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Bridging the STEM skills gap:

Employer/educator collaboration in New York

By Allison Armour-Garb, Senior Fellow
The Public Policy Institute of New York State, Inc.
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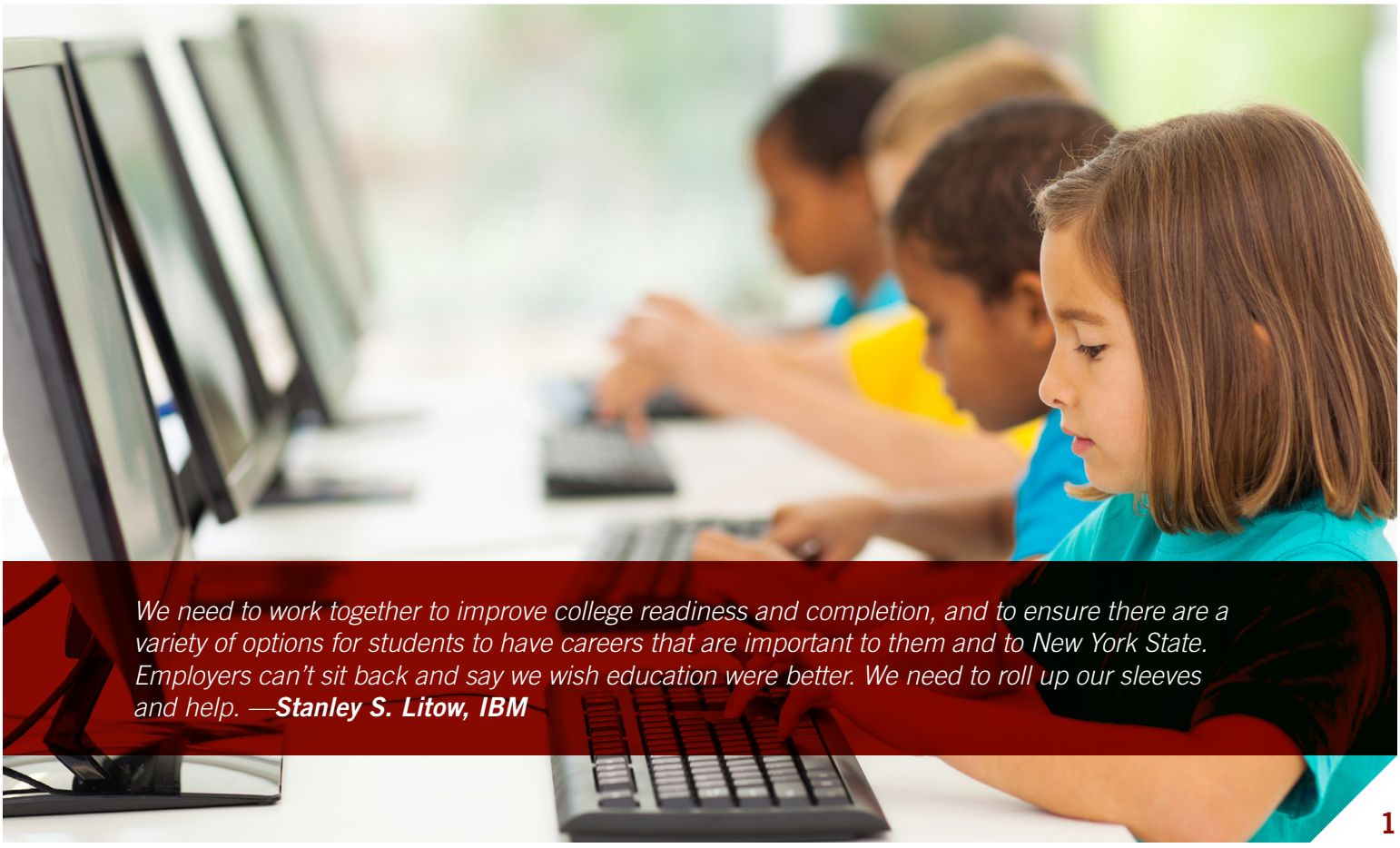

We need to work together to improve college readiness and completion, and to ensure there are a variety of options for students to have careers that are important to them and to New York State. Employers can't sit back and say we wish education were better. We need to roll up our sleeves and help. —***Stanley S. Litow, IBM***

About this Report

Bridging the STEM skills gap: Employer/educator collaboration in New York looks at the challenges our state's employers face in hiring skilled "new collar" workers in science, technology, engineering, and math (STEM), and explores how some are addressing those challenges through innovative partnerships with education programs and institutions.[1] Our goal was to gather data on employer skills needs in order to inform the decision-making of businesses and policymakers as they develop strategies to strengthen our state's workforce.

As the basis for this research, in December 2016 and January 2017 The Public Policy Institute of New York State conducted a survey of more than 100 executives familiar with their company's workforce development needs and practices. The survey was followed by interviews with STEM thought leaders.

The findings and views expressed in this report do not necessarily reflect the views of the funder. The author was Allison Armour-Garb. Kenneth Pokalsky edited the report and Rebekah Alexis was responsible for the layout. Heather Briccetti is president and CEO of The Public Policy Institute. We would like to thank all the executives who participated, whether on the record or anonymously, for their valuable insights.

Funding for this project was provided by the Verizon Foundation. Headquartered in New York State, Verizon has a diverse workforce of nearly 162,700 and generated nearly $132 billion in 2015 revenues. Verizon operates America's most reliable wireless network, with 113.2 million retail connections nationwide. The company also provides communications and entertainment services over mobile broadband and the nation's premier all-fiber network, and delivers integrated business solutions to customers worldwide.

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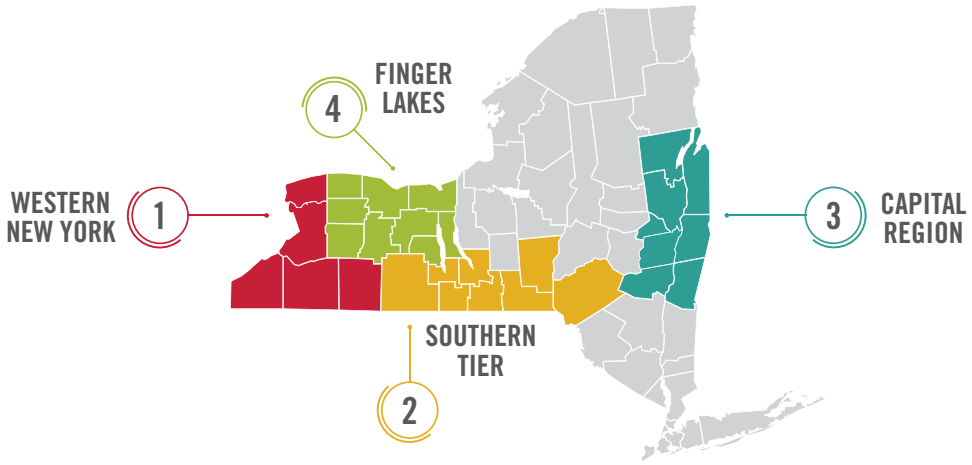
Executive Summary

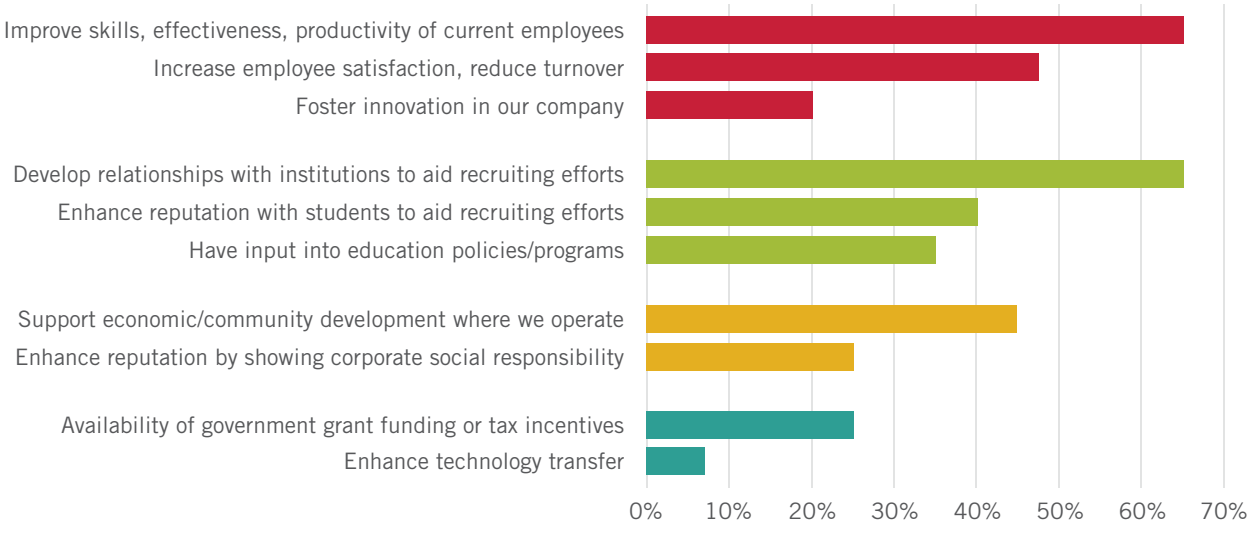
Regions experiencing most difficulty filling jobs



