industries represent a larger share of the overall regional economy.

Of the 4.27 million people working in the New York City, 1.6% are working in tech jobs in tech industries, 1.9% are working in non-tech jobs in tech industries and 3.5% are working tech jobs in non-tech industries. In comparison, of the 667,000 people working in San Francisco, 4.0% are working in tech jobs in tech industries, 4.1% are working in non-tech jobs in tech industries and 3.7% are working in tech jobs in non-tech industries. Of Silicon Valley's 1.41 million jobs, 10.3% are tech jobs in tech industries, 11.3% are non-tech jobs in tech industries and 3.2% are tech jobs in non-tech industries.



Note: Silicon Valley includes Santa Clara and San Mateo Counties.
San Francisco includes San Francisco County.

Sources: EMSI; HR&A Advisors, Inc. Analysis

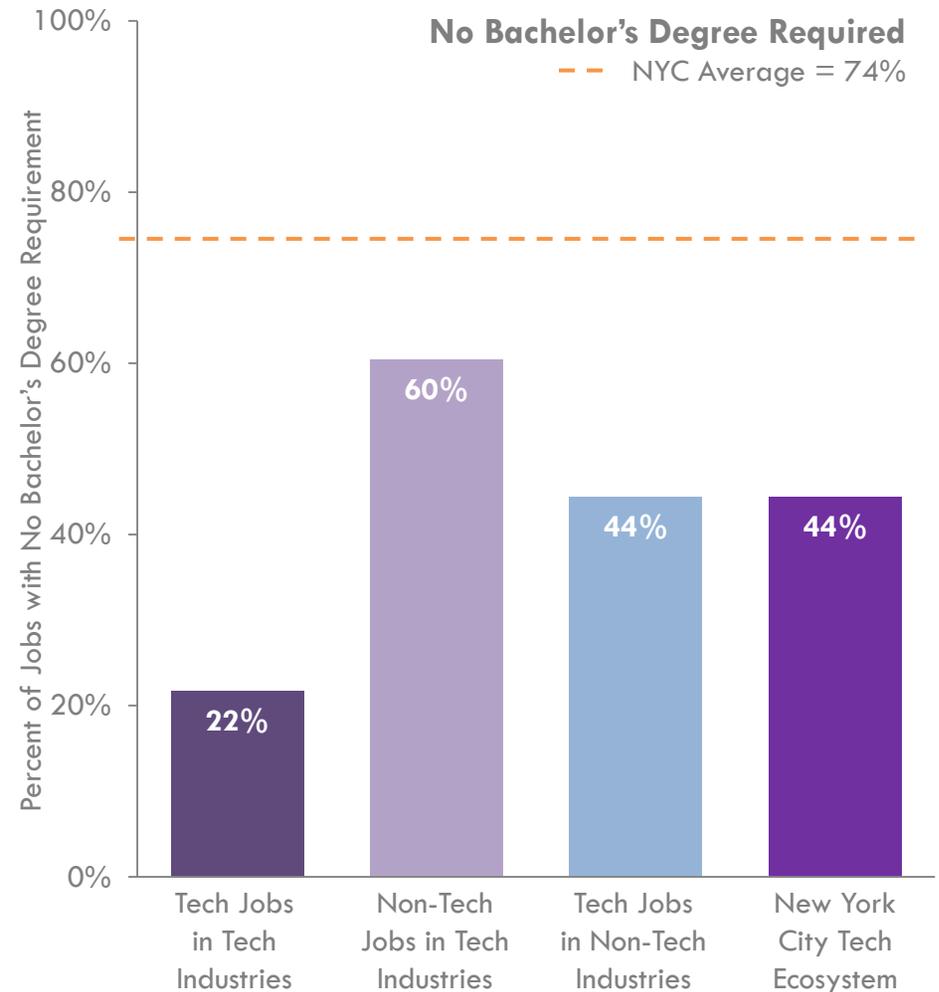
Definition and Composition

The NYC tech ecosystem includes more than just highly-educated workers – up to 44% of jobs in the NYC tech ecosystem do not require a Bachelor's degrees.

As expected, tech creates opportunities for people with higher education. However, many tech jobs are available for those who do not possess or desire to pursue a Bachelor's degree. In fact, up to 44% of jobs in the New York City tech ecosystem, or 128,000 jobs, are accessible to people without a Bachelor's degree.

Over 60% or 90,000 non-tech jobs in tech industries do not require a Bachelor's degree and are providing the largest share of opportunities for people with lower levels of educational attainment. Drilling down to the occupational level, four of the five most common non-tech occupations in tech industries do not require a college education. For example, over 113,000 office support staff are employed in New York City. This occupation comprises 3,100, or 3.7%, of all non-tech jobs in tech industries and 1.1% of total jobs in the New York City tech ecosystem.

Furthermore, many tech ecosystem jobs only require short-term or long-term on-the-job training. By removing the barrier of a college degree, opportunities in the tech ecosystem can potentially empower the 2.89 million New Yorkers ages 25 to 64 who do not hold Bachelor's degrees.



Sources: EMSI; HR&A Advisors, Inc. Analysis; O*NET Online website; American Community Survey 5-Year, 2008-2012

Definition and Composition

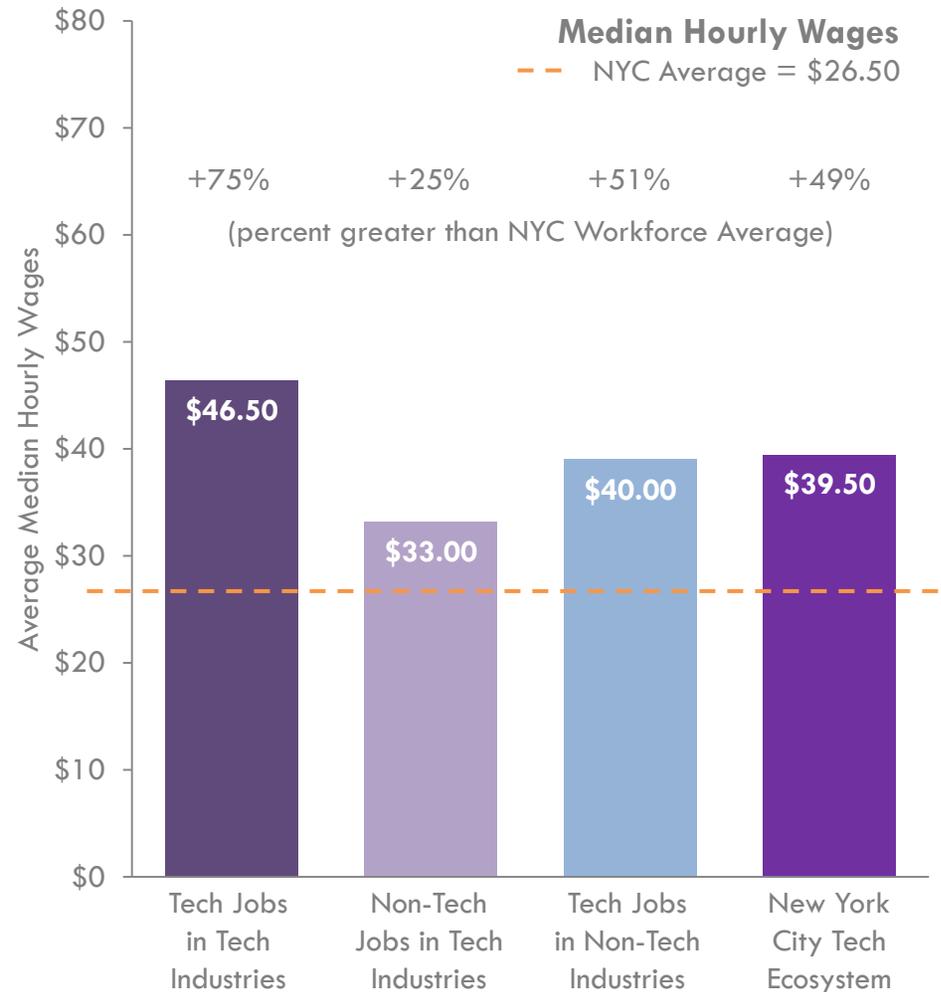
Workers in the NYC tech ecosystem earn 49% more than the average NYC hourly wage.

As of 2013, the average New York City median hourly wage was \$26.50. Tech ecosystem jobs pay above the City-wide average. In fact, tech ecosystem workers are paid 49% more than the City-wide average of \$26.50. In comparison to this average, tech workers in tech firms earn 75% more, tech workers in non-tech firms earn 51% more, and non-tech workers in tech firms earn 25% more.

New Yorkers working in manufacturing earn a median hourly wage of \$24.00, which is 39% less than the tech ecosystem. Retail employees in New York City earn less at \$17.25 an hour – 56% less than the tech ecosystem. Workers in accommodation and food services make the least at \$14.00 an hour – 65% less than tech ecosystem wages.

The most common tech occupation in tech industries is the applications developer. Almost 12,000 applications developers are employed at tech firms, making \$52.75 an hour, which is 33% more than the tech ecosystem average and 99% greater than the City-wide average. These 12,000 jobs are within an occupation that would not exist without the rise of ubiquitous computing, the internet, and mobile communication technologies.

