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BACKGROUND

The recent blossoming of Greater Philadelphia’s tech sector and the proliferation of area tech jobs in non-tech industries are major bright spots for the region. Recognizing tech’s rapid growth and the potential to build on the good work already happening in the region, the Economy League of Greater Philadelphia – with support from the U.S. Economic Development Administration, the JPMorgan Chase Foundation, the Lenfest Foundation, SEI, Ben Franklin Technology Partners, and Graduate! Philadelphia – led an in-depth research and strategy initiative to better understand our region’s technology workforce and identify priority strategies to expand, deepen, and diversify that workforce.

Through this work, we have developed a better understanding of the size and key characteristics of Greater Philadelphia’s tech workforce, identified gaps between employer demand and labor supply in our market, and set forth a collaborative action framework to ensure that area firms have the talent to meet future needs and residents have access to emerging opportunities. The results presented in this report draw upon labor market data analysis; interviews with executives from regional employers, education officials, workforce development and training experts, and other key stakeholders; and collaborative input from a diverse steering committee composed of leaders across Greater Philadelphia’s tech workforce landscape.
EXECUTIVE SUMMARY

Information technology has been a major driver of U.S. employment growth in recent years, both for workers with advanced education and people without a bachelor’s degree. In Greater Philadelphia, leveraging the potential of our tech workforce will support business growth and expand opportunity – two areas where we lag peer metros. To help advance efforts to drive tech talent growth in the region, the Economy League of Greater Philadelphia conducted an in-depth market assessment and led the collaborative development of a shared framework for action to achieve the following vision and goals.

Vision
A deep and diverse tech talent pool in Greater Philadelphia supports business growth and fosters economic opportunity for residents

Goals
- More employers invest in upskilling their incumbent workforce to fill high-skill IT openings
- More individuals in our region obtain IT education and training that meets rapidly evolving market needs
- More women, people of color, and dislocated workers consider careers in IT

Key Findings
Taking effective action to strengthen Greater Philadelphia’s tech workforce requires an understanding of the current regional labor market, an analysis of recent trends, and an assessment of future needs. An in-depth market assessment yielded six key findings about our region’s tech workforce.

1. Greater Philadelphia’s tech workforce is large and growing, but is constrained by an undersupply of qualified candidates and a lack of diversity.
2. IT employers in our region are struggling to fill high-skill job openings.
3. With the rapid pace of change in technology, employers need high-skill workers who can learn continuously, problem solve, and adapt to evolving business needs.
4. Several tech occupations provide career on-ramps for middle-skill workers, with one-third of the region’s IT workforce holding less than a bachelor’s degree.
5. Many regional residents – from K-12 students to adults – do not understand the wide variety of jobs, industries, and career paths in tech.
6. Greater Philadelphia’s IT education and training ecosystem is wide-ranging, but can better meet regional market needs
Driving Tech Talent Growth in PHL: An Action Framework

Driving tech talent growth in Greater Philadelphia will require sustained, collaborative focus by the wide range of firms, institutions, government agencies, foundations, and nonprofit organizations in the region. To guide this work, the Economy League and a core group of key stakeholders developed a shared action framework for leveraging our tech workforce to drive regional growth and opportunity.

STRATEGY 1

Increase incumbent worker training and employer-led solutions

Increased focus on upskilling existing IT workers is a particularly promising strategy for closing our region’s high-skill labor shortage. Enhancing capacity among industry partnerships will provide a broader platform for sharing best practices, leveraging public funding, and coordinating incumbent worker training among employers. Expanding work-based learning programs and coordinating human resources practices will also help broaden the tech talent pool.

STRATEGY 2

Align and scale educational and tech training programs

Our higher education system is complemented by a growing number of specialized tech training and coding bootcamps that provide alternative entry points to a tech career. Expanding the number of bootcamp seats can help address the supply gap of qualified candidates in the near-term. Longer-term, collaboration between industry-led workforce partnerships and postsecondary institutions as well as K-12 schools will help ensure that foundational and technical skills taught align with market needs and are adaptable to future trends.

STRATEGY 3

Raise awareness of potential tech careers among underrepresented populations

Educating more people—particularly young women and people of color—about the breadth of career opportunities in tech will help expand and diversify the talent pipeline for IT employers in Greater Philadelphia. Targeted outreach campaigns to reach these individuals, as well as career-changers and dislocated workers, will help drive growth and expand opportunity in the region.

STRATEGY 4

Improve access to data on tech talent in the region

Broad access to data and information about employer needs, career pathways, and education programs in Greater Philadelphia will help inform the actions of firms, educational institutions, and workforce providers. It will also empower jobseekers, students considering IT educational programs, and other interested stakeholders to take advantage of available opportunities.
THE CASE FOR TECH:
GROWTH & OPPORTUNITY

The expansion of Greater Philadelphia’s tech sector and significant growth of tech jobs across industries present a unique opportunity to drive growth and prosperity in the region. Employers in the Philadelphia area have added more than 25,000 new tech jobs since 2002, equivalent to 25% of all net job growth in Greater Philadelphia during that period. There is already a significant level of activity in the region among a wide range of stakeholders to meet employer needs and expand career pathways, with opportunities to align and scale these efforts. The growth and opportunity dynamics in tech, however, fit within a broader national context that further illuminates the potential opening for Greater Philadelphia.

Information technology has been a major driver of U.S. employment growth in recent years.

Between 2002 and 2015, employment in IT occupations grew by 44% in the United States—five times faster than overall national employment growth. Even in the wake of the Great Recession, IT employment growth has outpaced overall job growth nationally, with a 12% growth rate nearly doubling the overall figure of 6% between 2012 and 2015. This post-recession growth in IT employment was the fastest of any occupational group outside of personal care and service occupations. And tech employment has a powerful ripple effect on the economy. Research shows that each new tech job can spur up to five additional jobs—a multiplier effect that is particularly high compared with other sectors.

This rapid growth has led to increasing concern about a tech labor shortage, which could limit economic growth. Recent studies suggest that over the next decade, the number of STEM (science, technology, engineering and math) job openings in the United States will outpace the number of newly-minted STEM degree-holders by up to one million. The immediate talent shortage is a common concern among tech executives across the country. In 2016, 65% of respondents in the annual Harvey Nash KPMG CIO survey acknowledged that hiring challenges in tech are a significant obstacle to growth.

The Tech Opportunity

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1 The employment data presented here and throughout the report come from the U.S. Bureau of Labor Statistics (BLS) Occupational Employment Survey. While the data provides a foundation for understanding occupations and growth in our region, the rapid changes across technology jobs have created significant challenges in occupational classifications. With many jobs that cut across working BLS definitions, it can be difficult to obtain a fine-grained understanding of IT occupation needs from the data alone. For example, the occupation group “Computer Occupations, All Other” contains many highly relevant IT occupations for this analysis that cannot be disaggregated (see Appendix C).
What Is a tech job?

A wide range of occupations across many industries create, enable, or operate technology. These occupations include jobs within tech companies—for example, a software developer at Comcast—as well as tech jobs within non-tech industries, such as computer support at a law firm. Broadly speaking, technology occupations can be grouped into five categories: information technology, installation and repair, applied technicians, engineering, and manufacturing. The analysis underlying this report focuses solely on information technology (IT) occupations—the largest and fastest growing category in our region, with 102,000 jobs and 34% growth since 2002. As a whole, IT occupations have a range of entry points across education levels, pay better than average, and present opportunities for career pathways. The definition of IT in this analysis includes 19 formal occupations, including software developers, web developers, computer support specialists, database administrators, and more (see Figure 1).²

![Figure 1: 10 Largest IT Occupations in PHL (2015)](image)

Source: BLS Occupational Employment Statistics

Note: Remaining IT occupations with less than 3,000 employees are not shown here, including web developers, information security analysts, computer operators, operations research analysts, computer science teachers, multimedia artists and animators, and computer and information research scientists.

Workers with advanced education are well-represented in tech – and there are significant employment opportunities for people without a bachelor’s degree.

Individuals with a bachelor’s degree or an advanced degree comprise approximately 65% of the national tech workforce. This includes computer science degree-holders, who have no shortage of opportunities in tech, as

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² The 19 occupations are a subset of BLS-defined occupations, which the Economy League settled on following a literature review and analysis of Information Technology definitions in other studies. See Appendix C for definitions.
well as individuals majoring in other subjects. Nearly one in twelve U.S. students who pursue a non-STEM major end up in a STEM occupation.

But tech jobs are not reserved solely for workers with advanced education. More than one-third of tech workers hold less than a bachelor’s degree (see Figure 2). The tech workforce includes a broad range of middle-skill jobs—those that require some education or training beyond high school, but less than a bachelor’s degree—including computer user and network support specialists, web developers, health information technicians, and others. These jobs are often filled by workers with an associate degree, CompTIA certification, experience in coding bootcamps or other training programs, or some combination of these credentials and experience.

Figure 2: Educational Attainment of the U.S. Workforce (2015)

Not only do middle-skill tech jobs provide entry points into a growing field that pays family-sustaining wages, they are on-ramps to long-term career pathways. Entry-level employees in middle-skill jobs can develop and hone IT skills and business knowledge that, with continued training, can help to address firms’ needs higher up the organizational chart.

In Greater Philadelphia, leveraging the potential of our tech workforce will support business growth and expand opportunity – two areas where we lag peer metros.

Projections indicate that over the next ten years, Greater Philadelphia could see 26,000–44,000 job openings in IT, between new jobs and replacement openings as workers retire. This represents a major opportunity for our

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3 See p. 15 for more information.
region, a historically slow-growth economy with too few family-sustaining employment opportunities for residents.

Between 2011 and 2016, total employment in Greater Philadelphia increased by 7% – the slowest pace among the ten largest U.S. metro areas (see Figure 3). Our region lags fast-growth western and southern metros – with the Bay Area expanding by 18% and Dallas by 17% during that period – and also east coast metros like Boston and New York, where the job base grew by nearly 10%. The region’s labor force participation rate of 78.1% is below average among those same ten metro areas, as 800,000 of the 3.8 million working-age adults in Greater Philadelphia are neither working nor actively looking for work. At the same time, 26% of individuals in the city of Philadelphia live in poverty.