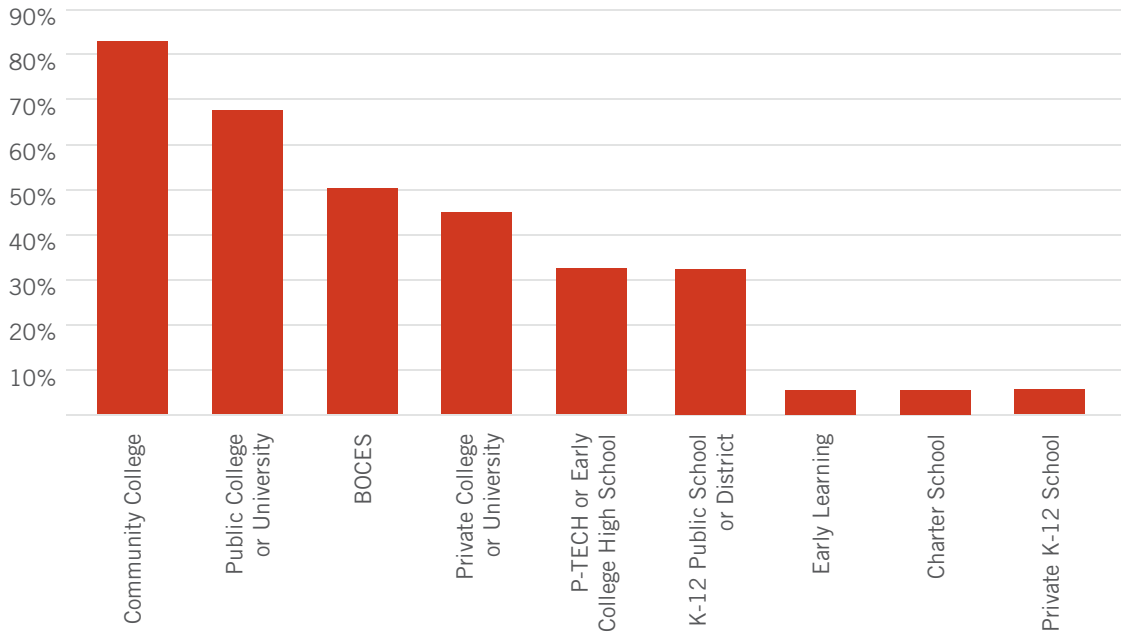
STEM jobs hardest to fill currently, and projected to have shortages over the next 5-10 years

1. Skilled Production Workers
2. Engineering
3. Information Technology
4. Mathematics Occupations

Top reasons to invest in or collaborate with education/training programs



Which education/training partners is your company most interested in?



What New York can do—recommendations

- Find new ways to ensure broad access to labor market data
- Align education performance metrics with economic demands
- Streamline education regulations and decision-making processes to facilitate innovation
- Couple college affordability with a focus on completion of a marketable credential
- Invest in replicating the pathways and programs that employers know work best

Introduction

Much has changed in New York's economy over the past decade—recession, recovery, demographic and technological shifts, changes in education and tax policies—but The Public Policy Institute's employer surveys show that talent shortages are an ongoing problem.

Figure 1. Public Policy Institute survey results on the skills gap over the last decade

2010

When PPI asked New York manufacturing executives "What is the greatest workforce issue you are facing?", the most often cited response was "inability to attract quality workers," and a majority of respondents pointed to "poor skills" as an important workforce issue.

2014

More than 60 percent of employers surveyed reported difficulty finding workers with data analysis skills or critical thinking skills, and more than half had difficulty finding workers skilled at problem-solving, communications, research, or applied mathematics.

2017

Employers reported difficulty filling positions in engineering, skilled production, and information technology. When asked what skills they have high difficulty finding in job candidates, the largest number of respondents cited scientific, technical, and engineering skills.

SOURCES: *PPI Manufacturing Report Survey (2010); PPI Workforce Development Survey (2014)*

New York created close to 100,000 jobs between December 2015 and December 2016.[2] Yet in many regions of the state the population is not growing, which means that employers who want to fill jobs are increasingly forced to select from the existing pool of potential workers.[3] Nationally, the economy has added 11.6 million jobs since the recession bottomed out in 2010, and 99 percent of those have gone to workers with at least some college education. Since the recession hit in 2008, there has been a net loss of 5.5 million jobs that required only a high school diploma.[4]

STEM jobs, in particular, are growing at a faster rate than overall employment and require higher skill levels than do many jobs in retail, food service, and hospitality.[5] Consistent with these trends, the executives responding to the 2017 Public Policy Institute survey reported that health occupations and skilled production—both of which are STEM fields—are the categories in which they had the largest numbers of job openings in 2016.

As technology evolves, the skills that STEM employers seek are changing faster than our education system has adapted to meet them. Thus, the skills gap—a divide between the skills employers need and the skills workers possess—is a threat to New York's competitiveness in the global economy. Caught in the crunch, New York's employers have taken the lead in investing in and partnering with education and training providers, in order to maximize the potential of workers in their own communities.

- What kinds of institutions and programs are employers partnering with?
- What do these partnerships look like in practice?
- What are their main goals, and how successful are they?
- What policy changes could make them even more successful?

This research shows that well designed collaborative programs can take underperforming students, who might otherwise have dropped out of high school or required remedial classes in college, and get them back on track. Working together, employers and educators are providing these students with the academic, technical, and professional skills and credentials they need to succeed in a STEM career. Such programs are being replicated across New York State, but the funding needed to sustain them is not guaranteed, and they still serve only a fraction of the students and communities who could benefit. If New York wants to maximize the economic future of its students and its businesses, creating model programs is not enough. Policymakers, education leaders, and employers need to take the next step, using a data-driven approach to rethink and retool our entire education system with the goal of ensuring college- and career-readiness for all P-12 students, and completion of a degree or employer-recognized credential for all postsecondary students. If the state is willing to commit the necessary resources, New York has the opportunity to solidify its position as a leader—not just in designing and creating, but in scaling and sustaining innovative models that bring educators and employers together to meet the workforce needs of the 21st century.

What does the skills gap look like in New York?

New York has some of the world's top universities and attracts highly credentialed scientists from around the globe, so how can we have a shortage of workers with STEM skills? The answer has to do with the fact that New York is a large and diverse state, with tremendous variation in demographics and economic conditions from region to region. In this research, we defined STEM according to the Standard Occupation Classification Policy Committee scheme. Under our definition, STEM covers a wide array of occupations—from manufacturing technicians to nurses, from civil engineers to computer programmers—and at credential levels from associate degree to Ph.D. In some of these fields, there are regional shortages, while in others, employers have no difficulty finding talented employees. Thus, rather than statewide, across-the-board shortages, this study and others have found local or regional skills mismatches, varying by industry.[6]

Figure 2. Regions experiencing most difficulty filling jobs

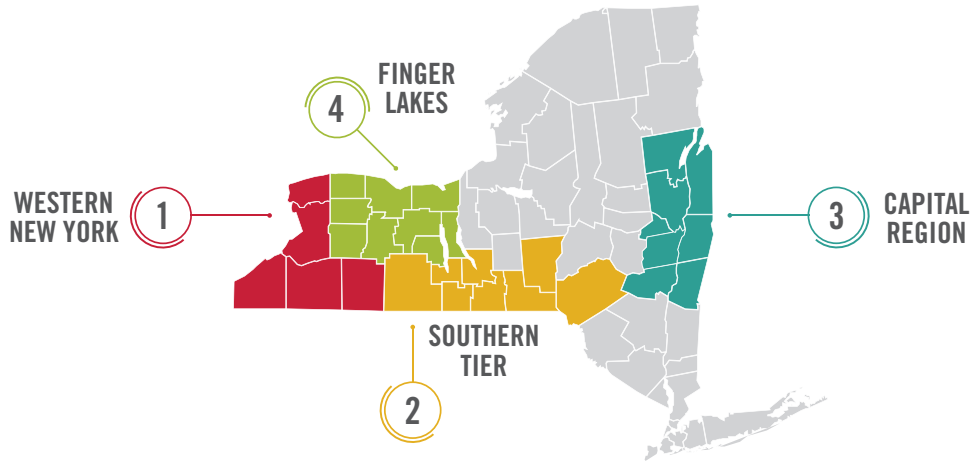
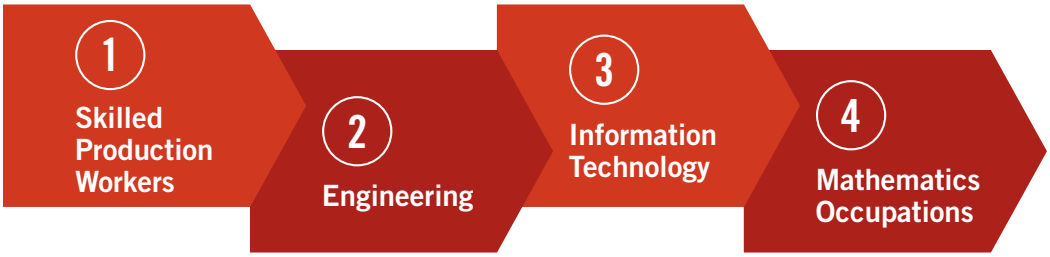


Figure 3. Hardest STEM jobs to fill



In the Public Policy Institute's 2017 survey, executives reported the highest difficulty filling positions in Western New York, where one-third of survey respondents reported high difficulty and 62 percent reported moderate or high difficulty filling positions. Similarly, in the Southern Tier, one-third of respondents reported high difficulty, and 45 percent reported moderate or high difficulty filling positions. In the Capital Region, one-quarter of respondents reported high difficulty and 63 percent reported moderate or high difficulty filling positions. In the Finger Lakes, 64 percent of survey respondents reported moderate or high difficulty filling positions, but only one of those reported high difficulty.

Across the state, employers reported that the hardest jobs to fill were skilled production vacancies. One quarter of survey respondents reported moderate or high difficulty filling positions in this category, and 12 percent reported high difficulty. Engineering is a close second, with 20 percent of respondents reporting moderate or high difficulty filling positions. Fourteen percent of respondents reported moderate or high difficulty filling information technology positions, and 10 percent reported moderate or high difficulty filling positions in mathematics occupations. In all of these STEM categories, respondents were almost equally split between "high" and "moderate" difficulty. At least a handful of employers noted difficulty filling positions in each of the other listed STEM categories—environmental science, social science, architecture, and health—and several wrote in additional categories in which they were having trouble filling jobs, including telecommunications, machine operators, and technicians.