Sources: EMSI; HR&A Advisors, Inc. Analysis; O*NET Online website



Definition and Composition

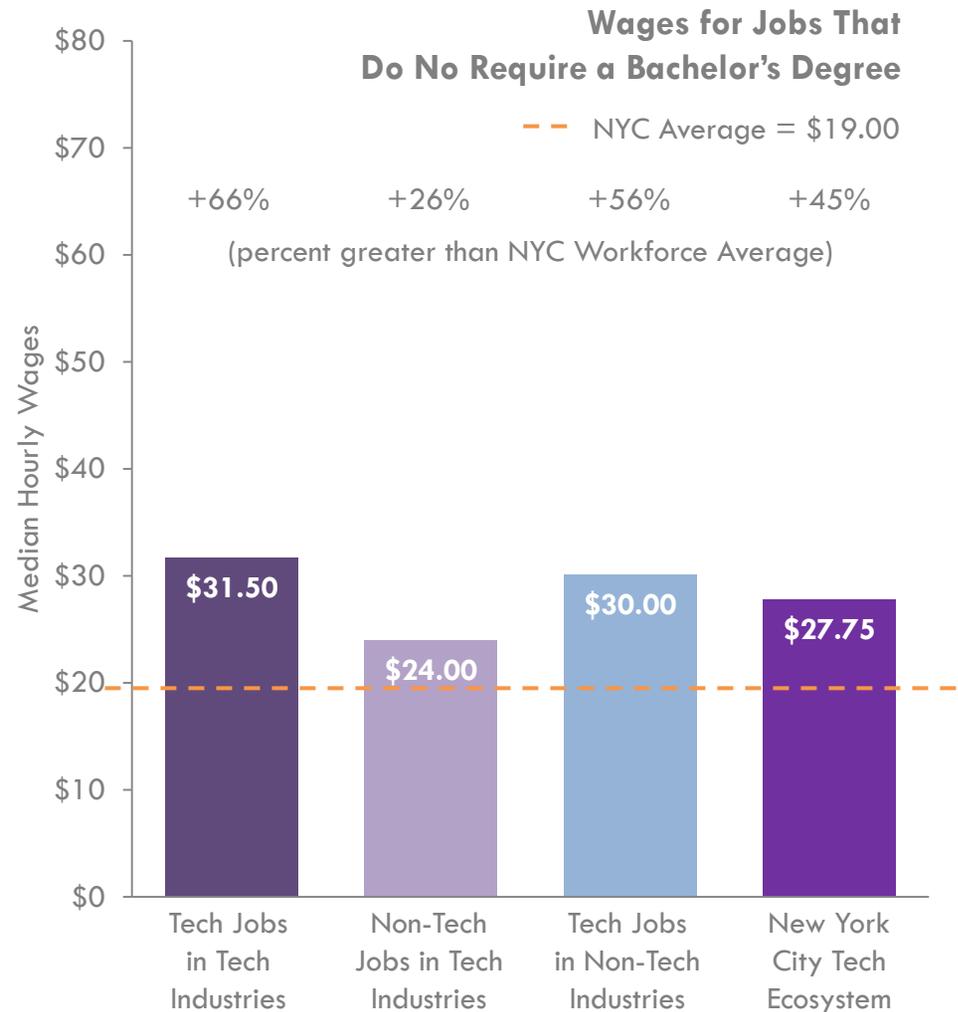
Jobs in the NYC tech ecosystem that do not require Bachelor's degrees pay 45% higher hourly wages than jobs with the same educational requirements.

For New York City tech ecosystem workers, wages are significantly higher than the average NYC median wage for jobs that do not require a Bachelor's degree. Tech jobs in tech industries that do not require Bachelor's degrees pay more than other jobs in New York City with similar educational requirements.

Representing over 5,600 jobs, sales representative is the most common non-tech occupation within tech industries that does not require a Bachelor's degree. In fact the position only requires short-term on-the-job training. While sales representatives earn a median hourly wage of \$33.60 across all industries, sales representatives comprise 7% of all non-tech jobs in tech industries and 2% of all tech ecosystem jobs, providing more higher-wage opportunities for workers with lower educational attainments.

In comparison, the most common occupation City-wide is the retail salesperson with 126,000 workers (3% of City-wide employment). In 2013, retail salespeople earned a median hourly wage of \$11.00 which, although higher than minimum wage, is well below the City-wide average and significantly below the New York City tech ecosystem average hourly wage.

Sources: EMSI; HR&A Advisors, Inc. Analysis; O*NET Online website



A Bachelor's degree is a prerequisite for most tech jobs.

While across the ecosystem, 44% of jobs do not require a Bachelor's degree, the majority of tech jobs in tech industries require some degree of education. With a Bachelor's degree, and in some cases, an Associate's degree, many opportunities exist within the New York City tech ecosystem.

Currently, mobile and web application developers are the most common occupation within the tech ecosystem. These jobs generally require a Bachelor's degree and pay \$52.70 per hour, which is 5% higher than the City-wide average for jobs requiring a Bachelor's degree.

With an Associate's degree, one can secure a job as a computer user support specialist within the tech industry and earn \$28.20 per hour. Note, however, that out of 18,000 Computer User Support Specialists in the NYC tech ecosystem, non-tech industries hold a 77% share of this occupation. According to the US Department of Labor's Occupational Information Network (O*NET), workers within this occupation are responsible for providing "technical assistance to computer users" by answering questions or resolving issues for users in person, over the phone, or electronically. These are key jobs within the IT departments of non-tech companies.

Sources: EMSI; HR&A Advisors, Inc. Analysis; O*NET Online website

Five Most Common Tech Jobs in Tech Industries

SOC Code & Classification		NYC Jobs	Hourly Wages	Education Level Requirement
15-1132	Software Developers, Applications	12,000	\$52.70	Bachelor's degree
15-1121	Computer Systems Analysts	6,600	\$44.60	Bachelor's degree
15-1131	Computer Programmers	6,300	\$41.70	Bachelor's degree
15-1151	Computer User Support Specialists	5,100	\$28.20	Associate's degree
15-1133	Software Developers, Systems Software	4,600	\$53.00	Bachelor's degree

Definition and Composition

Approximately 50,000 non-tech jobs that provide crucial support to tech industry operations do not require a Bachelor's degree.

Non-tech jobs in tech industries exhibit a range of hourly wages and educational requirements. Four of the five most common occupations do not require degrees.

Jobs that do not require a Bachelor's degree may have other requirements such as short-term on-the-job training, an Associate's degree, or work experience attained from a similar job. Of the 50,000 non-tech jobs within tech industries with no Bachelor's degree requirement, 6% require an Associate's degree at a minimum, 55% include short-term on-the-job training, 13% include moderate-term on-the-job training, and 12% include long-term on-the-job training. Another 14% require previous work experience in a related occupation.

Note, however, that a higher percentage of tech ecosystem jobs required a Bachelor's degree in 2013 than in 2003, which implies jobs requiring a secondary education are growing faster than those that do not. Nevertheless, there is a greater concentration of higher wage jobs with lower education requirements in the tech ecosystem than the overall New York City economy. This means that the New York City tech ecosystem offers more opportunities for lower educated workers than that of the overall economy.

Five Most Common Non-Tech Jobs in Tech Industries

SOC Code & Classification	NYC Jobs	Hourly Wages	Education Level Requirement
41-3099 Sales Representatives, Services, All Other	5,700	\$33.60	Short-term on-the-job training
43-4051 Customer Service Representatives	5,500	\$18.50	Short-term on-the-job training
49-9052 Telecommunications Line Installers and Repairers	3,900	\$37.60	Long-term on-the-job training
11-1021 General and Operations Managers	3,300	\$69.10	Bachelor's or higher degree, plus work experience
43-9061 Office Clerks, General	3,100	\$15.00	Short-term on-the-job training