Figure 3: Overall Employment Growth by Metro Area (2011-2016)

These statistics, of course, do not tell nearly the whole story of our region. They do underscore the need to take full advantage of bright spots in our economy that can drive growth and expand opportunity. Tech’s potential to support both of these critical priorities in Greater Philadelphia is clear – but we need a shared understanding of the dynamics of the tech workforce and a framework to guide our actions going forward.
MARKET ASSESSMENT

Taking effective action to strengthen Greater Philadelphia’s tech workforce requires an understanding of the current regional labor market, an analysis of recent trends, and an assessment of future needs. With this in mind, in 2016 the Economy League conducted a detailed market assessment of Greater Philadelphia’s tech workforce.

This market assessment defines and sizes the region’s tech workforce; examines employment growth trends; analyzes labor supply and demand dynamics; reviews education and training infrastructure; and highlights the strengths, weaknesses, and opportunities in Greater Philadelphia’s tech workforce. The results draw on extensive labor market data analysis and interviews with more than 30 individuals across the region’s tech workforce landscape. The assessment also incorporates detailed input from a steering committee of leaders representing regional employers, colleges and universities, workforce development intermediaries, government, youth education programs, and other civic organizations.

SIZE, GROWTH, SUPPLY & DEMAND

Greater Philadelphia’s IT workforce is large and growing.

Greater Philadelphia is home to a diverse set of firms with IT workforce needs, with significant demand from firms across the region’s strong finance, healthcare, biotech, and pharmaceuticals industry clusters. Greater Philadelphia is also home to longstanding tech anchors such as SAP and Unisys, and Comcast has evolved into a major tech player in recent years. The development of the Comcast Technology Center – one of the largest downtown tech campuses in the country – is a national story that has helped raise the profile of Greater Philadelphia as a tech hub. There are established and emerging tech clusters in Old City, King of Prussia, and University City, and a growing startup community with footholds in fintech, e-commerce, health IT, and software-as-a-service (SaaS).

Today, 102,000 people in Greater Philadelphia work in IT occupations, accounting for 4% of total regional employment (see Figure 4). While the size of our region’s tech workforce is smaller than most peer metros – closer in size to Houston and Atlanta than the Bay Area or New York – and tech job growth in the region has not been as fast as in peer metros, it still represents a major growth area for the regional economy. The number of tech jobs increased by 34% between 2002 and 2015, representing 25,000 net new jobs (see Figure 5). Between 2012 and 2015, 8,900 net new tech jobs were created. Outside of business operations and healthcare support occupations, no other occupational segment in our economy has grown more quickly than tech.

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4 See Appendix A for list of interviewees.

5 Software-as-a-service, also known as web-based software or on-demand software, is typically a subscription-based program and is accessed via web browser, allowing users to essentially rely on the provider for maintenance, security, software updates and management.
Tech has been critically important to the overall health of our regional economy. The 25,000 new tech jobs created between 2002 and 2015 was equivalent to 25% of all net new jobs created in the region during that period – a high share compared with most other peer metros (see Figure 6). This reflects both strong IT job growth but also slow overall job growth in our region.
The largest IT occupations in Greater Philadelphia include software application developers, computer systems analysts, and computer user support specialists.

The five largest IT occupations in Greater Philadelphia are software application developers (17,000 jobs); computer systems analysts (13,800); computer user support specialists (12,800); computer programmers (8,700); and computer and information system managers (7,600). Between 2012 and 2015, most of these occupations saw the largest job growth among tech occupations (see Figure 7). The number of software application developers in the region increased by 6,800 during that period. Strong growth in computer network support specialists is especially notable because this position often does not require a bachelor’s degree and represents a key gateway into the tech workforce.

Source: BLS Occupational Employment Statistics
Regional workforce development agencies cite seven IT occupations as high priority occupations across the five Southeastern Pennsylvania counties. Over the next 10 years, the agencies project fast growth in four of those occupations in Southeastern Pennsylvania: computer systems analysts (2,000 jobs added, 22% growth), computer user support specialists (1,700 jobs, 20% growth), software systems developers (1,400 jobs, 19% growth) and software application developers (1,000 jobs, 18% growth).

One-third of the region’s current IT workforce holds less than a bachelor’s degree, but the share of tech jobs not requiring a four-year degree is shrinking.

The tech workforce includes people with varying levels of formal education. While 43% of IT workers in our region hold a bachelor’s degree and 22% hold a graduate degree, an estimated 35% of area IT workers—approximately 35,000 people—hold less than a bachelor’s degree.

The share of new IT jobs available to those with less than a bachelor’s degree, however, is on the decline. Between 2002 and 2015, an estimated 19% of net new IT jobs created in Greater Philadelphia were in occupations requiring less than a bachelor’s degree. That figure has shrunk in recent years, with only 15% of net new IT jobs created between 2012 and 2015 requiring less than a bachelor’s degree.6

IT jobs pay significantly more than the mean regional wage across postsecondary education levels.

With a mean annual wage of $89,000, the average tech job in Greater Philadelphia pays $37,000 more than the average job in the region. The IT wage premium holds across education levels, with IT workers with an associate degree earning 30% more than the average associate degree-holder across all jobs, and IT workers with a bachelor’s degree earning 13% more than the average bachelor’s degree-holder across all jobs (see Figure 8).7 On average, IT salaries in Greater Philadelphia are lower than in other major tech hubs, with mean annual wages of $120,500 in the Bay Area, $105,300 in Washington, D.C. and $102,900 in New York (see Figure 9). The lower cost of labor in our region can be attractive for employers.

6 This data is based upon the BLS data on education required for entry into an occupation, whereas individual firms may have slightly different requirements.
7 While master’s degrees can be valuable for career advancement and for specialized occupations, there are no broad IT occupations that require a Master’s degree for entry, according to the BLS, which means there is no wage data in the corresponding chart. Similarly, there are no IT occupations available with less than a high school diploma, according to the BLS.
The number of local graduates with IT credentials is short of projected demand, compounding the challenges of significant inter-regional competition for IT talent.

Tech will continue to be a major engine of job growth in our economy. Projections anticipate 2,600-4,400 tech job openings every year for the next ten years, including net new positions and replacement openings as
Driving Tech Talent Growth in PHL – Technical Report

workers retire (see Figure 10). Greater Philadelphia’s colleges and universities, though, awarded just under 2,600 IT-related degrees and credentials in 2015 (see Figure 11).

Figure 10: Projections of Annual IT Openings in PHL (2016-2026)

Sources: BLS, Pennsylvania Department of Labor and Industry, Economy League of Greater Philadelphia
Note: These are four different projections based on different methodologies. See footnote 7 for more detail.

Figure 11: IT-Related Degrees Awarded by Institutions in PHL (2015)

Source: Integrated Postsecondary Education Data System

The low end of this projection is derived from BLS national employment projections and Pennsylvania Department of Labor and Industry projections. These projections assume significantly lower growth rates than Greater Philadelphia has experienced over the past decade. We utilized regional IT employment growth rates from 2002 to 2015 and 2012 to 2015 to create additional projections of employer demand over the next 10 years. Actual growth could be higher than these projections due to greater than expected growth in the tech sector or lower if there is an economic downturn or accelerated automation or offshoring.
If all these individuals remained in the region after graduation, the number of newly-trained employees entering the workforce each year would barely meet the low end of IT employment growth projections over the next decade. However, a sizeable share of local graduates leaves the region after graduation, with Campus Philly estimating that about 64% of students graduating from area institutions remain in the area after school. If the percentage of IT graduates staying in our region were to match that rate, we would need at least another 900–2,700 new workers annually to meet projected openings.

Some of this gap can be filled by recruiting from out of the region, but with many metros facing a similar talent crunch, competition for tech workers is particularly fierce and drives up costs for firms. With the competition and cost of out-of-region recruiting, there’s an even greater imperative to focus locally for our tech workforce needs.

Still, while workers with postsecondary credentials in computer science and other IT-related fields are in high demand, a much broader set of graduates enter the IT workforce. According to the 2013 NSF National Survey of College Graduates, on average only about one-third of college graduates working in computer and information science occupations graduated with a bachelor’s degree in computer science or computer engineering. Furthermore, nearly one in twelve U.S. students who pursue a non-STEM major end up in a STEM occupation.

**EMPLOYER NEEDS AND RESPONSES**

**Employers cite a need for more software developers in the region and struggle to fill a range of high-skill IT openings.**

Software developers are among the most sought after tech professionals in Greater Philadelphia. Regional job growth for software developers has outpaced all other IT occupations since 2012, and employers of varying sizes and industries report significant difficulty in filling openings. But these formal occupations do not capture the full diversity of jobs within software development and the specific needs of regional employers. Area firms report a particular need for more back-end developers (responsible for the data and infrastructure behind what end users see) with foundational knowledge of Java and .NET. This contrasts with front-end developers (responsible for the part of websites or applications that users interact with), who are generally easier to find for regional employers. Full-stack developers, who have command of both ends, are highly sought after by cutting-edge startups but fill a smaller share of the overall need in the region.

There is much more to IT than software development, and other hard-to-fill occupations in Greater Philadelphia span the IT workforce spectrum. DevOps engineers, who bridge the gap between software development and systems operations, are in particular demand. People in these roles typically have specialized knowledge in at least one stack – such as Linux, on which Amazon Web Services is based, or Microsoft’s Azure cloud platform - and are able to quickly learn and understand other skills and tools.

Quality assurance (QA) analysts – broadly responsible for assessing potential vulnerabilities and understanding how processes interact – are similarly difficult to find, as opposed to software testers who can be quickly

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9 We are using the term software developer, although some firms prefer the term software engineer. The latter term generally implies a requirement for at least a 4-year computer science or engineering degree.
trained for a discrete task. And with rapid growth in “big data” – providing more information than ever before to make business decisions, improve processes, and create new products – regional firms report difficulty in hiring data scientists to interpret this new information. Most data analyst positions require deep background in statistics, analytical techniques, and being able to interpret data.

Finally, several firms reported difficulty in hiring for tech sales and marketing positions. Many firms do not view the region’s large and experienced cohort of sales and marketing professionals across non-tech industries as particularly well-suited to sales in tech. While sales and marketing professionals do not necessarily need software development credentials, firms look for candidates that have worked in tech before, understand the foundations of the firm’s products, and can help clients use and understand technology.

There are several high-growth IT fields where employers are feeling a talent pinch, including cybersecurity, the Internet of Things, and cloud computing.

Along with the hard-to-fill occupations discussed above, employers also report an undersupply of talent with specialized knowledge in a few fast-growing IT fields. The talent crunch is most pronounced for cybersecurity professionals. Part of the challenge in this field is the need for seasoned, experienced professionals across occupations. The high stakes associated with the cybersecurity field means positions often come with hard requirements for years of experience and advanced education; it is not a field in which firms often recruit directly from college. Despite these high standards for cybersecurity workers, there are multiple points of entry into this field – one can come from a background of software development with an understanding of potential vulnerabilities or one can come from a networking background.