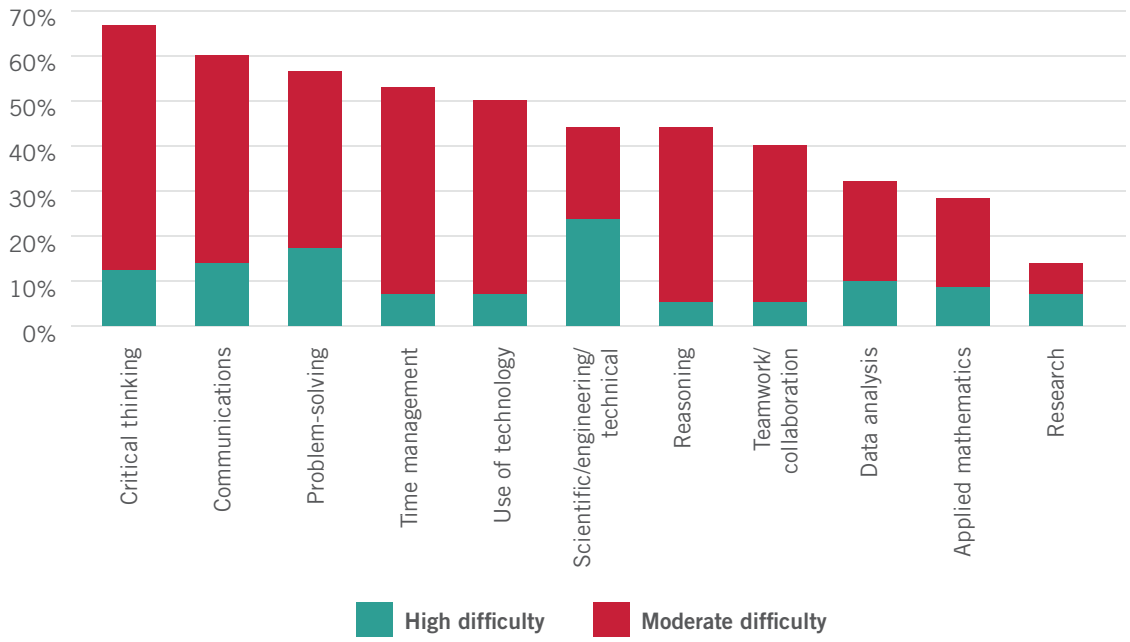
STEM positions comprise four of the top five categories of positions that New York employers are finding most difficult to fill. Seventeen percent of employers reported moderate or high difficulty filling non-STEM positions, with the bulk of those saying that they had "moderate" difficulty filling non-STEM positions.

When asked what skills they have had difficulty finding in job candidates, New York employers consistently point to the professional skills that are required in all kinds of workplaces. In response to the Public Policy

Institute surveys in both 2014 and 2017, more than half of employers reported high or moderate difficulty finding critical thinking, communications, and problem-solving skills. Figure 4 shows that in the 2017 survey, more than half also reported high or moderate difficulty finding candidates with time management skills, and—notably—multiple respondents wrote in that they have difficulty finding employees who are dependable, even though that was not listed as a response option. Stanley S. Litow of IBM underlines the importance of these traits in a career-ready workforce. "We've had a misnomer for the last decade or more, referring to the job skills required across the labor force as 'soft skills,'" he says. "These are not soft skills, they're essential skills—like writing, problem-solving, presentation skills. These are the flexible skills required in the workplace."

While shortages in professional skills were most pervasive, employers reported that STEM-specific skills and qualifications were the toughest to find. Almost a quarter of executives reported "high difficulty" finding candidates with the necessary scientific, engineering, and technical skills. Half reported moderate or high difficulty finding candidates skilled in using technology, and close to 30 percent reported moderate or high difficulty finding candidates with other STEM skills such as data analysis and applied math. This is consistent with previous research; for example, on the 2014 Public Policy Institute survey, more than half of employers reported difficulty finding workers with data analysis and applied math skills, and more than 20 percent of employers found it "very difficult" to do so.[7] Similarly, a 2014 nationwide survey by the Business Roundtable and Change the Equation found that CEOs had particular difficulty finding candidates with STEM skills.[8]

Figure 4. Skills most difficult to find



As for which qualifications were most difficult to find in job candidates, the largest number of employers mentioned bachelor's degrees in engineering. Related entries included Professional Engineering license, Registered Architect license, and master's degree in engineering. Numerous employers wrote in particular manufacturing skills and qualifications that do not necessarily require a bachelor's degree, including: sourcing and production quality, blueprints, mechanical skills, hand tool use, Fluorescent Penetrant Inspection (FPI) certification, ceramics, welding, and brazing. Nursing, human services, and health-related qualifications were sought at the bachelor's level and below, while accounting credentials were sought at the bachelor's level and higher. Several employers reported a difficult time finding candidates with bachelor's degrees combined with the right type of work experience. Computer science degrees and IT

security certifications were also sought. These findings are broadly consistent with a 2015 study by the Bureau of Labor Statistics, which found demand for STEM employees at the bachelor's and master's levels in information technology fields (including particularly high demand for software developers in New York), and demand below the bachelor's level in manufacturing and the skilled trades, including machinists and technicians.[9]

Dan Bower, President of HUNT Engineers, Architects & Land Surveyors, underlined the shortage of engineering skills: "At HUNT currently, eight out of ten résumés we receive for engineering positions are from non-U.S. citizens." In the short term, his 110-person company is considering partnering with an immigration law firm to facilitate obtaining visas and citizenship for these candidates.

Looking ahead to create a pipeline for its future workforce needs, HUNT is partnering with the Greater Southern Tier BOCES STEM Academy, a NYS P-TECH early college high school that opened its doors in September 2016. At the end of six years, students will graduate with both a high school diploma and an associate's degree and will be given a "first in line" opportunity for job placements with NYS P-TECH corporate mentors. (For more on the business-led NYS P-TECH initiative, see pages 14-15, below.)

New York's employers do not expect the skills gap to go away anytime soon. When asked whether they anticipated new or continuing skills shortages over the next five to ten years, survey respondents identified several areas for concern. Skilled production is the category in which they anticipate the most severe ongoing shortage. MACNY'S Bruce Hamm points out that this is consistent with national data. "The average age of a skilled worker in manufacturing nationally is 56 years old," he says. Taking into account retirements and expansion in the manufacturing sector, a 2015 study projects a shortage of 2 million workers between 2015 and 2025.[10]

Employers responding to the Public Policy Institute survey also predict severe shortages in engineering and information technology occupations. They anticipate a more moderate shortage in mathematics occupations. Perhaps unsurprisingly, these are the same top four workforce categories in which employers reported the highest difficulty filling jobs currently. Employers are more optimistic about such occupations as social science and architecture.

MANUFACTURING'S CHANGING LANDSCAPE IN NEW YORK

New York's manufacturing sector has seen tough times, but with technological changes and the rise of advanced manufacturing, the sector is rebounding and jobs are coming back.

"We often talk about, 'can we bring back good jobs in manufacturing'—and by that, we mean jobs that pay good wages with just a high school degree," says Chauncy Lennon of JPMorgan Chase. "Those jobs are shrinking and will continue to, mostly because of technology. We are seeing jobs coming back in manufacturing, but they are advanced manufacturing jobs that require a high school degree and some type of post-secondary training."

"Getting people interested in these careers is challenging—especially young people," says Bruce Hamm of MACNY. "Historically, over the last few decades, we've had so much manufacturing leave New York because of offshoring; we were one of the rust belt states. The fact that modern manufacturing has changed the whole equation hasn't penetrated to the public, the schools, the kids, or the parents for that matter."

Lennon agrees. "Factories used to be dirty, dark, and dangerous," he says. "Today, they are clean, well-lit, and safe"—with high-tech machines and increasingly automated production.

According to Hamm, teachers and school counselors may not be aware of how the manufacturing sector has changed, and as a result, "going into manufacturing is not even considered." He says that some of the best preparation for the new manufacturing jobs can be done in the public schools—specifically, career and technical education programs and Boards of Cooperative Educational Services (or BOCES)—as well as community colleges:

> *A lot of these jobs are not four-year-degree jobs; they're complex technical jobs that need middle skills. There are excellent jobs available as machinists and welders—we've got welders making six-figure salaries, and a good machinist can easily be fifty to sixty thousand dollars a year. Most of the apprenticeships that we're creating now have ending salaries in the $50,000 range, so they're coming out with $25 an hour, plus or minus.*

And the pace of manufacturing job creation may be picking up. The Business Council's

(Continued on page 9)

Figure 5. Anticipated workforce shortages

1	Skilled Production Workers
2	Engineering
3	Information Technology
4	Mathematics Occupations

The economic effects of the skills gap take several forms, starting with a reduction in employers' ability to meet the needs of their customers. "We're finding it hurts the manufacturers because you're having machines sit idle," says MACNY's Bruce Hamm. "People lose out on orders because they can't fill them."

The fact that skills mismatches are localized does not make them less consequential to New York's economy. An employer struggling to find skilled workers upstate is unlikely to take comfort in the fact that the very same skills are in oversupply on Long Island. Some workers may be willing to uproot to a distant town they've never heard of, but it is equally likely that the employer may go out of business or relocate to another state.

In addition to the impact on New York's existing employers, the availability of a skilled workforce—or lack thereof—has an effect on economic development efforts. "The first thing that companies do when they're looking to relocate into an area is to look at what the workforce looks like," says Hamm. "So if New York's economic developers are looking for companies to come here, we've got to demonstrate that we've got the workforce. The skills shortage is all over the country. If you can show you're actually doing something about it, you're on the good side of the equation."