Sources: EMSI; IMPLAN; HR&A Advisors, Inc. Analysis; O*NET Online website

Definition and Composition

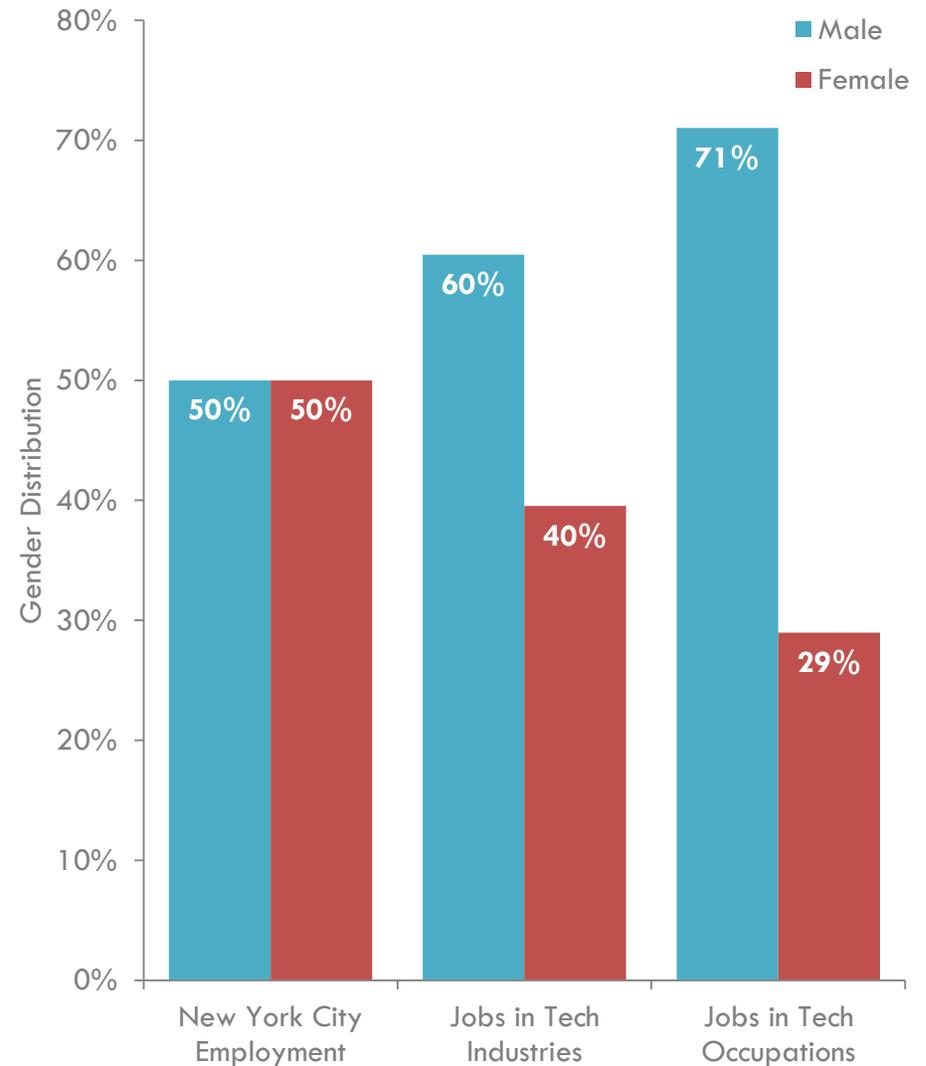
Compared to the NYC economy, where gender distribution is even, tech remains a male-dominated ecosystem.

Consistent with national-level findings, women are underrepresented in the NYC tech ecosystem. Across tech industries and occupations there are 20% to 50% differences between the number of male and female employees. Comparatively, City-wide gender is more equitably distributed.

Across all occupations in the tech ecosystem, the computer and information systems manager earns the highest hourly wage at \$75.80 and over 74% of these jobs are held by men. Men comprise 80% of all application developers, with an hourly wage of \$52.71. Of all the tech occupations, the medical and clinical laboratory technician, which employs 4,200 people, has the highest share of female employment at 67%. The hourly wage of this occupation is \$32.40, which is slightly less than the average NYC tech ecosystem hourly wage of \$39.50.

The NYC tech ecosystem presents employment opportunities for all ages, but especially for recent college graduates. Tech employs people predominately between the ages of 25 and 54, while the NYC economy has greater share of people aged 55 and greater.

Sources: EMSI; IMPLAN; HR&A Advisors, Inc. Analysis



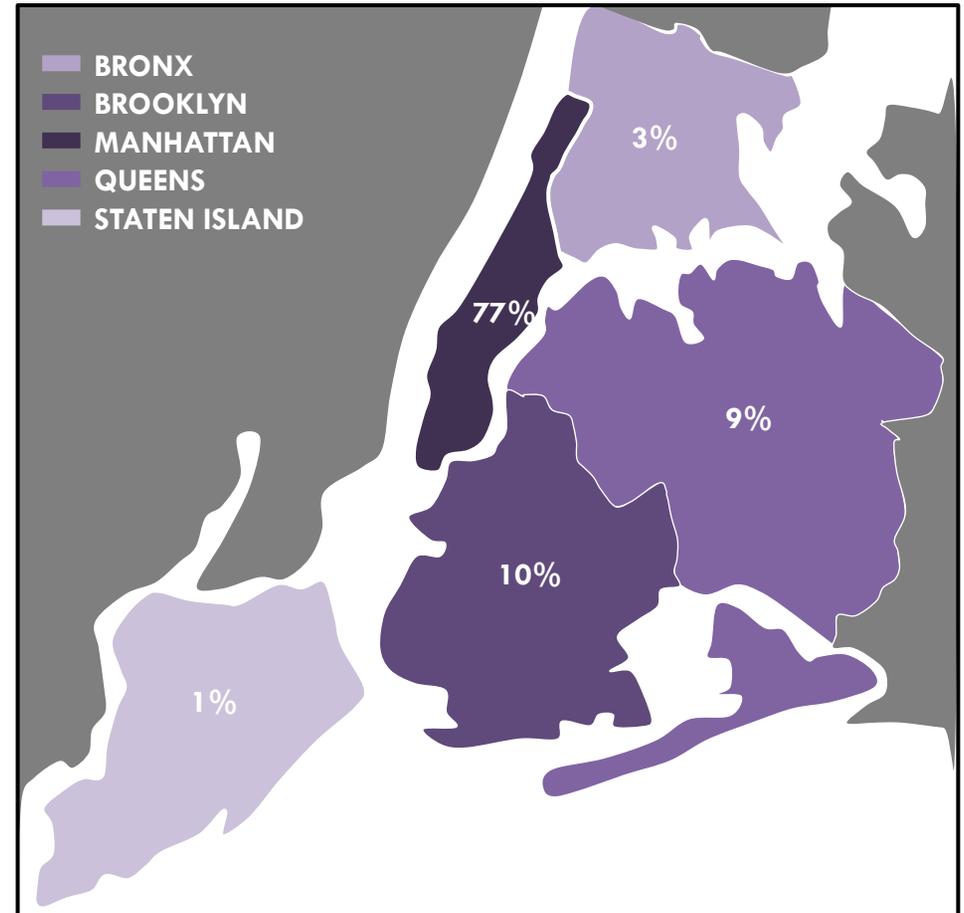
Definition and Composition

The distribution of jobs by borough in the NYC tech ecosystem mirrors the distribution of all NYC jobs.

Of the five boroughs, Manhattan is home to 77%, or 224,000 of the jobs in New York City's tech ecosystem, while Brooklyn and Queens are each home to approximately 10% of the ecosystem. 10 years ago, 74% of the tech ecosystem workforce was in Manhattan, while approximately 10% were in each Brooklyn and Queens. The Bronx and Staten Island had a 4% and 2% share, respectively. Comparatively, of the 4.27 million people working in New York City, 60% work in Manhattan, 15% in Brooklyn, 15% in Queens, 6% in the Bronx, and 3% in Staten Island.

Many tech and digital media firms are concentrating in Midtown South. However, NYCEDC initiatives such as Take the H.E.L.M. (Hire and Expand in Lower Manhattan) and the Relocation and Employment Assistance Program (REAP) are attracting tech firms to other parts of the City.

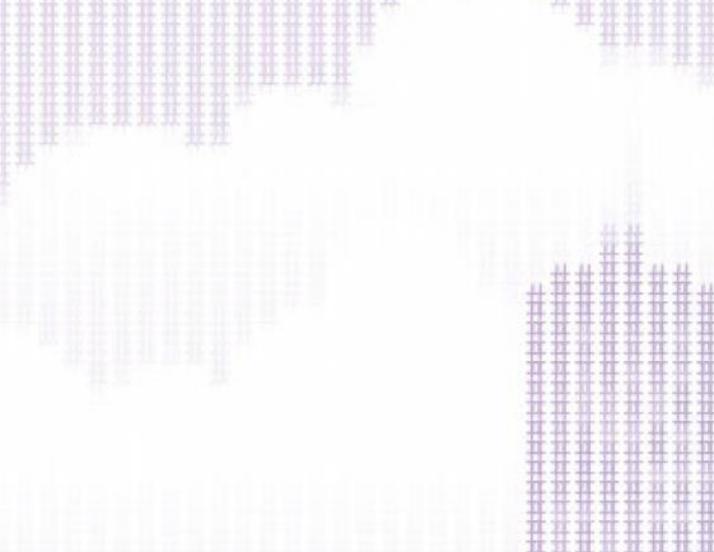
New clusters of tech companies are developing across the boroughs. In Brooklyn, the Brooklyn Tech Triangle, with neighborhoods including DUMBO, Downtown Brooklyn, and the Brooklyn Navy Yard, has emerged as the City's largest tech hub outside of Manhattan. Brooklyn's Tech Triangle is joined by the promising tech



and innovation hubs developing in Industry City and Greenpoint, in Brooklyn, Long Island City, in Queens, and The Hub, in the Bronx.