Demand is also high for individuals with specialized knowledge around the Internet of Things (IoT), an ecosystem in which sensors embedded in physical objects are connected through networks allowing machine-to-machine communication and data collection. Cloud computing, or the ability to store and access data on remote servers rather than on an individual’s computer or on a company’s campus, is a related field requiring specialized knowledge and experience that regional employers are having difficulty finding.

Beyond IoT and cloud computing, other stakeholders cited mobile and e-commerce as two particularly in-demand fields. These fields do not necessarily present different occupational needs than those listed above, but highlight the desire among some firms for specific applied software development and communication skills.

Although IT jobs require significant technical skills, many employers cite a lack of soft skills as a key challenge in the regional IT workforce.

While many tech jobs require a foundation of technical skills, area IT employers of all sizes and types consistently cite the need for more people with a range of soft skills to successfully navigate the rapidly evolving tech landscape.

For software developers, the constant churn of new programming languages in the market drives a persistent need for continuous learning. The most in-demand languages often change over just a few years and require developers to be able to quickly refresh skillsets. According to the Institute of Electrical and Electronic
Engineers, while foundational languages such as Java and Python continue to be important, new languages like Scala saw a fourfold increase in job listings from 2014 to 2016.

The need to learn quickly and problem solve is critical in positions across the tech workforce. In Accenture’s Technology Vision 2016 survey of 3,000 IT and business executives worldwide, “deep expertise for the specialized task at hand” was cited as only the fifth-most important skill needed from tech workers. Being able to learn quickly, shift gears, and multitask were all ranked as more important skills needed to succeed. Greater Philadelphia firms value these skills particularly in IT workers who show a capacity to understand business operations and can connect technology development with business needs. In many cases, workers who demonstrate a combination of business and technical skillsets find their way into higher-level positions.

**Some employers are hesitant to invest in training their IT workforce.**

Developers need to be able to constantly learn and update their skills to stay relevant in the market. Because of the rapid growth in languages and applications across IT, traditional educational institutions face challenges developing new curricula that meet evolving job market needs. While there are steps that higher education leaders can take to adapt more quickly and work more closely with industry, employers have a major role to play in developing and maintaining the talent they need.

Long vacancies are a challenge for employers. The skills and experience sought by employers often exceed the skills and experience among many job candidates. In a tight labor market, increased on-the-job training would help address these needs, but many firms across industries have underinvested in this area for some time. According to analysis by Wharton professor Peter Cappelli, in 1991 17% of young employees reported receiving training during the previous year; by 2011, only 21% said they received training during the previous five years.

Many firms are reluctant to invest in both upskilling long-standing employees and training less-experienced hires, largely out of concern that those employees may quickly move on to other opportunities. Some firms view training as cost-prohibitive, but many do not consider how true costs of keeping a vacancy open compare with the costs of training incumbent workers. Regardless of the reasons for underinvestment, many companies facing an IT workforce crunch would better address their hiring needs by establishing clearer career pathways and providing on-the-job training for incumbent employees.

**There is lack of clarity within some firms about IT workforce needs and how to address them.**

In some cases—especially in non-tech industries—underinvestment in on-the-job training is the result of internal misunderstandings within a firm about specific IT workforce needs and whether to hire or outsource.

IT employers often focus on candidates with a bachelor’s degree as a strategy to find individuals with the soft skills necessary for tech jobs. This approach, however, can have a limiting effect, as its screens out a broad segment of viable candidates. While many IT jobs can be done effectively without a bachelor’s degree, IT employers often find themselves at a loss for other effective ways to assess a candidate’s soft skills. And for some IT employers that do client-based work, clients often want to know the team that they will be working with and expect experienced, traditionally-educated team members.
At some firms, a lack of clarity about IT workforce needs is attributable to misalignment between the human resources professionals that manage the hiring process and the IT units where the open positions are situated. This misalignment can result in up-credentialing on job postings—including more education requirements than needed or a laundry list of technical skills that an IT manager would not necessarily expect one person to know. Some employers report that the newer the technology used in a given IT position, the more human resources professionals may require specific credentials such as an IT-related bachelor’s degree. On the other hand, some IT-intensive firms explicitly want job candidates without a computer science background to ensure a broad skill set and perspectives that provide a base for the firm to train new hires to suit their needs.

Many firms also grapple with when and what to outsource for their IT workforce needs. Some rely on a predominantly full-time, in-house workforce; some have a core team of full-time employees alongside a team of specialized local contractors; and others offshore specific, basic production tasks. For some tech firms as well as companies in non-tech industries like finance and healthcare, there are significant confidentiality and security issues that preclude or dissuade significant outsourcing of tasks.

**Anchor firms play a big role in attracting and retaining IT talent.**

Comcast is a major anchor in the Greater Philadelphia tech ecosystem, as are companies like SAP, SEI, and Vanguard, among others. When these firms adopt new workforce strategies or new initiatives, like Vanguard’s announcement of an innovation center in the city, it makes news and can spark discussion of similar options at other companies. Such companies have the size and personnel to organize career exposure programs, develop internship programs, and take a leadership position on creative strategies to address workforce challenges.

Still, the shortage of more immediately-recognizable, consumer-oriented tech firms in the region is a headwind for attracting and retaining top talent, particularly for startups and midsized firms. Some candidates want to work in a startup environment or at a midsized firm at the start of their careers before later transitioning to a larger company with more stability and economic certainty. The addition of a few major firms – or the organic growth of some homegrown firms into bigger names – could further boost the brand of Greater Philadelphia’s tech ecosystem and help in talent attraction and retention across the IT landscape.

**The region’s tech community has shown an interest in connecting young people with careers in IT.**

Many employers in the region have taken active roles in developing the future IT workforce. Several tech firms participate in programs that bring IT professionals into middle-school and high-school classrooms to talk with students about their work, host on-site student visits, and operate internship and apprentice programs for older students. Stakeholders in the region’s tech sector who are familiar with other tech hubs report a notable grassroots passion and willingness to collaborate in the Greater Philadelphia tech community, with local tech leaders willing to mentor young people and volunteer their time to teach at or even start tech education programs. There are opportunities to amplify this existing work to continue developing the next generation of tech talent.
The region has a longstanding, model industry partnership focused on connecting IT employers with talent.

An initiative of the Chester County Economic Development Council, the Innovative Technology Action Group (ITAG) is a major industry partnership that regularly convenes IT employers in the region. Funded in part by the private sector and in part by the Chester County Workforce Development Board, ITAG brings together a diverse set of business, education, training, and public sector leaders in the region to learn from one another and collaborate around shared workforce needs and solutions.

Established in the mid-1990s as an informal forum for IT employers, ITAG received funding from the Commonwealth of Pennsylvania in 2006 to create a formal industry partnership. ITAG sponsors a range of IT incumbent workforce training programs with discrete certifications and programs to help IT workers develop the cross-functional skills that employers need. In addition to training programs, ITAG sponsors several career exposure programs that hundreds of young people throughout the region take advantage of each year.

OPPORTUNITY PATHWAYS

Several middle-skill occupations provide potential on-ramps for workers into the IT workforce.

The pinch for high-skill openings in our region should not obscure the fact that the IT workforce includes people with varying levels of formal education. Today, an estimated 35,000 IT workers in Greater Philadelphia – 35% of the tech workforce – hold less than a bachelor’s degree.

Computer support specialist, particularly for help desk support, is the most common middle-skill gateway job highlighted by local firms. Associate degree programs providing background in software, hardware, networking, and diagnostics help prepare candidates for these positions, and certifications offered by CompTIA, Microsoft, Cisco, and others provide foundational skills. While technical skills are important, the primary focus of these positions is customer service, for which communication, interpersonal, and problem-solving skills are of the utmost importance.

Software testing and web development can also provide a gateway into the IT workforce. Software testers typically need a basic foundation in C# programming, test planning, and effective writing and communication to share findings of software bugs. Web developers can often enter the field with an associate degree or some postsecondary training in HTML, CSS and Javascript, along with strong communication skills to translate client needs into a well-designed and maintained site. In addition to software testing and web development opportunities, stakeholders also report opportunities in network administration – a pathway into the broader cybersecurity field – as well as geographic information systems (GIS).

There are also several training programs in our region that are preparing students for junior software developer positions. While many software developer jobs require a bachelor’s degree, training programs like ZipCode Wilmington are having success placing students into junior software development positions at area firms, particularly financial services firms in the Wilmington area. Java and .NET are widely viewed by regional
stakeholders as the most useful languages to learn, not only because they are in demand but because they provide a foundation that allows individuals to learn other languages more easily throughout their careers.

The impending retirement of baby boomer IT workers could create some unique on-ramp opportunities, particularly at older, larger firms in non-tech industries. Although not technically a middle-skill job, one occupation with a high concentration of near-retirement workers is mainframe developer, responsible for developing software and managing bulk data needs for large legacy corporations and government. In the long-term, firms relying on legacy technology platforms will eventually have to transition to more modern systems. In the short- to medium-term, however, these job openings could present unique pathways into an IT career if a company or workforce development organization developed a targeted training program, as many of the legacy programming languages and technical expertise required for these positions are no longer taught in traditional computer science programs.

**Potentially promising entry-level gateway occupations in IT are vulnerable to automation and offshoring pressures.**

More than one-third of the region’s current tech workforce holds less than a bachelor’s degree, but the share of new IT jobs available to such workers is on the decline. Up-credentialing is partly responsible for this trend, but automation and offshoring present larger threats to middle-skill IT jobs. A 2013 Hackett Group report estimated that 1.4 million existing IT jobs in North America and Europe were automated or offshored between 2002 and 2013.

The dynamics of offshoring have shifted in recent years, however, abating the transfer of jobs overseas, particularly for help desk support positions. Rising labor costs in India and China, coupled with communication barriers between workers and end-users in the United States, have created disincentives for offshoring help desk positions. However, that change has created additional incentives to explore other cost reduction measures, including automation.

Any task that can be "boxed" – meaning it is extremely clear and can be discretely assigned with no additional questions – can eventually be automated. That process is already underway. Many tasks assigned to software testers that only a few years ago required human analysis are now automated, and the remaining human elements are increasingly being delegated to existing positions higher up the organizational chart. The number of web developers shrunk by one-fifth nationally over the past few years as new software enabled users with relatively basic web needs to build their own sites at less cost.