Employer/Education partnerships to address the skills gap in New York

To a troubling extent, the origins of the skills gap can be traced to failures in the U.S. education system. Seemingly immune to the technological advances that have transformed almost every other aspect of modern life, education in America has remained relatively unchanged since the mid-nineteenth century. The system is self-contained and its methods self-replicating, passed down from colleges of education to teachers over generations. As Massachusetts'

Heather C. Briccetti, Esq. notes that the tax climate for manufacturing and emerging technology companies based in New York State has become more favorable in recent years. In 2014, New York State reduced the effective tax rate for "qualified manufacturers" to zero percent and enacted additional tax breaks targeting the manufacturing and emerging technology sectors, with the goal of stimulating investment and employment.

"Manufacturing is in need of workers who are tactile learners, work with their hands, can work shift work, and don't mind getting a little dirty. Policymakers and educators should do more to remove the stigma from manufacturing as a desirable career path."
—Ball Corporation, Capital Region

The environment could improve even further if the federal government enacts additional corporate tax reforms such as those proposed by House Speaker Paul Ryan (R-WI). "The current system for taxing foreign profits of American corporations incentivizes companies to build offshore," Briccetti says. "Ryan's proposal would flip the national tax incentives." Under his plan, companies would be taxed based on where their products are sold—rather than where they are produced or where the corporate headquarters or intellectual property are located. Thus, imports would be subject to federal tax while exports would not. By not taxing exports, the plan would incentivize U.S. companies to produce goods domestically.

*"Grants need to fully fund training, and training needs to be readily available and customized to the industry." —**Manufacturing company, Finger Lakes Region***

former education commissioner David P. Driscoll is fond of noting, "If Horace Mann were alive today, the only institution he would recognize would be our schools."[11] Without influence and ideas from outside the system, it is easy to see how American education could continue in the same way for decades into the future.

> *Education cannot be successful with K-12 educators working on their own. And I say this as a former Deputy Chancellor in New York City. Higher education cannot be successful without deep collaboration with the K-12 system. And the missing piece is employers. We need to work together to improve college readiness and completion, and to ensure there are a variety of options for students to have careers that are important to them and to New York State. Employers can't sit back and say we wish education were better. We need to roll up our sleeves and help.*
> —***Stanley S. Litow, IBM***

In recent years, the business community has taken the lead in calling for changes to bring our education system into step with the demands of today's world. Their investments in and partnerships with education are bearing fruit. This section presents a snapshot of employer involvement in education in New York, based on the Public Policy Institute survey results, and discusses some notable results of business involvement in three areas:

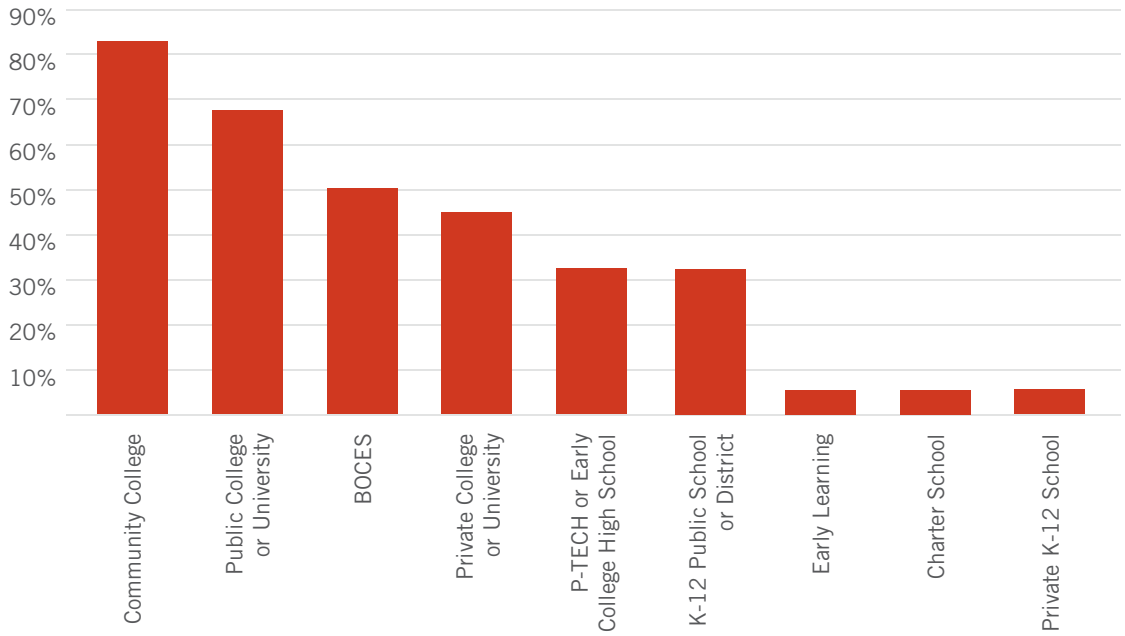
- modeling a data-driven approach to workforce development;
- progress in aligning education standards and requirements with economic demands; and
- redesigning education pathways to be responsive to regional STEM labor market opportunities.

Employer collaborations with education: Survey results

Many of the Public Policy Institute's survey respondents said that their company is currently investing in or collaborating with an education or training institution or program, or that they had done so recently. Their partners include every type of public and private education and training provider, but the most common are SUNY two- and four-year institutions. Also very common are partnerships with BOCES, followed by K-12 schools and districts—including some charters and private schools—and private colleges and universities. One respondent reported partnering with an early learning program. Perhaps most innovative are the collaborations with NYS P-TECH programs, which bring together school districts, higher education institutions, and employer partners to provide an integrated high school and associate degree program that prepares students to step right into middle-skills jobs.

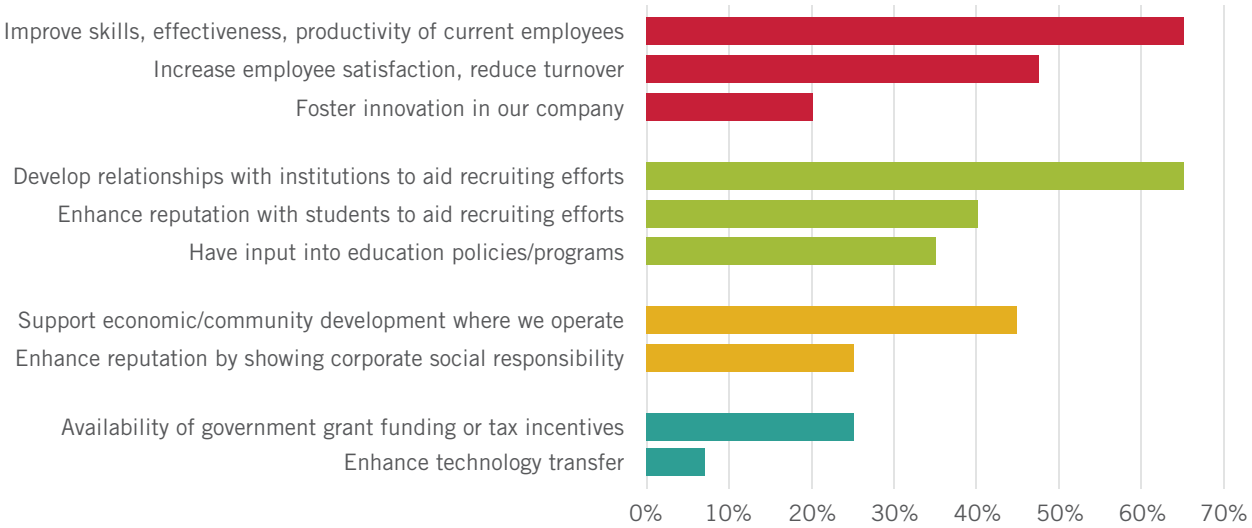
Those employers who were not involved in any education and training partnerships expressed strong interest in such collaborations. In fact, more than 80 percent said they would be interested in partnering with a community college, and only one respondent said their company would not be interested in any kind of partnership. Interest was particularly strong in partnering with higher education institutions and with BOCES, which are known for offering career and technical education programs, as opposed to K-12 and early learning programs. This reflects the broader pattern of demand for employees with technical skills and at least some college education, and likely also reflects executives' desire to realize a relatively rapid return on their investments.

Figure 6. Which education/training partners is your company most interested in?



When asked the main reasons why they would consider investing in or collaborating with educational institutions or training programs, employers felt that investing in current and future employees were equally important. The top cluster of bars in Figure 7 shows that 64 percent of respondents cited the need to improve the skills of current employees, 47 percent said such partnerships could help increase employee satisfaction and loyalty, and 20 percent said partnerships would foster innovation in their company. Similarly, executives cited the importance of developing relationships with institutions (64 percent) and students (40 percent) to aid recruiting efforts, and 36 percent thought providing input into education policies and programs would foster development of the future workforce (second cluster of bars).

Figure 7. Top reasons to invest in or collaborate with education/training programs



Fewer respondents cited corporate social responsibility and community development, government financial incentives, and technology transfer as top reasons to partner with education and training providers.

Modeling a data-driven approach to workforce development

To businesspeople, who are accustomed to data-driven decision-making, it may seem obvious that one should analyze the best available data before choosing how and where to invest resources. However, in the public sector, where bureaucratic norms and political priorities have great influence, not only are data sometimes neglected in making decisions; in many instances, there is a failure to even collect and maintain high quality data in the first place. Even if good data are available, public agencies may lack staff with the skills to analyze and apply that information. Moreover, there is often a tendency to downplay the importance of quantitative data, in favor of maintaining the status quo or reacting to popular controversies.

In the U.S., information about job openings, job placements, compensation, and prospects for advancement is highly fragmented, and the quality is poor. As a result, employers lack access to information on where to find candidates with the right skills.[12] On the other side of the equation, students, job seekers, and education and training providers lack adequate information on what job skills and qualifications are currently needed in their region, and which jobs have the best future prospects. "It's very hard for any one young person and their family to understand all the different kinds of opportunities that exist for them—this is true whether you live in a city, suburb, or rural community," says Chauncy Lennon of JPMorgan Chase.