Sources: EMSI; HR&A Advisors, Inc. Analysis; New Tech City, Center for an Urban Future (2013)





SECTION 2

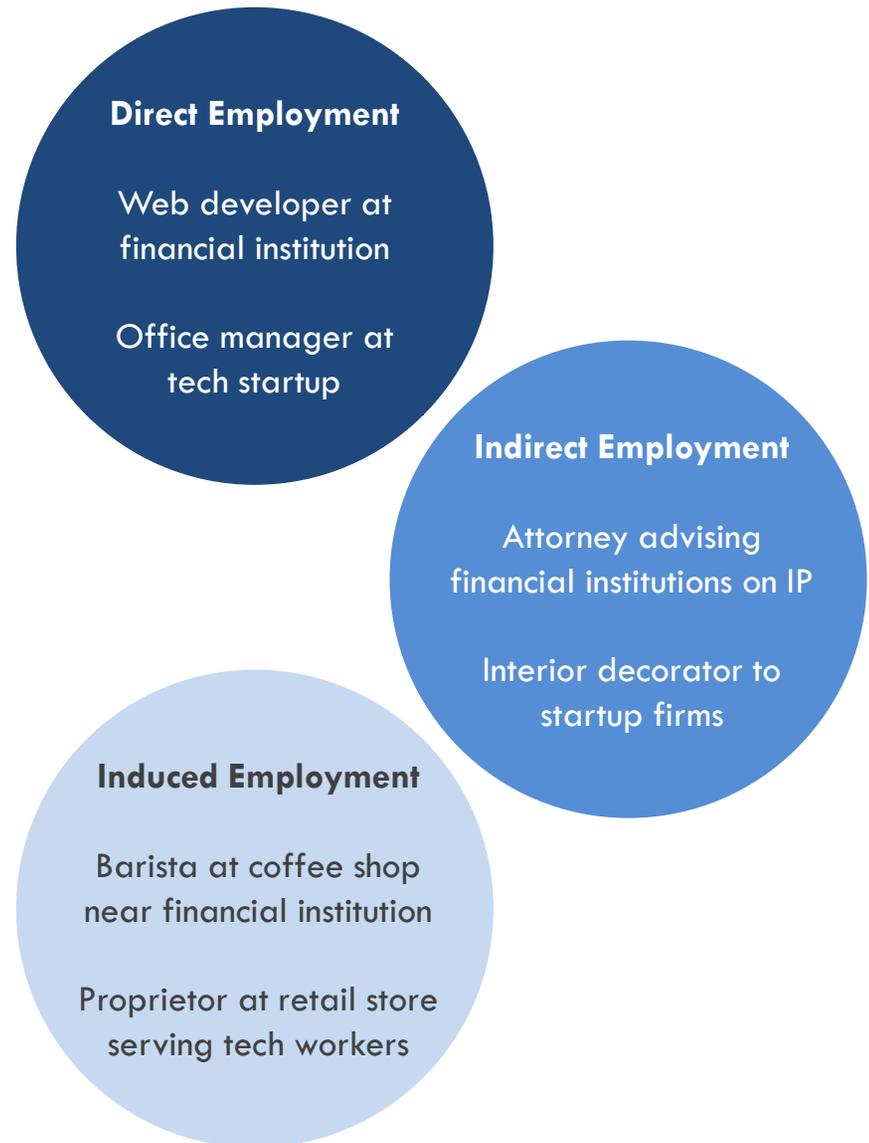
Economic & Fiscal Impact Analysis

HR&A's economic impact analysis measures the total economic impact of direct employment in the NYC tech ecosystem.

HR&A estimated the ongoing economic impacts of the New York City Tech Ecosystem using IMPLAN, a widely recognized input-out modeling tool. IMPLAN traces the pattern of commodity purchases and sales between industries that are associated with each dollar's worth of a product or service sold to a customer, analyzing interactions among 440 industrial sectors for New York City. IMPLAN reports impacts in terms of employment, employee compensation, and economic output generated by the New York City tech ecosystem.

Economic impacts are reported in terms of direct impacts and multiplier impacts, i.e. the sum of indirect and induced impacts as defined below:

- The **direct impact** is the employment, compensation, and output in the tech occupations or tech industries that collectively comprise the New York City tech ecosystem.
- The **indirect impact** is the employment, compensation, or output associated with businesses that supply the industries comprising the New York City tech ecosystem.
- The **induced impact** represents the employment, compensation, or output associated with household spending of employees who work in industries directly and indirectly affected by the New York City tech ecosystem.



The NYC tech ecosystem generates approximately 541,000 total jobs, which comprises 12.6% of the total NYC employment.

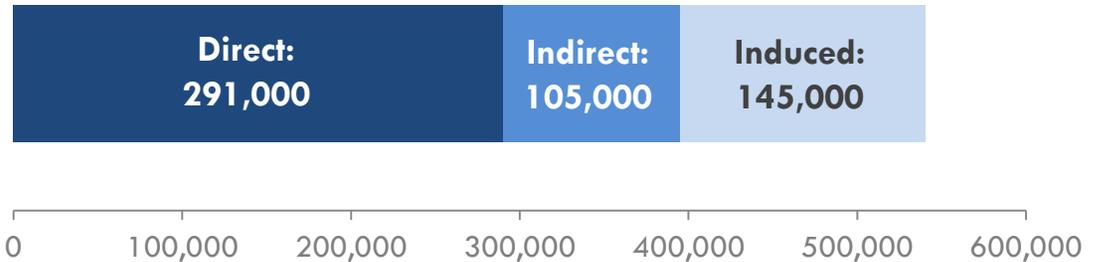
The economic impact study measures the impact of existing employment in the New York City tech ecosystem in terms of employment, employee compensation, and economic output (spending) generated.

The New York City tech ecosystem is responsible for 541,000 total jobs, equal to 12.6% of City-wide employment. 291,000 of these jobs are directly employed by the New York City tech ecosystem. The remaining 250,000 jobs are generated through the multiplier impacts of the direct NYC tech ecosystem employment.

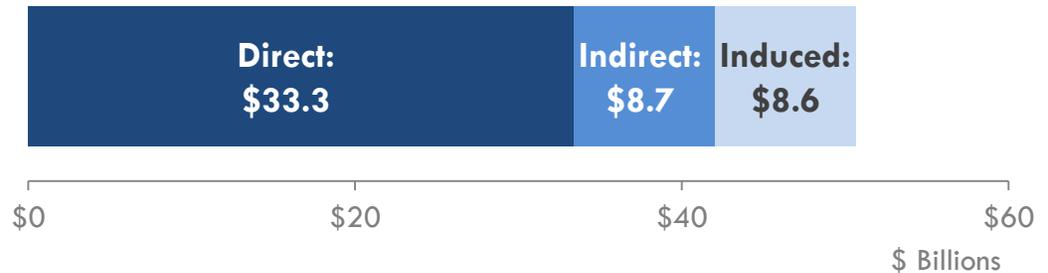
Because jobs in the tech ecosystem are disproportionately found in high-wage industries like finance and information, their impact on the City's economy is outsized relative to the number of jobs. Considering both direct and multiplier effects, the New York City tech ecosystem generates \$50.6 billion in employee compensation, or 13.1% of all compensation in the City. The \$124.7 billion in output generated by the New York City tech ecosystem represents 13.8% of total output in the City.*

*See Technical Appendix for more information; Sources: EMSI; IMPLAN; HR&A Advisors, Inc. Analysis

541,000 Total Jobs Generated



\$50.6 Billion Total Compensation Generated



\$124.7 Billion Total Output (Spending) Generated



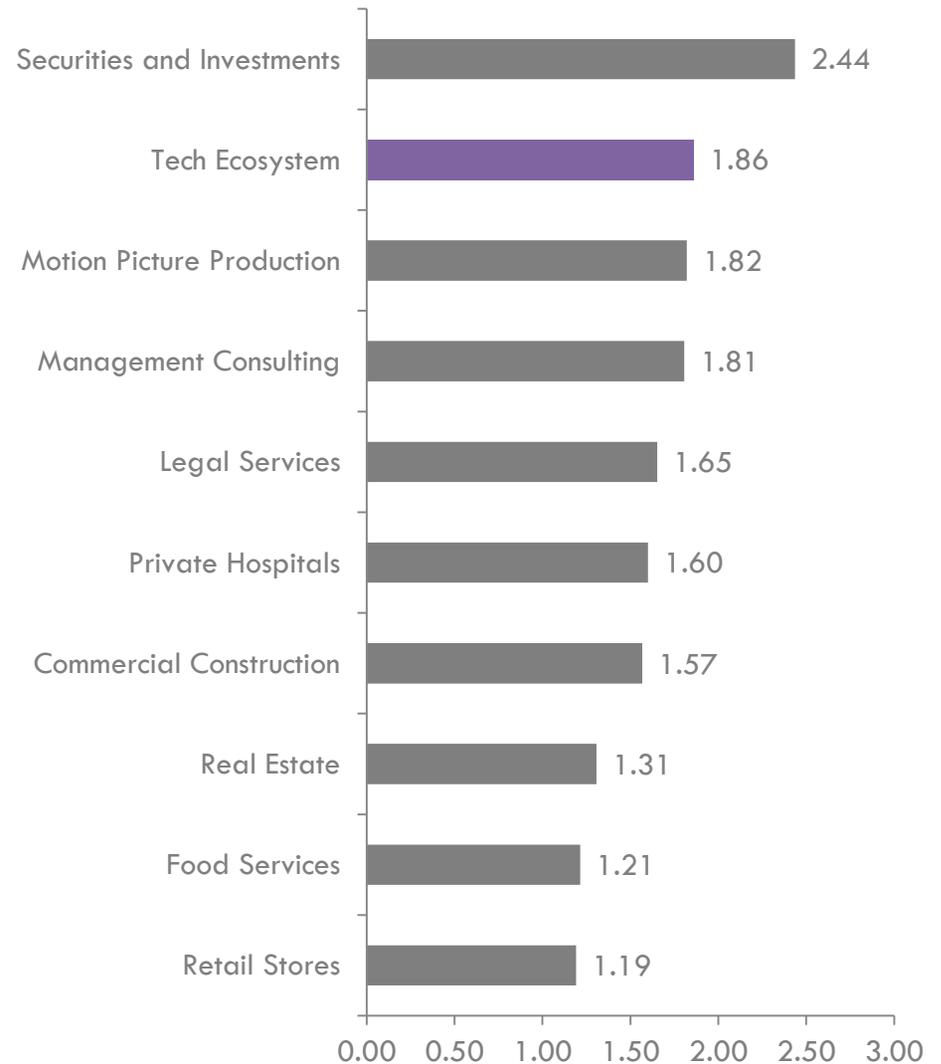
With its high-quality, well paying jobs, NYC’s tech ecosystem generates greater spin-off activity per employee than many leading industries in the City.