**Racial and gender disparities are significant in the IT workforce regionally and nationally.**

A pronounced lack of gender and racial diversity in the tech workforce is also a major contributor to the gap between labor supply and demand. Women comprise 49% of Greater Philadelphia’s workforce, but hold only 26% of tech jobs. African Americans comprise 10% of the region’s tech workforce versus 18% of the overall workforce, and Hispanics account for 4% of tech jobs compared with 8% of all jobs in the region (see Figure 12). Greater Philadelphia’s tech workforce is slightly more inclusive than the U.S. tech workforce, but
underrepresentation of women and people of color remains a significant barrier for individual opportunity and business growth in the region.

Figure 12: Diversity in the Greater Philadelphia Workforce (2015)

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates

IT training and exposure programs are critical in closing these gender and racial gaps (several promising programs in our region are highlighted in the following section), as is expanding basic digital access in low-income communities throughout the region. Nearly 20% of Philadelphians do not have access to the internet at home, and the percentage increases to 27% for households earning less than $30,000 per year. Programs such as Comcast’s Internet Essentials, launched in 2011, provide low-income families and seniors with low-cost internet service and computers, free digital literacy tutorials, and in-person training sessions. Locally, over 132,000 individuals have benefitted from this program to date.

There is lack of clarity among jobseekers about IT career paths and where these opportunities are in our economy.

The spread of technology into everyday life is generating a diversity of employment opportunities that extend far beyond common perceptions of tech jobs. While images of the entrepreneur building a high-growth startup or the professional hacker furiously writing code have become predominant notions of what a tech career entails, the reality is that most IT jobs are in non-tech industries. In major sectors like finance, healthcare, and education, IT is an increasingly critical part of operations and production. And tech career pathways in the corporate world often provide greater stability than the startup environment, which can appeal to many workers.
General awareness of such opportunities is limited, however, due in large part to the rapid pace of technological change and the lack of integration of basic tech education into school curricula. These challenges are particularly acute for young people of color and women, who are significantly underrepresented in the tech workforce both in Greater Philadelphia and nationally. Limited awareness of available opportunities in tech can make it difficult for women and people of color, young and old, to imagine themselves in a tech career.

Few programs or initiatives in our region adequately frame the range of experiences and skill sets involved with different IT occupations. Communicating the variety of skill sets used across IT careers – from artistic and creative talent applied in user-experience (UX) and user-interface (UI) work, to problem solving and attention to detail associated with quality assurance, to the people skills required for help desk positions – is critical to retaining the interest of young people and allowing them to see a path that interests them. The lack of understanding of career opportunities in tech extends to many parents and guardians, who play a significant role in shaping a child’s career interests but often have little idea of the broad and quickly evolving range of opportunities that tech has to offer.

**EDUCATION AND TRAINING ECOSYSTEM**

There are many programs addressing tech workforce needs in our region, but there are structural challenges and limited interconnections.

A rich ecosystem of educational institutions, training programs, and career exposure programs supports IT workforce growth across the region and serves a range of ages and communities. However, educational institutions across our region have faced challenges in adapting to rapidly changing IT market needs. With technological evolution outpacing educators’ capacity to update curricula, many students are left learning out-of-date techniques and approaches. Funding constraints are a driving factor behind the slow realignment of IT curriculum to meet market needs, and challenges in finding qualified instructors also play a role.

While many organizations focus on specific niches within tech workforce development, most recognize that developing a robust talent pipeline requires action by a wide range of stakeholders. Still, many providers do not fully understand what is going on elsewhere in the region or how they can connect to other supports. Greater coordination will help increase effectiveness and amplify impact.

**Colleges and universities can be slow to evolve in addressing IT workforce needs, but are taking steps to work more closely with employers.**

IT employers largely view our higher education institutions as major assets to talent development and attraction. Drexel has long been a leader in computer science and is viewed as a particularly strong program in the region, while graduates from Temple and Penn are also held in high esteem by regional IT employers. New cybersecurity programs at Villanova and Penn State have been cited as top feeders for specialized talent. Smaller colleges like Peirce College have built relationships with local employers and provide flexibility for working adults seeking IT degrees and credentials.
Still, higher education institutions have struggled at times to adapt to rapidly evolving market needs and to balance employers’ technical skill demands with their broader academic missions. Increased adoption of the CS+X curriculum model has helped expand the number of students in tech while preserving the breadth of a liberal arts education. The combination of computer science with another discipline through a double major, minor, or interdisciplinary work, the CS+X model meets employer demand for candidates with writing, critical thinking, and problem-solving skills alongside a foundation of technical skills.

Some educators also recognize opportunities for greater collaboration among higher education institutions in the region and the potential for joint conversations with employers regarding their talent needs and curriculum development. Most of these conversations in the region have typically been between individual schools and employers, but there is the potential for economies of scale with broader information-sharing and collaboration.

Expanding work-based learning opportunities as a complement to classroom and project-based education is critical. The Drexel co-op program is well-known and respected throughout the region, with many IT employers having regular rotations of co-op students. For some firms, this is a reliable pool for recruitment, and many hire top performers for full-time positions after graduation. Expanding such internship and co-op programs help employers with immediate project needs and reinforce employee-employer relationships that can boost the likelihood that talented students will stay in the region after graduation.

Community colleges are a natural home for IT workforce development, and there are promising models inside and outside the region.

Area community colleges offer a range of IT educational offerings through associate degrees, certificates, and non-credit training. They serve an important role for both students coming out of high school and those who are changing careers. For incumbent workers, community college programs offer valuable upskilling opportunities. Community colleges are working to make it easier for students to fulfill IT degree requirements through discrete certifications they earn over time – better aligning with the schedules and needs of working adults.

Like universities, community colleges face challenges in adapting to employers’ evolving IT workforce needs and understanding the key skills needed for a range of positions. Establishing stronger, sustained partnerships with industry for inputs on education and training programs and engaging IT professionals as faculty or student mentors can help enhance the ability of these colleges to align curricula with industry needs. However, salary constraints and structural labor issues often inhibit the ability of community colleges to hire qualified faculty with up-to-date skills.

One particularly promising initiative to strengthen the talent pipeline involving community colleges is Pathways in Technology Early College High Schools (P-TECH). Launched in 2011 by IBM, the New York City Department of Education, the City University of New York, and New York City College of Technology, P-TECH is a cost-free six-year program that combines high school, community college, and work experience. Students from low-income backgrounds apply by lottery to the high school and are guaranteed a spot in community college for advanced STEM training. Throughout the program, students are offered internships and mentorships with an employer partner. Upon graduation, students are first in line for positions at IBM or other employers.
Tech training programs, coding schools, and career exposure programs fill important workforce development gaps, and there are opportunities to scale efforts.

Beyond the formal education system, postsecondary training opportunities in Greater Philadelphia have spread in recent years. A growing number of independent training programs, coding bootcamps, and tech career exposure programs serve a range of populations and fill gaps within the formal education system. One of the longer-standing programs in the region is Tech Impact’s ITWorks, which targets 18-to-26-year-old high school graduates and provides a foundation of skills in computer hardware and networking. Creating IT Futures Foundation, the philanthropic arm of industry trade group CompTIA, operated a pop-up training program in Philadelphia in 2015 that also focused on hardware and networking training and certification. On the software side, Tech Impact also created ZipCode Wilmington, one of the few nonprofit coding schools in the nation. It has had success training students across a range of backgrounds and ages, meeting specific employer demands, and developing productive relationships with employers to create direct hiring pipelines. Other coding schools such as New York Code + Design Academy have developed a presence in Philadelphia, and some stakeholders cited Denver-based Galvanize as a top coding school that they’d like to see open in the region.

In addition to training programs targeting young adults and career-transitioning workers, Greater Philadelphia is also home to several youth-focused programs. Coded by Kids provides weekly courses for students ages 5 to 18 working through various stacks and using project-based learning. Hopeworks ‘N Camden uses tech as a vehicle to help young people from 14 to 24 build a range of professional and personal skills. Students begin with web development training, but can also move into geographic information systems work and develop other higher-level IT skills. Students at Coded by Kids and Hopeworks ‘N Camden complete project work for government and business clients, with small but growing portfolios of organizations that hire them for web development or GIS work. Other programs such as TechGirlz and Girls Who Code target girls from elementary school up through high school. These programs combine hands-on tech training with career exposure, connecting girls with a range of technology professionals to generate interest and excitement about careers in technology.

These programs are filling needed gaps in existing educational and career exposure opportunities. Still, most are relatively small; combined, they do not reach sufficient scale to fully address the supply/demand gap in our region. There are opportunities for more coordination between programs, both to scale best practices and to work collaboratively in building relationships with employers.

Apprenticeships offer opportunities to develop needed workplace skills, but are underutilized by many IT employers.

Like internships and co-ops, apprenticeships can be used by some employers to address immediate needs and develop a pool of eligible talent. While not appropriate for all employers or job types, apprenticeships can offer cost savings for employers and an opportunity to train workers with the specific skill sets needed for the job. For the employee, apprenticeships present the chance to demonstrate their value to an employer and receive intensive on-the-job training. Adapting the apprenticeship approach, however, requires a paradigm shift for

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10 See Appendix D.
many employers to a greater emphasis on long-term talent development, beginning with entry-level career pathways.

In Philadelphia, the Urban Technology Project (UTP) empowers high school graduates to develop and deepen their knowledge of computers and computer support through year-long service learning with the School District of Philadelphia and an apprenticeship with IT professionals within the District. UTP is the longest continuously running IT apprenticeship program in the country and has been recognized by the U.S. Department of Labor. Currently, UTP apprenticeships are focused on computer support specialists, with an annual cohort of about 20 apprentices, and the program hopes to expand into other sectors of IT. Work is underway to scale this model to a regional level.

**IT education can be better integrated into K-12 and CTE programs, and there are examples on which to build.**

At the K-12 level, schools have struggled to meaningfully integrate tech into curricula. Many schools are introducing tech tools to help students learn traditional subjects by investing in computers, iPads, and educational software. These tools can help students learn, but do not prepare them to join the tech workforce. Students in many schools are lacking a foundational introduction to IT at a young age, as well as more specialized coursework in computer science and other IT disciplines throughout middle school and high school. One barrier is a lack of faculty with the necessary background to teach students. Isolated “train the trainers” programs have helped teachers learn some basic tech education skills from professionals in the field, but a lack of sustained funding renders these skills obsolete over time.