> *And even if they are aware that job openings are out there, it's kind of "Ok, but how do I get from senior year in high school to a two-year degree in mechatronics or precision machining that positions me for a job where I start at $70,000 a year? What is the sequence of high school classes? What are the work-based learning opportunities, summer internships, and community college programs tied to employers in my region and the jobs they're looking to fill?"*

That is why his company's New Skills at Work program is investing $320,000 in an upstate college's project that models the ways in which better quality labor market data can enable better decision-making for regional economic development. Officials at Monroe Community College in Rochester knew, anecdotally, that well-paying middle-skills jobs in fast-growing sectors like advanced manufacturing were going unfilled due to a shortage of qualified workers. Unfortunately, there was a lack of comprehensive, publicly-available data that they could use in designing programs to address the problem; so they decided to purchase the information they needed from a private vendor that specializes in bringing together traditional and real-time labor market data.[13]

The project looked at five sectors—advanced manufacturing, skilled trades, information technology, hospitality and tourism, and health care—and included comprehensive surveys of local employers regarding their workforce needs, then paired this information with educational program completion data to conduct a gap analysis. The result was a report that quantified the extent of skills gaps and outlined what the college could do to address them.[14]

The college and its students will benefit from the project. "This is a partnership about bringing together employers and the community college to articulate pathways," says Lennon, "so families can look at them and make an informed choice about the opportunities out there for them to pursue." The college is using the data to justify strategic investments in particular programs, based on evidence of increased wages for completers, increased productivity for employers, and the wider economic impact. For example, when they identified a shortage of skilled machinists, the college responded by creating a new, accelerated version of their Precision Tooling Certificate.

The original report is published online, and the grant from JP Morgan Chase will enable the college to expand and transform it into an online database, facilitating analysis and broader dissemination.[15]

Aligning education standards and requirements with workforce demands

An important step in closing the skills gap is to clearly state what skills and knowledge a high school graduate should possess, and that is the essential role of education standards. New York's learning standards are a detailed statement of expectations for each grade level throughout primary school and high school. Adopted in 2010, New York's math and English standards are based on the Common Core State Standards used by more than 40 states. The Common Core standards are often described as "college- and career-ready standards" because they were developed with input from higher education and business. The drafters drew on statistical analysis of employment data from the Bureau of Labor Statistics and validated by interviews with managers from industries that employ highly-paid professionals and well-paid, skilled workers.[16] Furthermore, the standards are internationally benchmarked to help ensure that our students are globally competitive. For example, the drafters identified countries whose students were top performers on the Trends in International Mathematics and Science Study, then studied how those countries teach math, in order to gain insight on "the most effective sequencing of math topics." Researchers also looked at the language skills that high-performing countries expect of their students, including the types and complexity of texts.[17]

Figure 8 contains excerpts from New York's Common-Core-based English and math standards to illustrate how the standards address the skills in greatest demand in the Public Policy Institute's survey. This is only a brief sampling to give a sense of how the standards are worded and the kinds of skills they cover. Most of these skills are woven throughout the standards (which can be read in full on the New York State Education Department's **EngageNY.org** site). The standards are not just about mastering content and concepts. They emphasize modeling, critical thinking, and collaboration, requiring students to use math and literacy skills to analyze real-world situations, construct arguments, make informed decisions, solve problems, and present their findings—precisely the professional skills that employers are looking for.[18]

Figure 8. Examples of skills covered in the standards

Skill	Excerpt from New York's new P-12 Learning Standards
Critical Thinking	"Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning."
Communications	"Make strategic use of digital media (e.g., textual, graphical, audio, visual and interactive elements) in presentations to enhance understanding of findings, reasoning and evidence and to add interest."
Problem Solving	"Start by explaining the meaning of a problem and looking for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. Consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. Monitor and evaluate progress and change course if necessary."
Teamwork/Time Management	"Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed."
Reasoning	"Construct viable arguments and critique the reasoning of others."
Use of Data	"Use probability to evaluate outcomes of decisions."
Applied Math	"Summarize, represent and interpret data on a single count or measurement variable; summarize, represent and interpret data on two categorical and quantitative variables; and interpret linear models."
Research	"Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation."

SOURCE: *EngageNY.org*

*"Our partnership with Rochester Institute of Technology's Center for Quality and Applied Statistics has opened doors, so our team can apply more critical problem solving skills and a greater use of best practices within our organization. The formal training coupled with the ongoing support of the academic staff is helping foster an environment where change and new approaches to our workflow will become the norm." —**J.N. White Designs, Western New York***

In 2014, four years after aligning New York's learning standards with career readiness expectations, the Board of Regents approved new options for students to meet high school graduation requirements. The new regulations establish robust, alternative pathways to graduation, including pathways in career and technical education and STEM that are aligned with industry needs. The new options are intended to help prepare more students for success in the 21st century economy. The Business Council and its members advocated for these changes and continue to urge the New York State Board of Regents to preserve high educational standards as well as pathways that multiply the career opportunities open to New York's students.

Redesigning education pathways to align with STEM labor market opportunities

New York's business community is spearheading efforts to fundamentally redesign education pathways across multiple educational institutions within a region. This section spotlights two major initiatives, the NYS P-TECH program and the NYC Tech Talent Pipeline.

P-TECH is an innovative program that connects high school, college, and the world of work. Participating students earn a high school diploma and an associate degree at no cost, and emerge from the six-year program prepared for a well-paying career in a STEM field. Launched at a single school in 2011, the program has grown to 33 schools operating across New York, serving every economic region and a broad range of industries. In designing a P-TECH program, the first step is to identify specific middle skills jobs in the local economy. Mapping backward, program partners design a comprehensive, six-year integrated program to prepare students with the academic, technical, and professional skills to embark on STEM careers.

The program offers work-based learning in addition to traditional high school and college coursework. "Every P-TECH student has a mentor," says Stanley S. Litow of IBM. "They all have the opportunity for a paid internship, the opportunity to work in our research laboratories or other facilities, to engage in project-based learning."

P-TECH OUTCOMES AT A GLANCE

» Approximately one-half of New York's incoming community college students enroll in at least one remedial course, but P-TECH students do not need remedial college courses. They only take credit-bearing courses toward their degree. Not only is it more difficult for students who need remediation to graduate from college, the remedial education epidemic is also a huge waste of taxpayer money—$94 million annually at SUNY community colleges alone. The P-TECH program has the potential to eliminate these costs while simultaneously improving educational and workforce outcomes.

» P-TECH students are on pace to graduate with their associate degrees at far higher rates than the typical community college student. Five and a half years into their six-year program, 37 percent of the first P-TECH cohort has already completed an AAS degree, and another 30 percent or more are on track to complete the AAS degree by the end of the school year, for an overall anticipated college graduation rate of more than 67 percent. This is more than double the average graduation rate for a SUNY community college cohort, which is just 28 percent—*four years* after entering college.

» "The benefit to employers is to find people who are able to be effective in the workplace," says Litow. "It responds to what employers need, which is the right preparation for new-collar skills. We've already hired ten P-TECH students, and the program is not even completed. And these are people with significant skills, who've been prepared over multiple years." IBM has hired these early graduates from the flagship school with entry level salaries of approximately $50,000 per year, compared with the national average of $34,970 for young adults with an associate degree and $30,000 for those with a high school diploma alone. This salary advantage not only benefits individual students and their families but generates both increased local and state tax revenues and local economic growth.

» P-TECH's impressive outcomes are all the more impressive because the program is not academically selective. P-TECH serves disadvantaged students who would not otherwise have aspired to attend college.

SOURCE FOR P-TECH STATISTICS: *Robin Willner interview*

The NYC Tech Talent Pipeline is a $10 million public/private partnership that aims to improve the alignment of training and education pathways with the needs of technology employers, guided by an advisory board that includes such companies as Verizon, Facebook, AT&T, Microsoft, and JPMorgan Chase.[19] The program collects regular feedback from industry partners to identify which technology jobs are in demand and to define the skills and competencies needed to succeed in those roles. The program then helps education and training providers tailor programs to meet those needs through a comprehensive set of activities:

- Publishing a report on the key skills and competencies needed for in-demand, entry-level technology jobs;
- Facilitating an industry review of the curriculum at 15 New York City colleges, including Cornell Tech and several CUNY community colleges;
- Working with employer partners to develop job descriptions, screening tools, curriculum, and applied projects to demonstrate candidates' skills;
- Engaging industry partners in reviewing candidates before admission to education and training programs;
- Collecting candidate feedback from hiring managers after candidates completed training.[20]

"This is an example of organizing employers in a sector so you get a picture of what is needed, then working with community colleges and training groups to make sure there is coordination," says JPMorgan Chase's Lennon. "The New York Alliance for Careers in Healthcare is doing similar work in the health sector."

"New York should encourage kids to consider trades and 2-year skills-based education."
—***Manufacturing company, Capital Region***

Successful partnerships: Features and highlights

More than 80 percent of the Public Policy Institute survey respondents who were involved in education partnerships said that their partnership was at least moderately successful. Of those who said their partnership was "highly successful," the most common partners were community colleges and private higher education institutions. This section highlights selected partnerships and some of the features that make them successful.

Previous research has identified several elements of successful partnerships between employers and education institutions:

- Collaborations are focused at the local or regional level around a workforce development challenge that warrants collective action;
- Participants have shared goals, which are buttressed by a process for assessment, accountability, and continuing improvement;
- The partnership needs strong leadership, commitment from all parties, an effective structure, and shared governance mechanisms;
- There is effective and open communication; and
- All partners get value out of their participation in the collaboration.[21]

Bruce Hamm of MACNY believes that the communication that develops through well-structured partnerships helps educators and employers better understand and agree on the goals they share for their students. "I think the P-TECH model, which involves high school, college, and business—all three partners at the table—increases the chances that the dialogue about breaking down the silos will happen," he says. "We've seen high school teachers ask college teachers, 'Are we preparing our students to succeed with you guys?' That conversation just does not happen unless you're forcing the three groups to sit down. And we're seeing college instructors ask the same question of employers."