For every job in the tech ecosystem, 1.86 total jobs are created in the City economy. This multiplier effect is significant in the context of other leading jobs as the tech ecosystem can have a disproportionate impact on job creation throughout the City’s economy.

The figure to the right presents the multiplier effect of each direct job in other leading industries in the City, as expressed in IMPLAN’s 2012 model of the New York City economy. With the exception of securities and investments (2.44 multiplier), the tech ecosystem’s 1.86 employment multiplier outpaces many of the City’s leading industries, including legal services (1.65 multiplier), hospitals (1.60), and real estate (1.31).

In addition to its significant employment multiplier:

- For every dollar of direct compensation in the New York City tech ecosystem, \$1.52 of total compensation is created in the City.
- For every dollar of direct output in the New York City tech ecosystem, \$1.53 in total output is created in the City.



Sources: IMPLAN; HR&A Advisors, Inc. Analysis

HR&A's fiscal impact analysis estimates the total New York City tax revenue generated by the NYC tech ecosystem.

HR&A estimates fiscal revenue impacts from the New York City tech ecosystem based upon the 2012 ratio between gross regional product (GRP) in the New York City economy and New York City tax revenues. This ratio is applied to the IMPLAN model's estimate of new GRP to measure the tax revenue owing to the New York City Tech Ecosystem. The following fiscal impacts are considered:

- **Real Estate Tax:** An *ad valorem* tax imposed on real property in the City. The methodology for determining the property tax bill differs by property class. Residential property is classified as class one (1-3 units) with an effective tax rate of 1.15% of market value or class two property (over 3 units) with an effective tax rate of 5.92% of market value. Commercial property is classified as class four property, and taxed at an effective rate of 4.65% of market value.
- **Personal Income Tax:** A tax imposed on income paid to City residents (based on State adjusted gross income). The marginal tax rate is progressive based on income, ranging from 2.907% to 3.876%.
- **Sales and Use Tax:** A sales tax imposed on most purchases in the City, with exemptions for some items including clothing. The City's sales tax rate is 4.5%; the State sales tax portion of 4% and Metropolitan Commuter Transportation District surcharge of 0.375% are not included in this analysis. Special taxes including cigarette, commercial motor vehicle, mortgage, and auto use are also included.
- **Corporation and Business Income Taxes:** Includes general corporation, financial corporation, and unincorporated business income. The City has four different methods for computing these taxes (the simplest being 8.85% of net income) and imposes the method that generates the largest amount of tax.

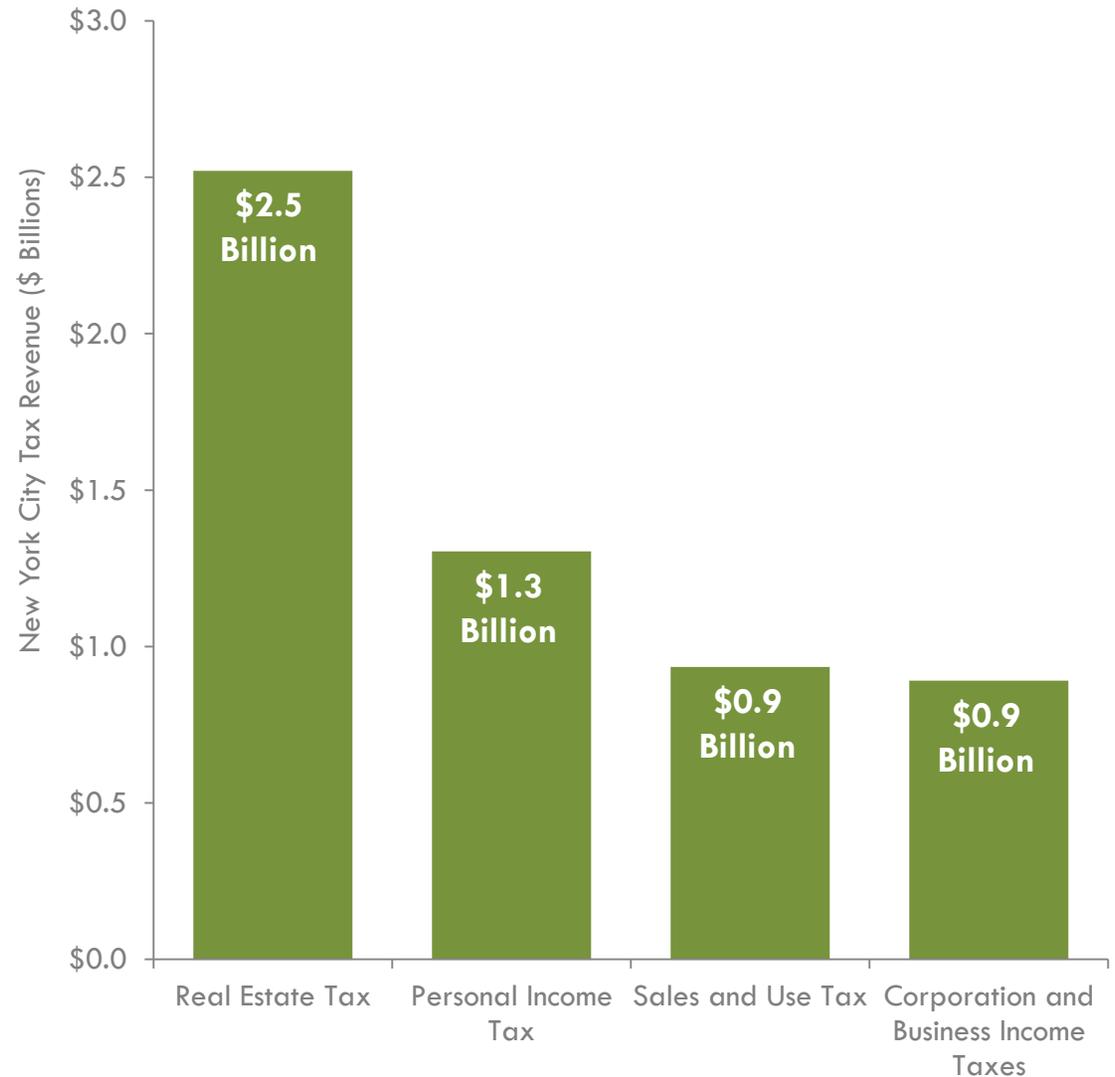
Ratio of New York City Tax Revenue to total GRP	
Real Estate Tax	2.89%
Personal Income Tax	1.50%
Sales and Use Tax	1.07%
Corporation and Business Income Taxes	1.02%

Source: NYC Comptroller's Comprehensive Annual Financial Report

The NYC tech ecosystem generates over \$5.6 billion in annual tax revenues to New York City.

The New York City tech ecosystem generates \$5.6 billion in annual tax revenues to New York City, representing approximately 12.3% of the City's total Fiscal Year 2013 tax revenue of \$45.7 billion. This revenue derives from a variety of City taxes and is critical to funding vital City services like education, fire, and police.

\$2.5 billion of this annual tax revenue owes to property taxes on real estate (from both commercial and residential). Significant amounts of City revenue are also generated via personal income tax (\$1.3 billion), sales and use tax (\$0.9 billion), and corporation and business taxes (\$0.9 billion) receipts that owe to economic activity associated with the tech ecosystem.*



*See Technical Appendix for more information.

Sources: EMSI; NYC Comptroller's Comprehensive Annual Financial Report; IMPLAN; HR&A Advisors, Inc. Analysis



SECTION 3

Public Policy Positions

HR&A suggests public policy considerations for the continued growth of the NYC tech ecosystem.

EDUCATION & WORKFORCE

- Create continuing education and workforce development programs that provide training for the required skills of growing tech occupations.
- Continue to support the technical programs of existing NYC-based universities and educational institutions.
- Expand efforts to incorporate computer literacy and other technical curricula into the New York City primary education system.

REAL ESTATE & INFRASTRUCTURE

- Create and expand tech hubs that centralize goods, supportive services and other resources critical to tech firms.
- Provide low-cost, flexible spaces for startups and business incubation, including critical step-up space to support new companies as they grow.
- Invest in state of the art infrastructure to enable the productivity of tech firms and workers across New York City.

ATTRACTION & RETENTION

- Promote New York City as a thriving, international hub of commerce and innovation that fosters opportunities for companies and workers.
- Centralize and coordinate New York City's existing and impactful tech-oriented programs and services.
- Maintain support for livable city initiatives that enhance New York City's attractiveness to tech ecosystem workers building their careers and lives.

Create continuing education and workforce development programs that provide training for the required skills of growing tech occupations.

Computer user support specialists are among the most common occupations in the New York City tech ecosystem and do not require a Bachelor's degree. A knowledge of circuitry and computer hardware, software, and programming is required to execute tasks associated with that occupation. Programs that provide the preparation needed to enter such occupations must be promoted, especially those that help sharpen or retool the skillsets of current or aspiring tech workers.