Beyond traditional K-12 programs, IT tracks in career and technical education (CTE) programs have grown in the region. However, some believe that most curricula being taught in these programs are significantly outdated, with students coming out of three-year CTE programs often not adequately prepared for currently available jobs.

The Science and Leadership Academy (SLA), a partnership school between the School District of Philadelphia and The Franklin Institute, has gained recognition for its IT education efforts. SLA’s curriculum is heavily focused on STEM learning, and the school emphasizes the soft skills cited by many regional stakeholders as necessary for success in IT occupations. Learning at SLA is project-based, allowing for creativity, problem-solving and communication skill-building, while the schedule is flexible to promote out-of-classroom learning through internships and dual enrollment programs.
DRIVING TECH TALENT GROWTH IN PHL:
AN ACTION FRAMEWORK

Grounded in the market assessment findings, the Economy League and the tech workforce steering committee developed a detailed action framework to achieve the shared vision of a deep and diverse tech talent pool in Greater Philadelphia that supports business growth and fosters economic opportunity for residents.

The priority strategies detailed in this framework flow from the opportunities and challenges identified in the market assessment: a limited talent pool for high-skill tech job openings; a large number of middle-skill incumbent tech workers; the need for tech workers with foundational technical skills that can also learn continuously and quickly adapt; a lack of awareness of tech career opportunities, particularly among women, people of color and dislocated workers; and a wide-ranging education and training system that can better meet market needs.

Vision

A deep and diverse tech talent pool in Greater Philadelphia supports business growth and fosters economic opportunity for residents

Goals

1. More employers invest in upskilling their incumbent workforce to fill high-skill IT openings
2. More individuals in our region obtain IT education and training that meets rapidly evolving market needs
3. More women, people of color, and dislocated workers consider careers in IT

Who is Involved

Realizing this vision and goals will require action by a wide range of stakeholders in Greater Philadelphia, each with a unique role to play in driving tech talent growth.
STRATEGY 1: INCREASE INCUMBENT WORKER TRAINING AND EMPLOYER-LED SOLUTIONS

Leveraging employers’ incumbent IT workforce is a particularly promising strategy for addressing the high-skill labor shortage in our region. Most on-the-job training and upskilling is powered by direct financial investment from employers, but employers alone cannot fully address the high-skill labor shortage. To get to sufficient scale, upskilling programs within individual firms must be combined with efforts to build greater capacity among industry-led workforce partnerships to advocate for specific training programs, leverage public funding for training, provide a venue for sharing best practices, and potentially serve as a vehicle for joint incumbent worker training. There are also opportunities to expand work-based learning programs and coordinate human resources practices to broaden the tech talent pool.

Priority Tactics

LARGE EMPLOYERS COLLABORATE AND BOOST INVESTMENT FOR INCUMBENT WORKER TRAINING

In many respects, incumbent workers are well-positioned to meet firms’ high-skill needs. Middle-skill employees in help desk, network administration, or database administration positions already know the business, have a baseline of foundational IT skills, and have various non-technical skills forged by years of work experience. Large employers often have a significant cohort of such workers, along with the resources and scale to provide targeted training. With additional training, firms can tap these incumbent workers to fill junior-level positions in software development, web development, or cybersecurity. And with employers reporting few challenges filling those existing middle-skill positions, internal movement up the organizational chart will not necessarily result in a downstream hiring crunch. Incumbent worker training would allow firms to fill high-skill positions while opening up on-ramp IT opportunities for middle-skill workers. Many firms understandably worry that employees will leave after receiving training, but this can be mitigated through explicit agreements for workers to stay at the firm for a specified period of time. There is no one-size-fits-all solution, but even non-financial changes – such as flexible scheduling to allow for workers to take courses, or co-locating training programs at an office – can be useful in upskilling a workforce.

SMALL AND MIDSIZE EMPLOYERS DEVELOP AND EXPAND PAID INTERNSHIP, CO-OP, AND APPRENTICESHIP PROGRAMS

For small and midsize employers, further participation in work-based learning programs can expand the pipeline of future employees. This low-cost strategy is a good fit for firms of this size, as they often have limited resources for upskilling investment and typically have smaller, more informal full-time job recruitment programs than larger companies. Many firms already have regular rotations of interns or co-op students, and use those students as a primary pool for hiring needs. There is opportunity to cast a broader net in recruiting students for these work-based programs. Expanding the potential pool of students beyond those pursuing bachelor’s degrees – in partnership with community colleges, training programs or bootcamps – would allow firms to not only bolster their chances of filling talent needs but also boost diversity.
INDUSTRY PARTNERSHIPS CONNECT MORE FIRMS TO BEST PRACTICES AND TRAINING OPPORTUNITIES

While most employer-led programs will be determined by individual firms, there is ample opportunity for firms to collaborate more closely around shared needs and solutions. Industry partnerships—formal partnerships in the Commonwealth of Pennsylvania that bring together multiple employers in a specific industry or cluster—provide opportunities for firms to share success stories, learn about effective training opportunities, and connect to public funding for upskilling. Increasing the number of employers participating in these partnerships could reduce the practice of firms poaching workers from each other and provide a larger public policy platform. While some firms in our region take advantage of existing partnerships, broader representation in these partnerships would amplify benefits to members and boost advocacy power.

HR LEADERSHIP GROUPS ENGAGE MEMBERS AROUND HIRING PRACTICES TO MEET IT WORKFORCE NEEDS

Firms can often face self-imposed barriers in finding qualified candidates when their job postings ask for more skills than truly needed and when they use bachelor's degrees as a blunt proxy for non-technical skills. Competency-based hiring, which provides alternative means for candidates to demonstrate that they have particular competencies—such as problem-solving, communications, or technical skills—rather than focusing solely on credentials, can be an effective way to identify more qualified workers. With IT employers reporting challenges in finding candidates with the requisite non-technical skills, embracing competency-based hiring practices could expand the candidate pool for employers and simultaneously open up opportunities for diverse candidates.

Case Study: AT&T Retrains its Existing Workforce to Reposition Itself

As AT&T works to transition from a legacy telecom giant to a modern tech and media company, it is making an unprecedented investment in retraining its existing workforce to fill new roles that will require competencies in software development, cloud computing, data science, and more. In an interview with the Harvard Business Review, an AT&T senior executive made the case for the company’s strategy: “You can go out to the street and hire for the skills, but we all know that the supply of technical talent is limited, and everybody is going after it. Or you can do your best to step up and reskill your existing workforce to fill the gap.” Half of all AT&T employees—140,000 workers—are going through re-training, with the firm spending $280 million annually on training programs, nanocredentials, and tuition reimbursement. Although the scale is massive, that sum works out to about $2,000 per worker, per year. The program is not just a financial investment, but a full wraparound service, with tools to identify skill gaps, map out future career pathways for existing workers, and connect to flexible training options via online learning partnerships with Udacity and Georgia Tech. If AT&T succeeds, it will be a model for legacy tech companies to compete against modern tech companies.

Key Performance Indicators
- Number of workers receiving upskilling investments
- Number of firms making incumbent workforce investments
- Number of students participating in work-based learning programs
- Conversion rate of interns into full-time employees
- Membership growth in industry partnerships
STRATEGY 2: ALIGN AND SCALE EDUCATIONAL AND TECH TRAINING PROGRAMS

IT employers point to Greater Philadelphia’s institutions of higher education as major assets in talent development and attracting young people to the region. Our higher education system is complemented by a growing number of specialized tech training and coding bootcamps that provide alternative entry points to a tech career. All of these elements are critical to developing Greater Philadelphia’s tech talent. In the near-term, training solutions and bootcamps can help to address the undersupply of qualified candidates. Longer-term, postsecondary institutions as well as K-12 schools can collaborate with industry partnerships to ensure that foundational and technical skills taught align with market needs and are adaptable to future trends.

Priority Tactics

TRAINERS AND FUNDERS EXPAND THE NUMBER OF TRAINING AND BOOTCAMP SEATS FOR SOFTWARE DEVELOPMENT AND HARDWARE SOLUTIONS

Greater Philadelphia has a growing number of accelerated training programs for software development, hardware skills, and networking solutions. The most promising programs pair technical skills training with a focus on soft skills and an internship to bring students up to a level that enables them to get to work immediately. Because these programs operate at such a small scale, however, their impact is limited. They would benefit from building a stronger network with each other to share resources for curriculum development and volunteer training. Closer collaboration would also help create economies of scale with employer relationships—both to learn about real-time employer needs and develop direct job pipelines.

HIGHER EDUCATION LEADERS COORDINATE CURRICULA TO BRIDGE GAPS BETWEEN EMPLOYER NEEDS AND POSTSECONDARY PROGRAMS

Further commitment to frequent and structured communications between academic institutions and IT employers in our region would strengthen relationships and allow academic institutions to keep up with changing market trends. Today, conversations are typically held between individual schools and employers, but opportunities exist to build economies of scale by sharing information more broadly, potentially through industry partnerships. Including community colleges and other postsecondary institutions in these conversations would expand opportunities for creating a more diverse tech workforce. This two-way relationship could also build partnerships enabling senior company employees to teach at colleges to ensure that students have access to the most up-to-date information available.

STATE AND LOCAL GOVERNMENTS PRIORITIZE AND FUND INCLUSION OF TECH LEARNING IN K-12 CURRICULA

A sustainable long-term tech talent pipeline will require meaningful integration of computer science and technology learning into K-12 curricula. This is also key to creating a tech workforce that reflects the overall
diversity of the region’s workforce. The broader challenges faced by a number of area public school systems have made progress on this front difficult, as tech must fit in alongside critical investments and reforms needed to raise proficiency in other subjects. However, learning tech skills is a critical element of 21st century job readiness that can reinforce other subjects and spark excitement in students. Tech education isn’t just about learning how to code – it helps develop critical thinking, problem solving, and communication skills that cut across disciplines. To build tech into everyday curricula, local schools would have to recruit new teachers and continuously retrain them to stay current with rapidly changing technology. Progress on adoption of tech into K-12 curricula will require a broad coalition of partners to make the case about the need for this change, how it would be funded, and how it would be sustained.