P-TECH OHM, in its second year of operation, is preparing students in the Mohawk Valley to work in the Utica-Rome region's emerging nanotechnology cluster. Students are pursuing an AAS degree in Semiconductor Manufacturing Technology at Mohawk Valley Community College. "Mohawk Valley EDGE has been cultivating this region for the nanotechnology industry since 2000," says Tim Fitzgerald, business liaison at the regional economic development entity. "This industry is seen as a catalyst to help reverse a long period of economic decline locally, and as a viable career path for young people interested in middle-skilled jobs and looking to stay in the region."

The program has the support of more than a dozen business partners from a range of sectors. "It's important that local business get involved with students at the high school level to give them an awareness of local jobs in the area," says Valerie Wasielewski, human resources manager at Chobani. "The students participating in the P-TECH program will gain an understanding of all the technical careers we can offer them. The education and experience they gain through this program would make them excellent candidates for employment upon graduation—it's a win-win for us both."

Like other P-TECHs, the program at Oneida-Herkimer-Madison BOCES enrolls students who otherwise might not have completed a college degree. "Some haven't been very successful academically in the past, others may have been bullied at their home district," said Christina Warner, the program's business liaison.

"For whatever reason, their previous learning environment didn't work, and what we offer in this program allows them to be more engaged." The teachers find ways to integrate STEM into other classes and turn lessons into group projects and hands-on activities. For example, Warner says, when the students were learning about ancient Chinese technology for social studies, "they each designed their own catapult, then used 3D printers to create the components. They launched ping-pong balls and collected data on how far the balls went, then used the data in algebra class." While the program is too new to have graduation statistics, it had a 98 percent attendance rate last year. "Last winter, the students would still come to school at the BOCES even if it was a snow day in their home district, if they could get a ride," says Warner. "It's the culture—it shows how engaged they are."

P-TECH OHM may be unusual in that it is a STEM program run by women. "Our administrator is a woman, and all of our full-time staff are female," Warner says. "Our math teacher worked as a Vice President/ Department Manager in Derivative Operations at Goldman Sachs for seven years. Prior to getting my first job as a school counselor, I was a Director of Business Development for a local tourism company."

> *"Having staff members with this prior experience in the business world has helped us to provide more authentic workplace learning opportunities. We pride ourselves on the fact that we are leading by example that women do belong in STEM-related fields."*

Tata Consultancy Services' (TCS) community initiatives have inspired and reached more than two million young people around the world to pursue STEM education and careers. The New York-based company is a founding partner of two national mentoring initiatives. US2020 provides mentoring for students from ethnic minorities and low-income groups, while Million Women Mentors was founded with the purpose of removing barriers facing women and to double their rate of participation in the STEM workforce. TCS's flagship student engagement program, TCS goIT, has engaged over 12,000 middle and high school students with hands-on experiences in computer science, inspiring them toward tech careers in all sectors.

"It is our duty as a nation to prepare our youth for opportunities of today and tomorrow," says TCS Head of Workforce Effectiveness Balaji Ganapathy. "The skills gap can be solved only if we understand and respond to the trends that are shaping and changing our economy."

> *"Industry, academia, government and civic organizations should collaborate on empowering students with employability skills, innovation excellence and digital fluency, unlocking the door to 21st century careers across all sectors."*

Conclusions and Recommendations

New York is home to an increasing number of successful partnerships between businesses and education and training institutions. The next move for policymakers is to take a step back and ask how government can best support the expansion of this trend on a systemic level. This research identified five key steps for policymakers seeking to make New York a leader in bridging the skills gap:

1. find new ways to ensure broad access to labor market data;
2. align education performance metrics with economic demands;
3. streamline education regulations and decision-making processes to facilitate innovation;
4. couple college affordability with a focus on completion of a marketable credential; and
5. invest in replicating the pathways and programs that employers know work best.

The business community has an important role to play in advocating for these policy changes.

Future research should track trends in employer needs and perceptions over time. As public-private partnerships designed to address the skills gap reach maturity, comprehensive data on their costs, cost-savings, and outcomes should be published and analyzed. This information should be considered alongside complementary information on training programs that operate outside educational institutions, such as

those overseen by the U.S. Department of Labor. Finally, as policymakers take steps to address the five recommendations presented here, the impacts of those changes should be studied to determine their effectiveness.

1. Ensure access to regional labor market data

Monroe Community College's middle-skills measurement initiative demonstrates the benefits of gathering, publishing, analyzing, and using a combination of traditional and real-time labor market data to guide investments and decision-making, but the project also raises important questions: As a state, should we encourage individual education and training institutions to go out and purchase this data piecemeal? Do other colleges and training providers have access to the funding and analytical capacity necessary to do what Monroe Community College is doing?

Business leaders say there is a better way. "Data is a public good," says JPMorgan Chase's Lennon. "It is highly inefficient for every actor to have to get their own data. As the economy gets more complex, with increasing number of different types of occupations with different skills demands, we need to keep investing in this so community colleges can understand what the opportunities are across the whole range of occupational pathways."

The solution is not obvious, but the need for a systemic approach is clear. "The demand for data is outstripping the supply of what states can do alone," Lennon says. "We need new and better ways for states to help meet the demand for this kind of data. Whether it is provided directly through state or other types of partnerships, there is a need." A reasonable start would be for the state to convene knowledgeable stakeholders to look at what data are currently available from different sources, define the information that New Yorkers need to make good decisions for their economic future, and explore potential approaches to addressing the problem.

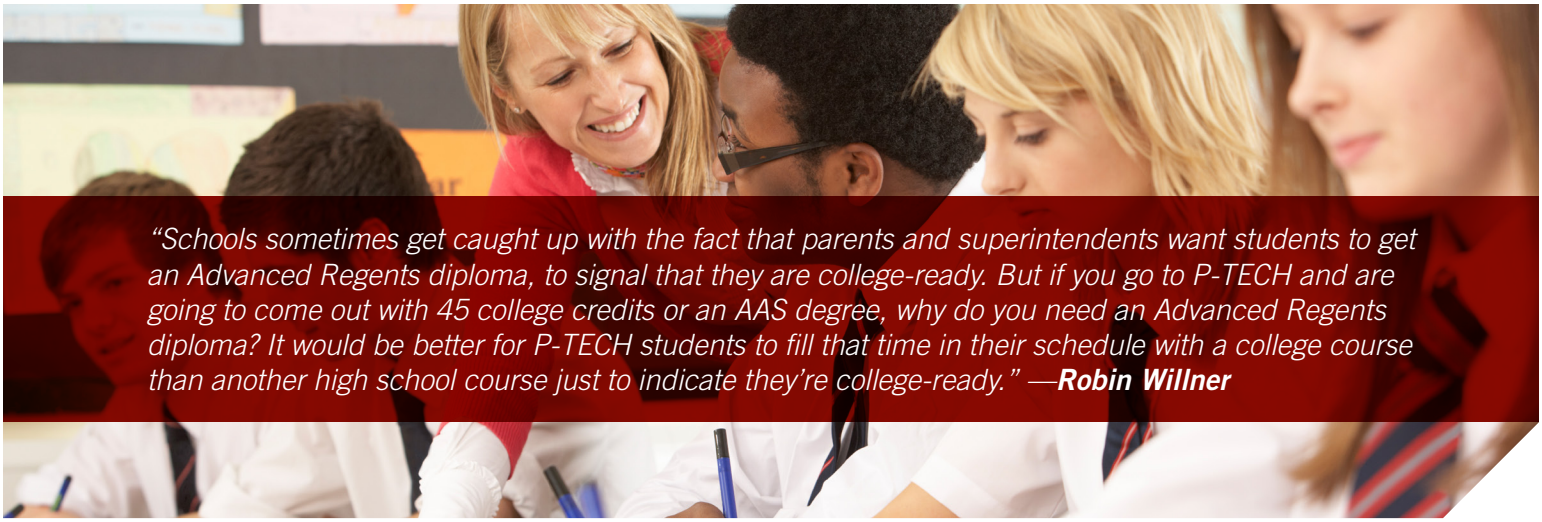
2. Focus K-12 accountability on college and career readiness

The employers and STEM experts who participated in this research repeatedly noted that the priorities of K-12 education system are not always in sync with economic opportunities. Not only do our schools sometimes funnel students toward courses and credentials that lack value outside the academy, the education establishment may also (albeit unintentionally) perpetuate the stigma associated with career-oriented courses and programs.

Whereas businesspeople are accustomed to designing products and processes to satisfy the needs and wants of particular customers, and success is measured by the bottom line, our education system is more complex. It must prepare students not only for academic success, but also to be ready to join the workforce, shoulder the responsibilities of citizenship, and live well-adjusted, fulfilling lives as members of their community. To help ensure that they are preparing students in all of these areas, schools have to look not only at whether students are getting through their classes. They also need to look beyond themselves to see how their alumni are doing when they get to the next level, whether it be higher education or the workforce.

Yet, as MACNY's Bruce Hamm points out, "The metric for high school success is graduation. They're not asking are they going to be successful in college, they're saying, 'Let's get them out of high school.'" The same problem applies to postsecondary institutions: "The colleges are asking, 'Is our enrollment good enough?' and they're getting some pressure now to graduate people, but it's not enough," says Hamm. "The question colleges are not asking is, 'Are these kids getting jobs?'" In other words, what gets measured gets done. Currently, Hamm says, "you have a set of metrics that almost ensure that all of this is in silos. You need people that are able to cross boundaries and start meaningful conversations—people in education that understand industry, educators that are willing to talk to each other as well as to the business community."