Programs that meet these needs exist in New York City, including **General Assembly** and the **Flatiron School**, educational institutions headquartered in Manhattan that offer an array of programs for entrepreneurs to develop skills relevant to the tech and digital industries. Another, run by the **Coalition for Queens**, a non-profit advocacy organization supporting the Queens tech community, is Access Code, a program targeting women, underrepresented minorities, and immigrants interested in learning programming. Participants work together to build mobile applications, learn about entrepreneurship, and demo their projects. The City should support the efforts of these and other private and non-profit initiatives, like **Girls Who Code**, an organization with programs that educate and equip girls with technology-

Sources: General Assembly website; Coalition for Queens website; Girls Who Code website



related skills, as greater diversity amongst gender, race, and ethnicity can further enrich the tech ecosystem. With financial support from the City, these programs can expand their outreach and impact.

Additional continuing education initiatives must be established City-wide if New York City desires to maintain a competitive workforce that can adapt to, and keep pace with, the rapidly evolving tech world.

Continue to support the technical programs of existing NYC-based universities and educational institutions.

Many universities and institutional programs are already in place to prepare students for careers in tech in part due to the **Applied Sciences NYC** program, a legacy of the previous mayoral administration.

Cornell Tech is leveraging a \$300 million donation from the City to build a \$2 billion campus on Roosevelt Island dedicated to training advanced-level engineers and technicians and commercializing significant research and development activities. The **City University of New York** (CUNY)'s two-year STEM program prepares graduates of public high schools for jobs in the New York City tech ecosystem. Mayor Bill de Blasio has committed to invest \$150 million to further develop this initiative. New York University's (NYU) **Center for Urban Science and Progress** is an applied sciences public-private research center in downtown Brooklyn that uses New York City as its laboratory for the exploration of urban informatics.

These are just a few of the many higher education options New York City has to offer; however, continued support from the City is critical to the longevity of their operations.

Sources: CUNY website; Cornell Tech website



Expand efforts to incorporate computer literacy and other technical curricula into the NYC primary education system.

According to Code.org, 33 of 50 states don't count computer science towards high school graduation math or science requirements. New York State, among others, does not acknowledge computer science as an official subject. In addition, out of the 75,000 New York City public school teachers, fewer than 100 teach the subject. Recognizing a need for highly trained technologists, private corporations have partnered with public agencies to address the lack of educational programming for technology-related skills.

Created in collaboration with the NYC Department of Education, NYC College of Technology, CUNY, and IBM, **P-TECH** has emerged as a valuable model for workforce development. This program, touted by President Obama in his 2014 State of the Union address, enables students to jump-start their careers by earning an Associate's degree in Information Technology during high school. **NYC Generation Tech**, created by the Network for Teaching Entrepreneurship and NYCEDC, aims to foster interest in business and technology through a two-week boot camp focused on the basics of business planning and programming that culminates in the design of mobile applications.



P-TECH and NYC Generation Tech are two model examples, but a systemic approach with a wider reach is needed. Supporting and expanding these investments in K-12 education as well as investing in teacher training and hardware for classrooms will increase the overall quality of the New York City tech ecosystem workforce enabling New York City to continue to be a dominant hub of technology nationally.

Sources: Code.org; "There are No Computer Science Teachers in NY", Crains article (2014); NYC GenTech website; P-TECH website.

Create and expand tech hubs that centralize goods and supportive services and other resources critical to tech firms.

Where Wall Street signifies finance and 5th Ave is synonymous with high-end retail, specific NYC locations should represent tech. Established hubs like **Silicon Alley** must continue to aggregate goods and services tailored to the necessities of firms and workers concentrated within their locations. Silicon Alley, located in the Midtown South submarket of Manhattan, is home to Google's NYC office and hundreds of tech startups and supportive venture capital, law, and consulting firms that benefit from being within close proximity to each other.

More tech hubs must be dispersed throughout the boroughs to facilitate equitable access to NYC tech ecosystem opportunities and grow the widest variety of tech companies. Emerging hubs like the **Brooklyn Tech Triangle** and **Long Island City** in Queens require infrastructure support desired by the tech community. Pedestrian walkways, bike lanes, and robust transit networks will allow for easier access between firms and goods. Placemaking strategies like ground-floor retail and outdoor seating are needed to attract and retain tech firms and transform areas into tech destinations. Additionally, an investment in broadband is critical as it largely influences where companies choose to locate.

Sources: *Brooklyn Tech Triangle Strategic Plan website*



Provide low-cost, flexible spaces for startups and business incubation, including critical step-up space to support new companies as they grow.

Like any new business, tech startups usually have limited access to capital and credit. Many startups prefer short-term leases and have specific space requirements that may change rapidly. In contrast, most landlords are unwilling to retrofit their spaces to meet the preferences of tech firms and desire tenants with excellent credit who can commit to long-term leases.

A recent report published by NYCEDC suggests that low-cost office space is becoming harder to find. The report forecasts that by 2025, demand by high growth industries for Class B and C office space will exceed supply.

Programs that close the gap between tech tenants and landlords address this issue by helping to preserve low-cost space. Additionally, academic institutions, public agencies, and commercial landlords must continue to partner to establish high-quality, turnkey office spaces to foster the incubation of tech businesses.

WeWork, a NYC-based co-working company, is one example. At \$400 per month for a desk, small firms can avoid the higher costs associated with establishing long-term physical locations in New York City. However, with



space for only 250 entrepreneurs at its SoHo location, the current waiting list has over 1,300 pending applications. Across the bridge in Brooklyn is another example – the **160 Varick Street** tech incubator created in 2009 under a partnership between NYCEDC, the NYU Polytechnic Institute and Trinity Real Estate. Non-traditional, affordable rental options like these should be expanded throughout the City to keep the high cost of business from impeding tech entrepreneurs from entering the market. In many cases, these models are becoming sustainable as demand for these services are outpacing supply.

Sources: “Commercial Real Estate Competitiveness Study”, NYCEDC (2013); WeWork website; NYU-Poly website

Invest in state of the art infrastructure to enable the productivity of tech firms and workers across NYC.

New York City is positioned as a high-tech mecca for entrepreneurs; however, some basic services are inconveniently lacking for such a modern city. A lack of reliable broadband access is the primary example of outdated infrastructure that impedes the progress and productivity of all New Yorkers.

The **Digital Roadmap**, released in 2011, outlines a vision in which 100% of New York City residences have internet service by 2014. Since its launch, access has been extended to over 300,000 low-income residents, and 50 parks now offer free public WiFi. Currently, the City is on track to continue the expansion of internet connectivity by providing free fiber optic broadband installation to businesses through the **ConnectNYC Fiber Challenge**. Although the capacity and access requirements for residents are vastly different than those for commercial businesses, Verizon's recent investment converting all copper wire in Lower Manhattan to fiber optics has well-positioned the neighborhood for both residential and commercial growth.

New York City must diligently continue to upgrade its infrastructure across all boroughs so that every New Yorker can have internet access to enrich their lives.

Achievements of the *Digital Roadmap Initiative*

300,000

Low-income residents with Internet access

40

Digital learning programs launched

2,000

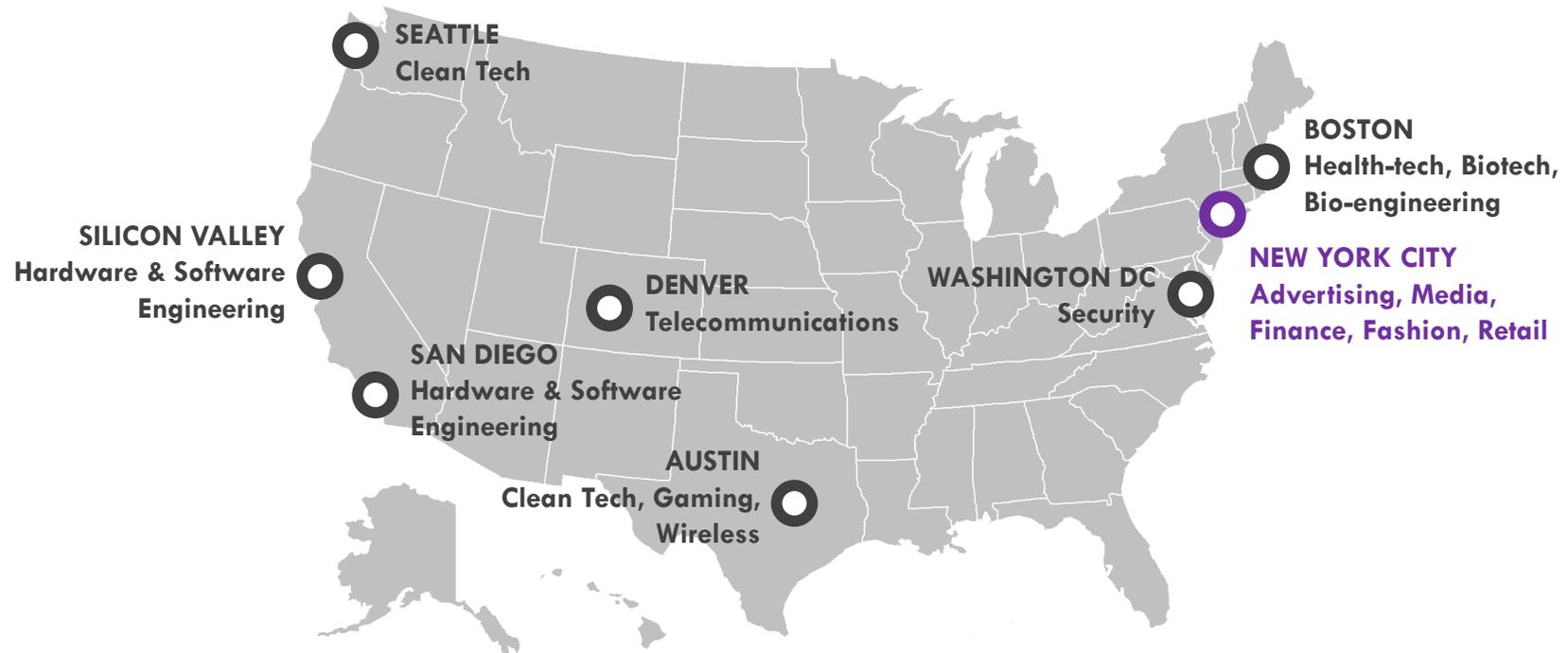
Public data sets

1,000

Made in NY technology companies

Sources: *Digital Roadmap Progress Report*, NYC.gov website; "A few feet from failure" article, *The Verge* (2013)

Promote New York City as a thriving, international hub of commerce and innovation that fosters opportunities for companies and workers.