Case Study: A Local Gold-Standard Training Program

Zip Code Wilmington, Delaware’s first coding school, is both a 12-week software development training school and a 26-week apprenticeship program that gives its participants real-world experience to prepare for a full-time position. Zip Code is strengthened by partnerships with Wilmington corporations that have high demand for software developers, such as JPMorgan Chase and Capital One, which guide curriculum development and hire graduates in apprenticeships and full-time positions. The program has a 93% placement rate within three months of graduation. Zip Code’s curriculum sets it apart from other coding schools since it focuses on teaching Java, a foundational programming language that continues to be in high demand. Employers who participate in the apprenticeship program cover $9,000 of the total $12,000 bootcamp fee, significantly reducing the cost for students. In 2016, Zip Code Wilmington was selected as one of 10 programs nationwide to participate in the U.S. Department of Education Educational Quality through Innovative Partnerships (EQUIP) program. Through EQUIP, Zip Code students are eligible to receive Pell Grants and a full semester of college credits toward an associate or bachelor’s degree in applied technology at Wilmington University.

Key Performance Indicators

- Number of students graduating with a credential in computer science or an IT field
- Number of students placed by bootcamps
- Number of schools including tech curriculum
STRATEGY 3: RAISE AWARENESS OF POTENTIAL TECH CAREERS AMONG UNDERREPRESENTED POPULATIONS

Even with the growing number of programs focused on exposing young people to tech careers via classroom visits, shadowing opportunities at firms, hackathons, internships, and more, there remains a knowledge gap among young people about the nature and extent of IT jobs in our regional economy. Additional efforts are needed to raise awareness of the breadth of career opportunities in tech – particularly for young women and people of color, who are significantly underrepresented in the region’s tech workforce. Beyond reaching young people and the adults in their lives, increasing awareness of IT job opportunities among adult workers in other industries who are either looking to change careers or who have been laid off will help expand the long-term pipeline of IT workers.

Priority Tactics

NONPROFIT LEADERS AND CORPORATE PARTNERS DEVELOP A COMPREHENSIVE OUTREACH CAMPAIGN

A comprehensive outreach campaign sharing a set of key messages with three targeted groups – students, adult figures who influence youth, and dislocated workers – would help expand and diversify the number of residents in Greater Philadelphia considering IT careers. For each of these groups, targeted infographics or short videos highlighting the diversity of careers and people in tech could be impactful tools if paired with the right distribution channels. A nonprofit could lead this effort with one or more corporate partners providing financial and technical assistance, particularly around design and videography.

For students, exposure to tech career skills and pathways needs to start early and targeted efforts to deepen their understanding of specific pathways should follow as they get older. Students should be able to imagine different tech careers, and be aware of resources and programs within and outside of school to support this career exploration.

For parents and educators, guiding students toward tech can be daunting given the proliferation of tech career pathways. More employer and tech leader engagement with parents and teachers at PTA meetings or other community-based gatherings would help build awareness among this group and highlight the vast opportunity in this sector for their children.

Beyond these groups, many career-changers and dislocated workers may assume that a tech career is out of the picture without realizing that many tech workers come from a non-computer science background. These workers should be able to easily access programs and other training resources that can aid in this transition, and be aware of examples of successful career-changers in the region.

EMPLOYERS AND YOUTH PROGRAMS EXPAND CAREER EXPOSURE WITH INCREASED ATTENTION TO FOLLOW-UP

Dozens of tech career exposure efforts by intermediaries and individual firms in our region provide important opportunities for young people to learn about what careers in tech look like. Emphasizing hands-on experience
**Myth-Busting: What Does a Tech Career Really Look Like?**

**There are a wide variety of tech careers – it's not just coding.**
Artistic and creative talent can translate to a job in user-experience (UX) or user-interface (UI) work; problem-solving and attention to detail can translate to a job in quality assurance; people skills can translate to a job in computer support. Communicating the variety of skill sets used across IT careers is critical to keeping young people with varied interests from tuning out early.

**Tech jobs are in many types of firms and industries, not just start-ups.**
While the idea of someday working at a tech startup captures the imagination of many young people, most tech jobs in our region and nation are in non-tech industries. And though these positions may not be high-profile startups, they also require workers to use technology creatively to solve compelling challenges and problems, and can offer corporate career pathways with stability and other benefits that are attractive to many workers.

**Tech jobs are open to people of all backgrounds.**
The tech workforce has a reputation for its lack of diversity, but tech is a growing opportunity area for people of all backgrounds. A number of existing programs in Philadelphia are already focused on increasing the number of women and underrepresented minorities in tech, and scaling these programs as well as increasing awareness of IT careers as a whole can draw more diverse populations to tech jobs.

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**Key Performance Indicators**

- Number of women and people of color in the tech workforce
- Number of women and people of color pursuing tech education and training
- Number of dislocated workers pursuing tech training
- Number of students majoring in IT at local colleges

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In these programs is essential, as young students can easily tune out during talks or presentations. Furthermore, creating more direct follow-up opportunities for students would amplify the benefits of one-off programs. Following a more traditional career exposure experience, students could be directed to one of the many ongoing extracurricular tech education programs in our region. While traditional career exposure approaches and training are needed, opportunities exist to think more creatively about how to best connect young people with the tech community. To this end, hackathons have grown in popularity, and extracurricular youth tech programs in our region have also looked at creative ideas like a competitive coding league.
STRATEGY 4: IMPROVE ACCESS TO DATA ON TECH TALENT IN THE REGION

Broad access to data and information about employer needs, career pathways, and education programs in our region helps inform the actions of employers, educational institutions, and workforce providers. It also empowers jobseekers, students considering IT educational programs, and other interested stakeholders to take advantage of available opportunities. Data on employer needs, skill gaps, and opportunities presented in this report is only a snapshot of current conditions and past trends. The needs of IT employers, the landscape of education and training programs, and awareness of tech career opportunities are all different today than what they were five or ten years ago, and the pace of change is likely to accelerate. Ongoing data collection around all aspects of the tech talent pipeline will be critical in ensuring that the actions being taken by regional stakeholders to drive growth and expand opportunity in IT are grounded in current facts and trends.

Priority Tactics

NONPROFIT AND PUBLIC SECTOR LEADERS CREATE AND MAINTAIN SHARED INFORMATION FOR STUDENTS AND JOBSEEKERS

Individual organizations in the region, from youth development non-profits to academic institutions, provide a variety of information about the career pathways and certification needs for IT occupations. Streamlining this content and combining it with information about area education and training programs would make it easier for prospective students to understand available opportunities and which skills and certifications lead to advancement. Any organization leading this effort, however, would require investment from corporate or philanthropic partners to create and maintain these shared resources.

INDUSTRY PARTNERSHIPS IMPLEMENT REGULAR DATA COLLECTION AND ANALYTICS ON TECH TALENT TRENDS AND NEEDS

Gaps in existing available data on the tech workforce create blind spots for employers, educators, and workforce professionals. For example, reliable estimates of job postings and the education level or skills required by industry sector would better inform where to focus education and training efforts. Conducting a comprehensive survey of tech firms and IT departments to understand their changing tech needs, training efforts, views on relevant certifications and skills needed, and hiring projections could provide a region-wide basis for specific training needs. Consistent analysis of this data would also yield information on how tech talent responds to industry trends, and vice versa. Due to the rapid changes in the technology market, regularly updating needs assessments will be important.
MOVING THE FRAMEWORK FORWARD

Driving tech talent growth in the region is a long-term proposition that will require sustained, collaborative focus by the wide range of firms, institutions, government agencies, foundations, and nonprofit organizations involved in this work. While transformation will take time, actions we take today to advance the strategies and tactics presented in this report will help put Greater Philadelphia on a path to better leveraging our tech workforce for growth and opportunity for all residents in the region.

Early Implementation Efforts

CONVENCING IT EMPLOYERS AND EXPANDING DATA COLLECTION

The Innovative Technology Action Group (ITAG) is an industry partnership and a regional leader around Technology/IT employer engagement and workforce development. ITAG is an initiative of the Chester County Economic Development Council and is funded in part by the private sector and the Chester County Workforce Development Board. ITAG brings together a diverse set of business, education, training, and public sector leaders from Southeastern PA to learn from one another and collaborate around shared workforce needs and solutions. Going forward, ITAG has committed to expanding its bi-monthly regional meetings to include PHL tech workforce initiative steering committee members. This will help to build new relationships among major IT employers in Greater Philadelphia and provide a natural ongoing home for collaborative efforts to advance the action framework highlighted in this report.

ITAG will also expand its annual Technology/IT employer needs assessment survey to reach more firms and collect additional critical information on employer needs including training, hiring, and more. The Economy League will assist ITAG with design and distribution of the expanded survey and will help identify additional partners to extend the survey’s reach. Leveraging ITAG’s existing annual survey to reach a broader audience of employers will help regional leaders maintain up-to-date and detailed information about changing labor market needs and dynamics on an ongoing basis, allowing for more targeted interventions by employers, educators, funders, and others going forward.

ENGAGING HR LEADERS

Recognizing the role of HR decision-making in addressing current and future tech workforce challenges, the Philadelphia Regional Chapter of the Society for Human Resource Management (Philly SHRM) has committed to engaging its member base around IT workforce hiring and training best practices. Part of the world’s largest HR professional society, Philly SHRM provides professional development and networking opportunities for more than 1,400 area human resource practitioners representing more than 500 of Greater Philadelphia’s leading employers. Philly SHRM will be conducting focus groups in 2017 to help shape their approach to deepening member engagement around IT hiring issues.
STEERING COMMITTEE

The Driving Tech Talent Growth in PHL analysis and action framework was guided by a steering committee comprised of leaders from IT employers, higher education, workforce development organizations, government, philanthropy, and other regional nonprofits. The committee met throughout the fall of 2016 and winter of 2017.

Tom Ahart, Director of College Success Services, Graduate! Philadelphia

Jason Bannon, Director, Marketing and Communications, Ben Franklin Technology Partners

Saul Behar, VP and General Counsel, University City Science Center

Phillip Brooks, STEM Manager, City of Philadelphia Commerce Dept.