Recent changes in federal law provide the business community with an unprecedented opportunity to ensure that schools are held accountable based on outcomes that are important to student success in today's economy. The bipartisan federal law that replaces No Child Left Behind, known as the Every Student Succeeds Act (ESSA), gives states flexibility to craft their own systems to hold schools



*"Schools sometimes get caught up with the fact that parents and superintendents want students to get an Advanced Regents diploma, to signal that they are college-ready. But if you go to P-TECH and are going to come out with 45 college credits or an AAS degree, why do you need an Advanced Regents diploma? It would be better for P-TECH students to fill that time in their schedule with a college course than another high school course just to indicate they're college-ready." —**Robin Willner***

accountable for student outcomes. In the next few months, state leaders are making big decisions about what it means to be a successful school, what rate of academic progress is acceptable, and what to do when schools are not meeting our expectations. The state has invited business representatives to join other stakeholders in providing input on those decisions.

To ensure that college and career readiness is the main driver of school performance ratings and improvement strategies, New York State's accountability system must:

- Maintain high academic standards;
- Ensure that schools are rated primarily based on academic outcomes (supplemented by early-warning indicators) that are closely linked with students' ultimate success in college and the workplace;
- Include measures of college and career readiness, designed with input from the business community.

By itself, a well-designed school accountability system cannot solve New York's skills gap, but it is an important piece of the puzzle. Therefore, chambers of commerce and business leaders across the state are working with a broad coalition of organizations to augment their voices in advocating to use ESSA to support our economy and advance student success.

3. Rework education decision-making processes to enable agility in responding to change

Multiple STEM experts interviewed for this study emphasized the need to streamline the education regulations and processes that are impeding student success. "The academic decision-making change process doesn't operate in the same way as other sectors," says IBM's Litow. In the private sector, a CEO reviews the company's competitiveness every quarter and uses that information to make adjustments. "That is what it means to be agile," Litow says. "In education, the university president may see what is needed, but the process may take a long time."

New York's education policymakers "need to think very seriously about how to incorporate the changing requirements of the labor force into curriculum more quickly," says Litow. "For example, someone who got a computer science degree five years ago didn't need digital or design skills." In particular, interviewees say the regulations governing the approval of new career and technical education programs are too cumbersome to keep up with the pace of technological change in the economy. "Industry moves in six-month cycles," says MACNY's Bruce Hamm. "If it takes you two years to get a program approved, that is way too long."

P-TECH director Willner points out a catch-22 that makes it difficult to develop career and technical education (CTE) programs in emerging fields. "Each approved CTE program needs to offer a certain number of courses taught by a certified CTE teacher," Willner explains. "But as you get into new technology areas, it takes a lot of time to create a new teacher licensing exam, and nobody wants to create a new licensing exam if there are no programs. We basically have a system that was designed to ensure quality and integrity in current labor market fields, but it's very difficult to start a new field because by definition there's no demand."

In addition to developing new, broad-based teacher certifications and fast-tracking CTE program approvals, other regulatory relief should be linked to student outcomes. For example, seat time requirements for high school credit could be waived to encourage dual college credits as long as students can demonstrate mastery in both the high school and college standards. Students who demonstrate real-world college and career success should earn the same recognition as those who complete advanced academic and technical high school courses.

"The pace of change in the workforce is increasing, and the pace of change in academia has to keep up," Litow concludes. "Those institutions that change more quickly will be at the front end of that change," and their graduates will be the ones who are best able to compete in today's economy.

4. Couple college affordability with a focus on college completion

As the economy changes and a high school diploma is no longer a ticket to a living wage, politicians and advocates have advanced proposals to make college more affordable. In his 2017 budget, Governor Cuomo proposed the Excelsior Scholarship, which would offer free tuition at SUNY and CUNY two- or four-year colleges for full-time students if they or their families earn $125,000 a year or less. While not expressly embracing the proposal, business leaders interviewed for this report expressed support for expanding college access—provided that it goes hand in hand with ensuring that students are able to complete a meaningful credential.

"Affordability is a critical issue," says IBM's Litow. "For many students, financing postsecondary education is a challenge, so making sure everyone has real access is an important piece," agrees Lennon of JPMorgan Chase. He points out that tuition is just one of many expenses associated with financing higher education. "There are other challenges with cost of child care, transportation, fewer hours spent working, and other barriers." Clearly, free tuition would make college more affordable. "If you make college more affordable, more students can attend college," says Litow, "and that's one part of the problem."

But how to ensure those students are successful in completing a degree or other recognized credential? Lennon's answer sounds deceptively simple. "Research on community colleges shows that the worst thing is for someone to enroll without an idea of why they're there," he says. "We have to get away from idea that it's ok to show up and then figure it out." This comes back to the points made earlier—there is a lack of access to information on career pathways, and educators and students in particular may be unaware of the opportunities available in their region. "Students are consumers and need to have more information about the quality of choices they're making," says Lennon. "What works for persistence is coming in with a clear sense of what you want to accomplish, and for college to be designed in a way that helps you keep forward momentum."

In sum, says Lennon, "affordability and enrollment have to be connected to the question of awareness, to helping people understand that each college program is tied to certain occupational choices, and helping people make those choices." This research finds that where secondary and postsecondary educators and employers come together under the auspices of government to design pathways that lead to real jobs, as they have in the P-TECH program, graduation rates improve. "We need to make sure that the state's college tuition policy includes P-TECH," Willner is quick to note. "P-TECH deals with college completion," agrees Litow, not just access.

Litow believes that New York has an opportunity to boost its competitiveness by taking the lead in turning around low college completion rates—particularly for low-income students and students of color. "If we solve both parts of the problem, affordability and completion," he says, "a larger number of New York's students will be able to move up the career ladder."

5. Invest in replicating what works

> *"In business, people always say that if we get something right, the speed with which we can replicate it is what differentiates us. The challenge is to replicate it so that the positive element is replicated systemically across the business. This is true in the public sector too… but education has always had difficulty replicating successful models. If you look across a state, you can always find examples of well-functioning schools, but their means of achieving success is not replicating."*
> —***Stanley S. Litow, IBM***

The business leaders interviewed for this study come from different sectors and have a variety of perspectives, but they agree that New York should invest in replicating the pathways and programs that employers have found most effective. "It is most important that New York put investments behind models that really work," Litow says. "IBM spends several hundred million dollars on training, we make investments in research—these are investments in our future."

At the local level, employers see a need to strengthen career and technical education programs. "BOCES and other vocational education programs are highly undervalued and underfunded," says an executive from Ball Corporation in the Capital Region. "Investing in vocational trades at the high school level would be a great start in creating the paradigm shift needed to support manufacturing jobs in New York State and around the country."

The fact that more than 80 percent of the executives who responded to the Public Policy Institute survey expressed interest in partnering with a community college to help meet their need for skilled workers—combined with the fact that community colleges were also cited as some of the most highly successful partnerships—suggests that New York State, SUNY, and CUNY may want to take a closer look at the structure and funding of community college-based workforce development programs to ensure they are capitalizing on their success and maximizing their impact.

Lennon advocates a systemic approach that would replicate models like the NYC Tech Talent Pipeline model in other sectors across the state. "New York City has taken a step forward by deciding to focus on pathways in its approach to workforce development," he says.

> *How can New York State use its resources to help build strong efforts, organized in sectors, so you have coordination between CTE, BOCES, community colleges, and four-years—so that (a) students are aware of the pathway opportunities they have, (b) they are able to pursue those programs, and (c) the programs are coordinated with employers? The state should be facilitating that alignment, so that in each region there's the right kind of infrastructure to make sure that employers are getting the kinds of talent they need, and that students are getting the opportunities they need to pursue stable and secure careers. —**Chauncy Lennon, JPMorgan Chase***

The expansion of the P-TECH program is an example of the kind of replication that Litow says is too often lacking in the education world. "We started with one school," he says. "We're now at 60 [across the U.S. and internationally], and by the end of 2017 we'll have 90, in an increasing number of states and countries." Despite its growing reach, Litow is not content as long as there are students who lack access to the program. "It has replicated quickly, but it's not nearly enough," he says. "That is why we advocated for the Perkins bill"—the federal law governing career and technical education, which passed the House in 2016. Given its strong bipartisan support, some observers are optimistic that the Perkins Act will be reauthorized this year.

If that happens, Litow believes the resulting changes in federal policy and funding will enable P-TECH to become "the model across the U.S. for high school and community college." And as the birthplace of P-TECH, he says, "New York will have the opportunity to lead."

Notes

[1] The term "new collar" was popularized, if not invented, by IBM CEO Ginni Rometty and refers to the technology "jobs of the future … that can be done without a four-year college degree." See, e.g., "IBM CEO Ginny Rometty Speaks with CNBC's Deirdre Bosa on 'Closing Bell' Today," CNBC Transcript, January 9, 2017, http://www.cnbc.com/2017/01/09/cnbc-exclusive-cnbc-transcript-ibm-ceo-ginny-rometty-speakswith-cnbcs-deirdre-bosa-on-closing-bell-today.html

[2] "Monthly Jobs Press Release," New York State Department of Labor, January 19, 2017, https://labor.ny.gov/stats/pressreleases/pruistat.shtm.

[3] Population increases downstate and in the Capital Region/Hudson Valley, driven by the birth rate and immigration from foreign countries, are offset by upstate outmigration to other states. "New York State's Population Growth Has Stalled," All Over Albany, December 21, 2106, http://alloveralbany.com/archive/2016/12/21/new-york-state-population-2016; http://newyork.cbslocal.com/2016/03/24/nyc-population-us-census/.

[4] Anthony P. Carnevale, Tamara Jayasundera, and Artem Gulish, *America's Divided Recovery: College Haves and Have-Nots* (Washington, D.C.: Georgetown University, 2016), https://cew.georgetown.edu/cew-reports/americas-divided-recovery/

[5] Manufacturing Institute and Deloitte, *The Skills Gap in U.S. Manufacturing: 2015 and Beyond* (2015), p. 14, http://www.themanufacturinginstitute.org/~/media/827DBC76533942679A15EF7067A704CD.ashx; Change the Equation, "Vital Signs New York," p. 1, http://vitalsigns.changetheequation.org/state/new-york/print (between 2014 and 2024, STEM jobs in New York will grow 14%, compared with 9% for non-STEM jobs).