Compared to economic sectors like media and finance that serve as pillars for the New York City economy, the success of tech may seem eclipsed. Tech, embedded in each sector, has reached an emergent stage. In response, New York City should cultivate its reputation as a leader in tech by promoting itself as an incubator for new ideas and ventures, an attractive destination for existing firms in tech and other industries, and a gateway for global investment. New York

City has a number of significant assets: a prolific network of professionals and thought leaders, an abundance of funding sources, and a world-class pool of creative and innovative talent. The City must continue to communicate the importance of these assets to the tech workforce, especially since much of New York City's tech is deeply integrated within its other strong economic sectors, which can be advantageous to growing and sustaining both tech and non-tech firms.

Sources: EMSI; HR&A Advisors, Inc. Analysis

Centralize and coordinate New York City’s existing and impactful tech-oriented programs and services.

New York City offers a wide range of programs to attract and retain tech and non-tech firms. Services like the **Small Business Digital Toolkit**, a free online program offering guidance on topics from social media to e-commerce to help non-tech firms successfully utilize digital tools, are readily available. Another vibrant program is the **Made in NY** branding campaign that markets and supports firms within the City tech community. It is critical that the information promoting such services is better organized and effectively disseminated to keep key recipients aware of the valuable and numerous resources at their disposal.

The City has made significant efforts to encourage the growth and retention of workers and firms within the tech ecosystem. NYCEDC initiatives like **NYC BigApps** and **Take the H.E.L.M.** (Hire and Expand in Lower Manhattan) are aimed at developers and growing startups. BigApps contestants have gone on to receive over \$8 million in venture capital to grow their app businesses, while winners of Take the H.E.L.M. are encouraged to move their firms to Lower Manhattan. These creative and effective initiatives must remain part of an annual roster of coordinated New York C tech-focused programming.

Sources: NYC.gov; NYCEDC NYC BigApps

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Katherine L. Oliver, Commissioner
Mayor's Office of Media and Entertainment

Maintain support for livable city initiatives that enhance New York City’s attractiveness to tech ecosystem workers building their careers and lives.

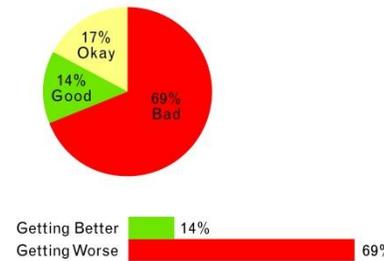
New York City is an expensive place to live. The recently published **Talking Transition** report reveals that the majority of New Yorkers, no matter which borough they live in, feel that access to affordable housing is getting worse.

Housing affordability is a concern for workers within the tech ecosystem as well. Addressing affordability is a crucial role in attracting and retaining workers needed by growing firms in the tech ecosystem. The City must construct affordable and market-rate, low- and middle-income housing in all boroughs so that residents have options they can afford. Along with affordable housing, the continued construction of parks, schools, mass transit access and other elements of a livable city ensures that the City remains globally competitive.

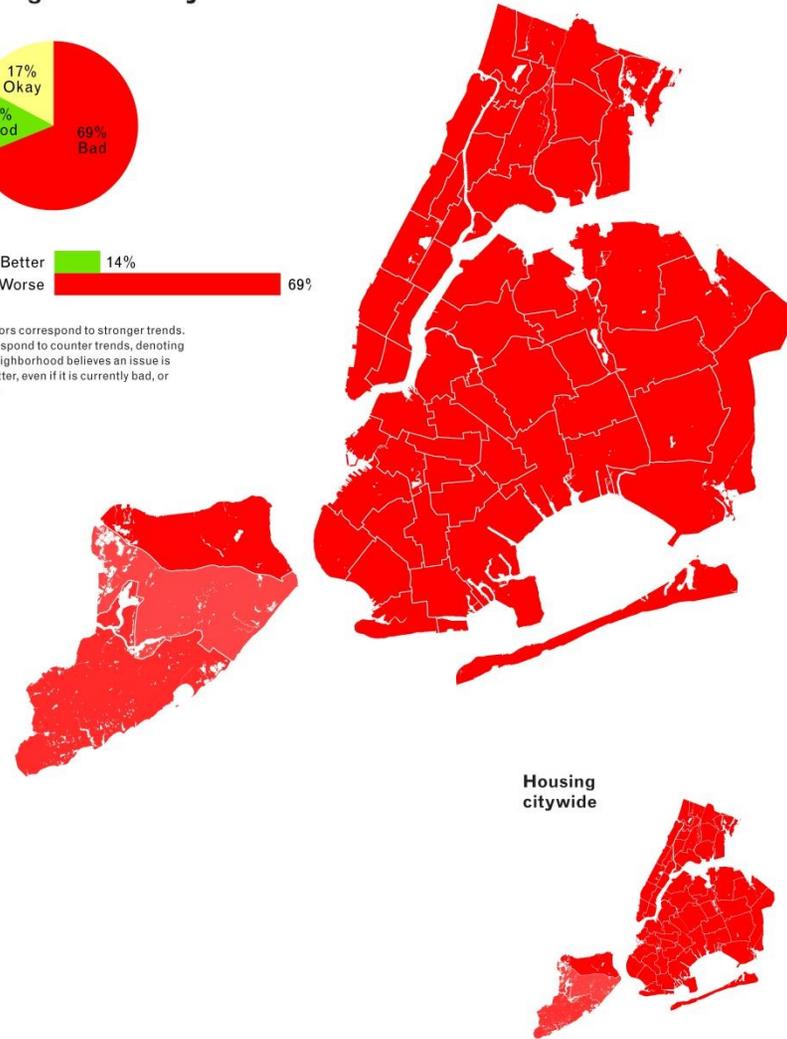
New York City residents, both present and prospective, must be ensured of the opportunities that exist in the City for jobs and economic mobility. To achieve this, the City must continue to stimulate the creation of middle-class jobs in order to bolster the labor pool and broaden the tax base. In addition to the usual economic sectors in which job creation has been traditionally focused, the tech ecosystem should be included.

Sources: *Talking Transition website*

In my neighborhood housing affordability is...



Darker colors correspond to stronger trends. Dots correspond to counter trends, denoting where a neighborhood believes an issue is getting better, even if it is currently bad, or vice versa.





Technical Appendix

HR&A Advisors specializes in analyzing the economic and fiscal impacts of industries, policy interventions, and development projects.

About HR&A Advisors, Inc.

HR&A Advisors, Inc. is an industry leading real estate, economic development and energy-efficiency advisory firm with offices in New York City, Washington DC, and Los Angeles. The firm has studied the economic impacts of Times Square, the High Line, the New York State Film Production Credit, and the New York State affordable housing industry.

The firm also has significant experience developing strategies to grow New York City's tech ecosystem, having served as program manager for NYCEDC's Take the H.E.L.M. competition to attract creative economy tenants to Lower Manhattan, program manager for NYCEDC's NYC BigApps 2014 competition to facilitate the creation of mobile and

web applications that leverage City data to solve civic issues, and economic advisor for the Brooklyn Tech Triangle plan to enhance downtown Brooklyn's tech sector.

The following technical appendix details:

- HR&A's process in defining the New York City tech ecosystem;
- HR&A's process in measuring the economic and fiscal impacts of the tech;
- The economic data packages (EMSI and IMPLAN) that HR&A employed in the course of this analysis.



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This study was motivated by a desire to develop a full accounting of New York City's tech ecosystem.

Unlike most industries that are neatly defined by the North American Industrial Classification System (NAICS), tech jobs are embedded in industries throughout the economy, requiring a careful methodology for accurate measurement.

A guiding principle of HR&A's definitional process is that the tech ecosystem should be defined based on both industry and occupational data. There are tech jobs present in industries that should not be wholly classified as "tech," such as finance or healthcare. Accounting for these tech jobs requires a definition that captures tech jobs using occupational data. Similarly, there are non-tech jobs at tech industry firms, such as a sales associate working at a software company. Although such jobs are not "tech" jobs themselves, they provide necessary support to tech employers, and thus are directly enabled by tech. Accounting for these jobs requires a definition that captures tech-enabled jobs using industry data.