Malik Brown, AVP, Employer Relations, Peirce College

Luke Butler, Strategy and Operations Manager, Curalate

Patrick Callihan, Executive Director, Tech Impact

Chris Carey, HRIS Director, SEI

Don Clark, Executive Director, Talent Acquisition, Comcast

Bernie Dagenais, President & CEO, Main Line Chamber of Commerce

Edison Freire, Director of Gateway Initiatives, JEVS Human Services

Carol de Fries, VP, Workforce & Economic Innovation, Community College of Philadelphia

Jeff Friedman, Dir. of eGovernment Business Development, Microsoft

Matt Goldfine, Manager, Government Relations and Grants, University City Science Center

Claire Greenwood, Executive Director, CEO Council for Growth, Chamber of Commerce for Greater Philadelphia

Mike Grigalonis, COO and EVP, Chester County Economic Development Council

Grace Harpole, Program Director, IT Works, Tech Impact

Stacy Holland, Executive Director, Lenfest Foundation (Co-Chair)

Sarah Hollister, VP, Youth and Gateway Programs, JEVS Human Services

Charity Hughes, VP, Human Resources, VWR; President, Philly SHRM

Heloise Jettison, Director, Talent Development, City of Philadelphia Commerce Department

Farah Jimenez, President & CEO, Philadelphia Education Fund

Rich Mahler, VP, Finance & Administration, Revolutionary Security

Barbara Mattleman, Executive Director, Graduate! Philadelphia

Dean Miller, President & CEO, PACT

Sylvester Mobley, Executive Director, Coded by Kids

Bob Moul, CEO, Cloudamize (Co-Chair)

Terry Pittman, Director of Talent and Education, Main Line Chamber of Commerce

Dan Rhoton, Executive Director, Hopeworks ’N Camden

RoseAnn Rosenthal, President & CEO, Ben Franklin Technology Partners of Southeastern Pennsylvania

Jameel Rush, Director of Organizational Development, Day & Zimmerman; President-elect, Philly SHRM

Leigh Ann Shaffner, VP, HR Strategy, Comcast

Chad Stender, Director of Operations, SeventySix Capital

Stephen Tang, President & CEO, University City Science Center

Tracey Wilen-Rossman, Chief Marketing Officer, Chariot Solutions (Co-Chair)
ACKNOWLEDGMENTS

The Economy League would like to thank the steering committee members for their guidance, input and support throughout this initiative. The broad representation of sectors and organizations in the committee was critical to developing an informed analysis and action framework, and that cross-sector collaboration will be critical to drive change going forward. A special thank you as well to the dozens of individuals who made time for interviews and focus groups, providing rich perspective on strengths, challenges and opportunities within Greater Philadelphia’s tech workforce.

This work would not be possible without critical financial support from the U.S. Economic Development Administration, the JPMorgan Chase Foundation, the Lenfest Foundation, SEI, Ben Franklin Technology Partners, and Graduate! Philadelphia. We also extend a special thank you to the Economy League’s board of directors.

CREDITS

Research and Editorial Team: Nick Frontino, Michael Larson, Cathy Lin, Josh Sevin and John Taylor of the Economy League of Greater Philadelphia
APPENDICES

A. INTERVIEWS

The Economy League conducted interviews throughout the fall of 2016 and winter of 2017 with a range of tech workforce stakeholders.

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
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<tbody>
<tr>
<td>Malik Brown</td>
<td>Peirce College</td>
</tr>
<tr>
<td>Jeff Bryers</td>
<td>Children's Hospital of Philadelphia</td>
</tr>
<tr>
<td>Luke Butler</td>
<td>Curalate</td>
</tr>
<tr>
<td>Patrick Callihan</td>
<td>Tech Impact</td>
</tr>
<tr>
<td>Chris Carey</td>
<td>SEI</td>
</tr>
<tr>
<td>Srinath Chigullapalli</td>
<td>Vanguard</td>
</tr>
<tr>
<td>Waverly Coleman</td>
<td>Community College of Philadelphia</td>
</tr>
<tr>
<td>Robert DeFinis</td>
<td>Philadelphia OIC</td>
</tr>
<tr>
<td>Carol de Fries</td>
<td>Community College of Philadelphia</td>
</tr>
<tr>
<td>Yi Deng</td>
<td>Drexel University</td>
</tr>
<tr>
<td>Bimal Desai</td>
<td>Children's Hospital of Philadelphia</td>
</tr>
<tr>
<td>Marybeth DiVincenzo</td>
<td>Chester County Economic Development Council</td>
</tr>
<tr>
<td>Andy Farella</td>
<td>Children's Hospital of Philadelphia</td>
</tr>
<tr>
<td>Farrah Farnese</td>
<td>Philadelphia Youth Network</td>
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<tr>
<td>Edison Freire</td>
<td>JEVS</td>
</tr>
<tr>
<td>Rick Genzer</td>
<td>Ben Franklin Technology Partners</td>
</tr>
<tr>
<td>Jessica Giannasca</td>
<td>Children's Hospital of Philadelphia</td>
</tr>
<tr>
<td>Claire Marrazzo Greenwood</td>
<td>CEO Council for Growth</td>
</tr>
<tr>
<td>Mike Grigalonis</td>
<td>Chester County Economic Development Council</td>
</tr>
<tr>
<td>Apu Gupta</td>
<td>Curalate</td>
</tr>
<tr>
<td>Sarah Hollister</td>
<td>JEVS</td>
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<tr>
<td>Charity Hughes</td>
<td>VWR</td>
</tr>
<tr>
<td>Heloise Jettison</td>
<td>City of Philadelphia</td>
</tr>
<tr>
<td>Nancy Kunkle</td>
<td>Chester County Economic Development Council</td>
</tr>
<tr>
<td>Rich Mahler</td>
<td>Leidos/Revolution Security</td>
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<tr>
<td>Omar Mencin</td>
<td>Ben Franklin Technology Partners</td>
</tr>
<tr>
<td>Sylvester Mobley</td>
<td>Coded by Kids</td>
</tr>
<tr>
<td>Scott Nissenbaum</td>
<td>Ben Franklin Technology Partners</td>
</tr>
<tr>
<td>Mel Payne</td>
<td>Consultant</td>
</tr>
<tr>
<td>Scott Peters</td>
<td>Armor</td>
</tr>
<tr>
<td>Sarah Singer Quast</td>
<td>Philadelphia Youth Network</td>
</tr>
<tr>
<td>Jameel Rush</td>
<td>Day &amp; Zimmerman</td>
</tr>
<tr>
<td>Alex Urevick-Acklesburg</td>
<td>Zivtech</td>
</tr>
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</table>
B. FOCUS GROUP

The Economy League held a focus group with member of the Innovative Technology Action Group in January 2017.

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
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</thead>
<tbody>
<tr>
<td>Pat Bokovitz</td>
<td>Chester County Workforce Investment Board</td>
</tr>
<tr>
<td>Frank Buttaro III</td>
<td>New Horizons Computer Learning Centers</td>
</tr>
<tr>
<td>John Carney</td>
<td>Carney Consulting</td>
</tr>
<tr>
<td>Suzanne Cruit</td>
<td>Penn State Great Valley</td>
</tr>
<tr>
<td>Brian Dainis</td>
<td>Curatech</td>
</tr>
<tr>
<td>Marc Davis</td>
<td>HomeNet Automotive</td>
</tr>
<tr>
<td>Liam Dempsey</td>
<td>LBDdesign</td>
</tr>
<tr>
<td>Joshua East</td>
<td>New Horizons Computer Learning Centers</td>
</tr>
<tr>
<td>Matt Fischel</td>
<td>Johnson &amp; Johnson</td>
</tr>
<tr>
<td>Dan Fogarty</td>
<td>Berks County Workforce Development Board</td>
</tr>
<tr>
<td>Leah Fox</td>
<td>LoanLogics</td>
</tr>
<tr>
<td>Erik Gudmundson</td>
<td>Pegasus Technologies</td>
</tr>
<tr>
<td>Thelma Haylock</td>
<td>Pfizer</td>
</tr>
<tr>
<td>Tom Kirk</td>
<td>Cogeco Peer 1</td>
</tr>
<tr>
<td>Steve Koss</td>
<td>Unisys</td>
</tr>
<tr>
<td>Jim Lauckner</td>
<td>J*Lis Management Consulting</td>
</tr>
<tr>
<td>Jose Matthews</td>
<td>Chester County OIC Career-Corps</td>
</tr>
<tr>
<td>Austin Morris Jr.</td>
<td>Morris Risk Management LLC</td>
</tr>
<tr>
<td>Jeff Robbins</td>
<td>SEI Investments</td>
</tr>
<tr>
<td>JT Singh</td>
<td>West Chester University</td>
</tr>
<tr>
<td>Lisa Van Ess</td>
<td>NIIT Technologies</td>
</tr>
<tr>
<td>Andrea Vaughn</td>
<td>Chester County Intermediate Unit</td>
</tr>
<tr>
<td>Steve Yurick</td>
<td>AVT</td>
</tr>
</tbody>
</table>
### C. INFORMATION TECHNOLOGY OCCUPATIONS

The following table includes the official Bureau of Labor Statistics titles and definitions for the 19 IT occupations included this analysis.

<table>
<thead>
<tr>
<th>IT Occupation</th>
<th>Duties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer and Information Research Scientists</td>
<td>Conduct research into fundamental computer and information science as theorists, designers, or inventors. Develop solutions to problems in the field of computer hardware and software.</td>
</tr>
<tr>
<td>Computer and Information Systems Managers</td>
<td>Plan, direct, or coordinate activities in such fields as electronic data processing, information systems, systems analysis, and computer programming.</td>
</tr>
<tr>
<td>Computer Network Architects</td>
<td>Design and implement computer and information networks, such as local area networks (LAN), wide area networks (WAN), intranets, extranets, and other data communications networks. Perform network modeling, analysis, and planning. May also design network and computer security measures. May research and recommend network and data communications hardware and software.</td>
</tr>
<tr>
<td>Computer Network Support Specialists</td>
<td>Analyze, test, troubleshoot, and evaluate existing network systems, such as local area network (LAN), wide area network (WAN), and Internet systems or a segment of a network system. Perform network maintenance to ensure networks operate correctly with minimal interruption.</td>
</tr>
<tr>
<td>Computer Occupations, All Other</td>
<td>All computer occupations not listed separately: Computer Systems Engineers/Architects; Web Administrators; Geospatial Information Scientists and Technologists; Geographic Information Systems Technicians; Software Quality Assurance Engineers and Testers; Database Architects; Data Warehousing Specialists; Business Intelligence Analysts; Information Technology Project Managers; Search Marketing Strategists; Video Game Designers; Document Management Specialists.</td>
</tr>
<tr>
<td>Computer Operators</td>
<td>Monitor and control electronic computer and peripheral electronic data processing equipment to process business, scientific, engineering, and other data according to operating instructions. Monitor and respond to operating and error messages. May enter commands at a computer terminal and set controls on computer and peripheral devices.</td>
</tr>
<tr>
<td>IT Occupation</td>
<td>Duties</td>
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<td>---------------------------------------------------</td>
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</tr>
<tr>
<td><strong>Computer Programmers</strong></td>
<td>Create, modify, and test the code, forms, and script that allow computer applications to run. Work from specifications drawn up by software developers or other individuals. May assist software developers by analyzing user needs and designing software solutions. May develop and write computer programs to store, locate, and retrieve specific documents, data, and information.</td>
</tr>
<tr>
<td><strong>Computer Science Teachers, Postsecondary</strong></td>
<td>Teach courses in computer science. May specialize in a field of computer science, such as the design and function of computers or operations and research analysis. Includes both teachers primarily engaged in teaching and those who do a combination of teaching and research.</td>
</tr>
<tr>
<td><strong>Computer Systems Analysts</strong></td>
<td>Analyze science, engineering, business, and other data processing problems to implement and improve computer systems. Analyze user requirements, procedures, and problems to automate or improve existing systems and review computer system capabilities, workflow, and scheduling limitations. May analyze or recommend commercially available software.</td>
</tr>
<tr>
<td><strong>Computer User Support Specialists</strong></td>
<td>Provide technical assistance to computer users. Answer questions or resolve computer problems for clients in person, or via telephone or electronically. May provide assistance concerning the use of computer hardware and software, including printing, installation, word processing, electronic mail, and operating systems.</td>
</tr>
<tr>
<td><strong>Database Administrators</strong></td>
<td>Administer, test, and implement computer databases, applying knowledge of database management systems. Coordinate changes to computer databases. May plan, coordinate, and implement security measures to safeguard computer databases.</td>
</tr>
<tr>
<td><strong>Information Security Analysts</strong></td>
<td>Plan, implement, upgrade, or monitor security measures for the protection of computer networks and information. May ensure appropriate security controls are in place that will safeguard digital files and vital electronic infrastructure. May respond to computer security breaches and viruses.</td>
</tr>
<tr>
<td><strong>Medical Records and Health Information Technicians</strong></td>
<td>Compile, process, and maintain medical records of hospital and clinic patients in a manner consistent with medical, administrative, ethical, legal, and regulatory requirements of the health care system. Process, maintain, compile, and report patient information for health requirements and standards in a manner consistent with the healthcare industry’s numerical coding system.</td>
</tr>
<tr>
<td>IT Occupation</td>
<td>Duties</td>
</tr>
<tr>
<td>----------------------------------------</td>
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</tr>
<tr>
<td>Multimedia Artists and Animators</td>
<td>Create special effects, animation, or other visual images using film, video, computers, or other electronic tools and media for use in products or creations, such as computer games, movies, music videos, and commercials.</td>
</tr>
<tr>
<td>Network and Computer Systems Administrators</td>
<td>Install, configure, and support an organization's local area network (LAN), wide area network (WAN), and Internet systems or a segment of a network system. Monitor network to ensure network availability to all system users and may perform necessary maintenance to support network availability. May monitor and test Web site performance to ensure Web sites operate correctly and without interruption. May assist in network modeling, analysis, planning, and coordination between network and data communications hardware and software. May supervise computer user support specialists and computer network support specialists. May administer network security measures.</td>
</tr>
<tr>
<td>Operations Research Analysts</td>
<td>Formulate and apply mathematical modeling and other optimizing methods to develop and interpret information that assists management with decision making, policy formulation, or other managerial functions. May collect and analyze data and develop decision support software, service, or products. May develop and supply optimal time, cost, or logistics networks for program evaluation, review, or implementation.</td>
</tr>
<tr>
<td>Software Developers, Applications</td>
<td>Develop, create, and modify general computer applications software or specialized utility programs. Analyze user needs and develop software solutions. Design software or customize software for client use with the aim of optimizing operational efficiency. May analyze and design databases within an application area, working individually or coordinating database development as part of a team. May supervise computer programmers.</td>
</tr>
<tr>
<td>Software Developers, Systems Software</td>
<td>Research, design, develop, and test operating systems-level software, compilers, and network distribution software for medical, industrial, military, communications, aerospace, business, scientific, and general computing applications. Set operational specifications and formulate and analyze software requirements. May design embedded systems software. Apply principles and techniques of computer science, engineering, and mathematical analysis.</td>
</tr>
<tr>
<td>Web Developers</td>
<td>Design, create, and modify Web sites. Analyze user needs to implement Web site content, graphics, performance, and capacity. May integrate Web sites with other computer applications. May convert written, graphic, audio, and video components to compatible Web formats by using software designed to facilitate the creation of Web and multimedia content.</td>
</tr>
</tbody>
</table>
D. REGIONAL TECH TRAINING & EXPOSURE PROGRAMS

The following table represents a preliminary mapping of technology training and career exposure programs in the Greater Philadelphia region. It is not meant to be comprehensive.

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
<th>Location</th>
<th>Target Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChickTech</td>
<td>Host a yearly conference, networking events, and high school mentorship/educational program that runs through the school year.</td>
<td>National, Chapter in Philadelphia</td>
<td>K-12</td>
</tr>
<tr>
<td>Code Day</td>
<td>24-hour collaborative event that brings students of all experience levels together to work on coding and app development. Focus is on the excitement of coding, not always skill development.</td>
<td>National, 24 cities including Philadelphia</td>
<td>All</td>
</tr>
<tr>
<td>Code for Philly</td>
<td>Organizes weekly coding/hacking meetups in the Philadelphia Area. Website also hosts a job board and members section.</td>
<td>Philadelphia</td>
<td>High School and College Students</td>
</tr>
<tr>
<td>Coded by Kids</td>
<td>Provides free tech education, tech industry exposure and career mentorship in the tech industry. Located in graduate hospital, but expanding to other neighborhoods in the city</td>
<td>Philadelphia</td>
<td>K-12</td>
</tr>
<tr>
<td>Coded by U</td>
<td>Coding academy for adults that is 12 weeks in length and held at Benjamin’s Desk. There is also a discounted version that is sponsored by the City of Philadelphia for underserved adults.</td>
<td>Philadelphia</td>
<td>All</td>
</tr>
<tr>
<td>Creating IT Futures</td>
<td>Conducts IT market and education research and operates three development programs called IT Ready, DevPrep, and CertNext. These classes teach both hard tech skills and soft skills like professionalism.</td>
<td>National</td>
<td>All</td>
</tr>
<tr>
<td>FemmeHacks</td>
<td>Student-led hackathon that takes place over a weekend. Started at Drexel and is now hosted by Penn.</td>
<td>Philadelphia</td>
<td>All</td>
</tr>
<tr>
<td>Girl Develop It</td>
<td>Provides classes on web and software development, mobile applications, etc. Emphasis is on judgment free zone.</td>
<td>National, 53 chapters</td>
<td>Adults</td>
</tr>
<tr>
<td>Girls Who Code</td>
<td>Runs programs during the school year teaching computing skills like programming, robotics, and web design, as well as trips to tech companies.</td>
<td>National</td>
<td>High School Girls</td>
</tr>
<tr>
<td>Hack GFS</td>
<td>High school student run hackathon based out of Germantown Philadelphia.</td>
<td>Philadelphia</td>
<td>College Students</td>
</tr>
<tr>
<td>Hopeworks ‘N Camden</td>
<td>Nonprofit that has been working for over 11 years with Camden youth. Utilizing an advanced training curriculum in web site design/development, GIS and Salesforce, Hopeworks works with youth 14-23 to get back in school.</td>
<td>Camden</td>
<td>Ages 14-24</td>
</tr>
<tr>
<td>Horizons School for Technology</td>
<td>Horizons is the bridge between traditional college education and the world of technology. We provide immersive software engineering courses during the summer or semester that give students the software skills of an engineer and the perspective of an entrepreneur.</td>
<td>National</td>
<td>College Students</td>
</tr>
<tr>
<td>Mogulette</td>
<td>Hosts workshops and speakers to give attendees the inspiration and skill to achieve success in the tech workforce</td>
<td>Philadelphia</td>
<td>High School Students</td>
</tr>
<tr>
<td>New York Code + Design Academy</td>
<td>12 Week program in full stack HTML, CSS, Java, and Ruby.</td>
<td>Global</td>
<td>All</td>
</tr>
<tr>
<td>PennApps</td>
<td>Student led hackathon that takes place over two weekends a year.</td>
<td>Philadelphia</td>
<td>All</td>
</tr>
<tr>
<td>Program</td>
<td>Description</td>
<td>Location</td>
<td>Target Age</td>
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<tr>
<td><strong>Philadelphia OIC</strong></td>
<td>Also provides MONK KEYSPOT service, which brings a mobile computer lab to communities across Philadelphia; focused on basic digital skills. Soon to open accredited associate degree programs in IT via City College.</td>
<td>Philadelphia</td>
<td>All</td>
</tr>
<tr>
<td><strong>Philly Code Fest</strong></td>
<td>Philly Codefest is currently organized as an annual software and hardware hackathon where people of all backgrounds and skill levels have the opportunity to participate, learn and compete. It is hosted by the College of Computing &amp; Informatics at Drexel University.</td>
<td>Philadelphia</td>
<td>College Students</td>
</tr>
<tr>
<td><strong>Philly Pilot</strong></td>
<td>8 hour coding boot camps where students learn how to code and work with technology.</td>
<td>National</td>
<td>College Students</td>
</tr>
<tr>
<td><strong>STEM Philly</strong></td>
<td>Works to increase access and engagement with STEM opportunities for both Philadelphia Students and educators.</td>
<td>Philadelphia</td>
<td>High School Students</td>
</tr>
<tr>
<td><strong>Tech Impact</strong></td>
<td>Hosts the program IT Works which is a 16-week job training in immersive IT. 11 weeks of classroom instruction, with a 5-week internship. Focus on hardware side of IT.</td>
<td>National, but based in Philadelphia</td>
<td>High School Graduates, 18-26</td>
</tr>
<tr>
<td><strong>TechGirlz</strong></td>
<td>Hold education workshops, Techshopz, and an annual Summer Camp.</td>
<td>Global, but based in Philadelphia</td>
<td>Middle School Girls</td>
</tr>
<tr>
<td><strong>Urban Technology Project</strong></td>
<td>A joint initiative between Communities in Schools of Philadelphia, Inc. and the School District of Philadelphia, to empower youth and their communities through meaningful technology experiences that link youth leadership development, education, and community building. It is comprised of the Digital Service Fellows AmeriCorps Program and the Computer Support Specialists Information Technology (IT) Apprenticeship Program.</td>
<td>Philadelphia</td>
<td>High School Graduates, 18-26</td>
</tr>
<tr>
<td><strong>Zip Code Wilmington</strong></td>
<td>3-month coding program followed by a 26 week apprenticeship that leads to a job. Focus on Java and .Net.</td>
<td>Wilmington, DE</td>
<td>All</td>
</tr>
</tbody>
</table>