HR&A developed and refined a list of tech industries and tech occupations in conjunction with industry experts. HR&A first held a methodological discussion with a working group composed of experts in labor and economic data analysis. HR&A subsequently convened thought leaders drawn from firms and organizations in the tech ecosystem to test the working definition. These discussions allowed HR&A to

develop the final definitions used in the report.

Industries are based on the 2012 NAICS codes as defined by the U.S. Census Bureau. Two rules guided classification of industries as tech industries:

Rule 1: Is this industry enabled by tech?

Rule 2: Does this industry primarily produce tech?

Industries meeting these criteria are shown on page 67.

Occupations are based on the Standard Occupational Classification (SOC) codes as defined by the Bureau of Labor Statistics and the Occupational Information Network (O*NET), a comprehensive database of occupational attributes and characteristics which uses questionnaires to collect data on the educational levels and skills required to effectively perform a job. Three rules guided classification of occupations as tech occupations:

Rule 1: Does this occupation directly produce tech?

Rule 2: Does this occupation facilitate the use of tech by others?

Rule 3: Would this occupation cease to exist without the presence of tech?

Occupations meeting these criteria are shown on pages 68 to 70.

Tech Industry NAICS Codes

NAICS Code & Classification	2013 NYC Jobs
3341 Computer and Peripheral Equipment Manufacturing	415
3342 Communications Equipment Manufacturing	496
3344 Semiconductor and Other Electronic Component Manufacturing	652
3345 Navigational, Measuring, & Control Instruments Manufacturing	1,128
3364 Aerospace Product and Parts Manufacturing	473
4541 Electronic Shopping & Mail Houses	9,943
5112 Software Publishers	1,806
5171 Wired Telecommunication Carriers	15,903
5172 Wireless Telecommunication Carriers (except Satellite)	1,093
5174 Satellite Telecommunications	1,139
5179 Other Telecommunications	2,577
5182 Data Processing, Hosting, and Related Services	5,404
5191 Other Information Services	23,781
5415 Computer Systems Design and Related Services	60,319
5417 Scientific Research and Development Services	16,152
Number of Industries Included	15
Total Number of Jobs Included	141,281

Sources: EMSI; HR&A Advisors, Inc. Analysis

Tech Job SOC Codes (pg 1 of 3)

SOC Code & Classification		2013 NYC Jobs
11-3021	Computer and Information Systems Managers	15,857
15-1111	Computer and Information Research Scientists	271
15-1121	Computer Systems Analysts	17,671
15-1122	Information Security Analysts	2,887
15-1131	Computer Programmers	12,120
15-1132	Software Developers, Applications	24,148
15-1133	Software Developers, Systems Software	8,282
15-1134	Web Developers	6,058
15-1141	Database Administrators	3,957
15-1142	Network and Computer Systems Administrators*	11,506
15-1143	Computer Network Architects	3,490
15-1151	Computer User Support Specialists	18,313
15-1152	Computer Network Support Specialists	4,493
15-1199	Computer Occupations, All Other	2,265
15-2031	Operations Research Analysts	3,250
17-2011	Aerospace Engineers	74
17-2031	Biomedical Engineers	95
17-2041	Chemical Engineers	264

Sources: EMSI; HR&A Advisors, Inc. Analysis

Tech Job SOC Codes (pg 2 of 3)

SOC Code & Classification		2013 NYC Jobs
17-2061	Computer Hardware Engineers	316
17-2071	Electrical Engineers	2,490
17-2072	Electronics Engineers, Except Computer	660
17-2112	Industrial Engineers	939
17-3012	Electrical and Electronics Drafters	805
17-3021	Aerospace Engineering and Operations Technicians	62
17-3023	Electrical and Electronic Engineering Technicians	1,696
17-3024	Electro-Mechanical Technicians	108
17-3026	Industrial Engineering Technicians	146
27-1014	Multimedia Artists and Animators	4,292
27-4011	Audio and Video Equipment Technicians	5,493
27-4012	Broadcast Technicians	2,880
27-4014	Sound Engineering Technicians	2,750
27-4032	Film and Video Editors	3,966
29-2011	Medical and Clinical Laboratory Technologists	4,248
29-2031	Cardiovascular Technologists and Technicians	1,058
29-2032	Diagnostic Medical Sonographers	1,489
29-2033	Nuclear Medicine Technologists	405

Sources: EMSI; HR&A Advisors, Inc. Analysis

In analyzing the characteristics of the tech ecosystem, HR&A relied on employment data provided by Economic Modeling Specialists Intl. (EMSI).

A CareerBuilder company, EMSI is a leading national provider of employment data and economic impact analysis. EMSI clients include the New York State Department of Labor, North Carolina Department of Commerce, and Oklahoma Department of Commerce. HR&A utilized EMSI's Analyst tool in estimating the size of the New York City tech ecosystem and its associated wages, educational requirements, and demographics.

EMSI gathers and integrates labor market data from a wide array of sources, including the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) and Occupational Employment Statistics (OES), U.S. Bureau of Economic Analysis, O*NET, U.S. Census Bureau American Community Survey (ACS) and County Business Patterns (CBP), and state departments of labor.

Integrating data from multiple sources allows EMSI to provide a broad accounting of employment that is unavailable from any one traditional source. To fully account for the New York City tech ecosystem, HR&A relied on EMSI data pertaining to three classes of workers:

1. QCEW/UI employees: All jobs covered by federal/state unemployment insurance.
2. Non-QCEW employees: Jobs except from unemployment insurance coverage including the military, railroads, and small non-profits.
3. Self-Employed: Jobs held by people who consider self-employment a significant part of their income.

EMSI's proprietary estimation process enables it to accurately report detailed data for every county in the United States (including each borough in New York City), and even employment data which is undisclosed by government sources due to confidentiality issues. EMSI reports industry level data to the six-digit NAICS code, and occupational data to the five-digit SOC code. Moreover, EMSI provides a "cross-walk" between industry and employment data (staffing patterns and reverse staffing patterns) that enabled HR&A to account for tech jobs in tech industries, tech jobs in non-tech industries, and non-tech jobs in tech industries.

EMSI also reports the most common educational or training requirements for each of the 800+ SOC codes based upon data from the U.S. Bureau of Labor Statistics.

HR&A utilized the IMPLAN input-output model to estimate the economic impacts of the tech ecosystem.

Created by MIG, Inc. (formerly the Minnesota IMPLAN Group, Inc.) IMPLAN is a leading national input-output model. IMPLAN clients include many public and private sector organizations, such as the federal government, New York State Department of Labor, New York Office of the State Comptroller, and Cornell University. IMPLAN traces the pattern of commodity purchases and sales between industries that are associated with each dollar's worth of a product or service sold to a customer, analyzing interactions among 440 industrial sectors for New York City. IMPLAN reports direct impacts and multiplier (indirect and induced impacts) to sectors across the economy.

HR&A utilized the 2012 IMPLAN model, which is the most recent model year available. HR&A designated the five boroughs of New York City as the study area. The economic impact study is designed to measure the impact of existing employment in the tech ecosystem in terms of employment, employee compensation, and economic output (spending) generated:

- **Employment** includes full-time and part time jobs.
- **Employee compensation** includes wage and salary income as well as employee benefits and employer-paid payroll taxes.
- **Economic output** is the total value of production across all industries in the economy. It is equivalent to total spending in the economy.

Direct Employment in the tech ecosystem (including 58,000 tech workers in tech industries, 150,000 tech workers in non-tech industries, and 83,000 non-tech workers in tech industries) comprised the direct employment impact on the New York City economy. HR&A used IMPLAN to project the multiplier impacts of this direct employment.

To prevent double-counting of tech employment, HR&A subtracted multiplier impacts reported in tech industries, as 100% of tech employment was already accounted for by the direct impacts of the tech ecosystem. This subtraction prevented approximately 12,000 jobs in tech industries from being double-counted as both direct and multiplier jobs.

HR&A's methodology for projecting fiscal impacts is based on economic impacts generated and existing ratios between economic activity and tax revenue.

HR&A estimated that the New York City tech ecosystem generates \$87.1 billion in annual gross regional product (GRP). As GRP is an encompassing measure of economic activity in the City economy, we assume that this GRP generates tax revenue to New York City in the same proportion as the current ratio between total New York City GRP in 2012 (\$655 billion) and fiscal year 2013 tax revenues as reported by the *Comprehensive Annual Financial Report of the Comptroller*.

As described in the body of this report, HR&A estimated the amount of tax revenue supported by the tech ecosystem across four buckets of taxes: real estate tax (for both commercial and residential property as the US Census Bureau reports that 72 percent of New York City workers also live in the City), personal income tax, sales and use tax, and corporation and business income tax (which includes general corporation, financial corporation and unincorporated business income). The ratios between current tax revenues and total economic output for each of these taxes is shown in the figure to the right.

For instance, New York City sales and use tax revenues in 2013 were \$7.03 billion, which is 1.07% of total City GRP. As HR&A's economic impact analysis estimated \$87.1 billion in total GRP owes to the tech ecosystem, we project the tech ecosystem generated \$0.9 billion in sales and use tax revenues for the City (1.07% of \$87.1 billion).

Ratio of New York City Tax Revenue to total GRP	
Real Estate Tax	2.89%
Personal Income Tax	1.50%
Sales and Use Tax	1.07%
Corporation and Business Income Taxes	1.02%

Source: NYC Comptroller's Comprehensive Annual Financial Report





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