[6] Bureau of Labor Statistics, "STEM crisis or STEM surplus? Yes and yes," *Monthly Labor Review* (May 2015), https://www.bls.gov/opub/mlr/2015/article/stem-crisis-or-stem-surplus-yes-and-yes.htm

[7] Allison Armour-Garb, *Common Core: Here to Stay?* (New York: Public Policy Institute of New York State, 2016), p. 6, http://www.ppinys.org/reports/2016/PPI-Common-Core-Here-to-Stay.pdf

[8] Dane Linn, "CEOs tackle skills gap in schools, workplaces and beyond," *The Hechinger Report*, December 22, 2015, http://hechingerreport.org/ceos-tackle-skills-gap-in-schools-workplaces-and-beyond/

[9] BLS, "STEM crisis," pp. 10-12.

[10] Manufacturing Institute and Deloitte, *The Skills Gap in U.S. Manufacturing*, p. 5.

[11] David P. Driscoll, "Teacher Licensing Testing: Testing Our Teachers to Reflect Changing Demands," p. 112, http://images.pearsonassessments.com/images/NES_Publications/2009_ES_Publications/14_Driscoll.pdf

[12] Accenture, Burning Glass Technologies, and Harvard Business School, *Bridge the Gap: Rebuilding America's Middle Skills* (2015), p. 26, http://www.hbs.edu/competitiveness/Documents/bridge-the-gap.pdf

[13] Rural Futures Institute, "Data in Practice: Snapshot," in *Bridging the Skills Gap: Using Data to Support Decision-Making for Local/Regional Development* (University of Nebraska), http://ruralfutures.nebraska.edu/skills-gap/monroe-community-college/

[14] Monroe Community College, Economic Development & Innovative Workforce Services, *Measuring Middle-Skills Occupational Gaps Within the Finger Lakes Regional Economy* (2015), https://user-tybgwup.cld.bz/Measuring-Middle-Skills-Gaps-within-the-Finger-Lakes-Regional-Economy#2

[15] Rural Futures Institute, "Data in Practice."

[16] "Development Process," Common Core State Standards Initiative, http://www.corestandards.org/about-the-standards/development-process/; American Diploma Project, *Ready or Not: Creating a High School Diploma That Counts* (Washington, D.C.: American Diploma Project, 2004) 105-107, http://www.achieve.org/ReadyorNot

[17] David T. Conley, *The Common Core State Standards: Insight into Their Development and Purpose*. Washington, D.C.: Council of Chief State School Officers, 2014, 3, http://www.ccsso.org/Documents/2014/CCSS_Insight_Into_Development_2014.pdf

[18] Achieve, *Understanding the Skills in the Common Core State Standards* (Washington, D.C.: Achieve, 2012), http://www.achieve.org/publications/understanding-skills-common-core-state-standards

[19] NYC Tech Talent Pipeline, *NYC Industry Insights: Key Skills and Competencies Needed for In-Demand, Entry-Level Tech Jobs in New York City*, (New York: NYC Tech Talent Pipeline, 2016), https://static1.squarespace.com/static/54d3a0dee4b026182d00678f/t/5811163c03596ed124325eb4/1477514814173/TTP+NYC+Industry+Insights.pdf

[20] NYC Tech Talent Pipeline, *NYC Industry Insights*, p. 4.

[21] The Economist Intelligence Unit, *Closing the Skills Gap: Companies and Colleges Collaborating for Change* (2014), pp. 12-13 (citing Kisker and Carducci 2003), https://www.luminafoundation.org/files/publications/Closing_the_skills_gap.pdf

Bibliography

Accenture, Burning Glass Technologies, and Harvard Business School. *Bridge the Gap: Rebuilding America's Middle Skills*. 2015. http://www.hbs.edu/competitiveness/Documents/bridge-the-gap.pdf

Achieve. *Understanding the Skills in the Common Core State Standards*. Washington, D.C.: Achieve, 2012. http://www.achieve.org/publications/understanding-skills-common-core-state-standards

American Diploma Project. *Ready or Not: Creating a High School Diploma That Counts*. Washington, D.C.: American Diploma Project. 2004. http://www.achieve.org/ReadyorNot

Armour-Garb, Allison. *Common Core: Here to Stay?* New York: Public Policy Institute of New York State. 2016. http://www.ppinys.org/reports/2016/PPI-Common-Core-Here-to-Stay.pdf

Bureau of Labor Statistics. "STEM crisis or STEM surplus? Yes and yes." *Monthly Labor Review* (May 2015). https://www.bls.gov/opub/mlr/2015/article/stem-crisis-or-stem-surplus-yes-and-yes.htm

Carnevale, Anthony P., Tamara Jayasundera, and Artem Gulish. *Understanding Online Job Ads Data: A Technical Report*. Washington, D.C.: Georgetown University, 2014. https://cew.georgetown.edu/wp-content/uploads/2014/11/OCLM.Tech_.Web_.pdf

Carnevale, Anthony P., Tamara Jayasundera, and Dmitri Repnikov. *America's Divided Recovery: College Haves and Have-Nots*. Washington, D.C.: Georgetown University, 2016. https://cew.georgetown.edu/cew-reports/americas-divided-recovery/

Change the Equation. "Vital Signs New York." http://vitalsigns.changetheequation.org/state/new-york/print

Common Core State Standards Initiative website. www.corestandards.org

Conley, David T. *The Common Core State Standards: Insight into Their Development and Purpose*. Washington, D.C.: Council of Chief State School Officers. 2014. http://www.ccsso.org/Documents/2014/CCSS_Insight_Into_Development_2014.pdf

Driscoll, David P. "Teacher Licensing Testing: Testing Our Teachers to Reflect Changing Demands." http://images.pearsonassessments.com/images/NES_Publications/2009_ES_Publications/14_Driscoll.pdf

EngageNY.org website. https://www.engageny.org/resource/new-york-state-p-12-common-core-learning-standards

Linn, Dane. "CEOs tackle skills gap in schools, workplaces and beyond." *The Hechinger Report* (December 22, 2015). http://hechingerreport.org/ceos-tackle-skills-gap-in-schools-workplaces-and-beyond/

Manpower Group. *2015 Talent Shortage Survey*. 2015. http://www.manpowergroup.com/wps/wcm/connect/db23c560-08b6-485f-9bf6-f5f38a43c76a/2015_Talent_Shortage_Survey_US-lo_res.pdf?MOD=AJPERES

Manufacturing Institute and Deloitte, *The Skills Gap in U.S. Manufacturing: 2015 and Beyond*. 2015. http://www.themanufacturinginstitute.org/~/media/827DBC76533942679A15EF7067A704CD.ashx

Monroe Community College, Economic Development & Innovative Workforce Services. *Measuring Middle-Skills Occupational Gaps Within the Finger Lakes Regional Economy*. 2015. https://user-tybgwup.cld.bz/Measuring-Middle-Skills-Gaps-within-the-Finger-Lakes-Regional-Economy#2

National Network of Business and Industry Associations. *Work-and-Learn in Action: Successful Strategies for Employers*. 2015. http://businessroundtable.org/sites/default/files/BRT%20Work%20and%20Learn%20Nov12.pdf

North Carolina Commission on Workforce Development. *2014 Employer Needs Survey*. 2014. http://www.nccommerce.com/Portals/11/Documents/Commission/2014%20Employer%20Needs%20Survey.pdf

NYC Tech Talent Pipeline. *NYC Industry Insights: Key Skills and Competencies Needed for In-Demand, Entry-Level Tech Jobs in New York City*. New York: NYC Tech Talent Pipeline, 2016. https://static1.squarespace.com/static/54d3a0dee4b026182d00678f/t/5811163c03596ed124325eb4/1477514814173/TTP+NYC+Industry+Insights.pdf

PwC. "Inside New York State Tax Reform: Understanding the Impact on Manufacturers." Tax Insights from State and Local Tax Services. May 7, 2014. https://www.pwc.com/us/en/state-local-tax/newsletters/salt-insights/assets/pwc-inside-new-york-state-tax-reform-understanding-impact-man.pdf

Rural Futures Institute. *Bridging the Skills Gap: Workforce Development in Rural Communities in the Great Plains*. University of Nebraska, 2014-2016. http://ruralfutures.nebraska.edu/skills-gap/

The Conference Board, Corporate Voices for Working Families, the Partnership for 21st Century Skills, and the Society for Human Resource Management. *Are they really ready to work? Employers' Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century U.S. Workforce*. 2006. http://www.p21.org/storage/documents/FINAL_REPORT_PDF09-29-06.pdf

The Economist Intelligence Unit. *Closing the Skills Gap: Companies and Colleges Collaborating for Change*. 2014. https://www.luminafoundation.org/files/publications/Closing_the_skills_gap.pdf

Appendix: Research Methodology, Survey Questions, and Data Limitations

The study focused on education and training programs provided by educational institutions. Training programs that operate independently of educational institutions, such as those overseen by the U.S. Department of Labor, were beyond the scope of this research.

The interviews quoted in this paper were conducted via email and telephone in January 2017. The survey was conducted in December 2016 and January 2017. It was distributed to a curated list of Business Council members, including chambers of commerce and members of The Business Council's Workforce Development committee and Government Affairs Council. Respondents were asked to complete the survey in full and forward it to anyone else who may have been interested in participating.

There are some limitations to what can be concluded from the data because the survey reached only a portion of the state's employers, and not all of the employers who were invited to participate responded. For this reason, this report does not attempt to generalize survey conclusions to all employers in the state or in any particular sector or region. Rather, the responses provide a window into a particular set of workforce challenges that New York employers are facing (the skills gap) and a particular kind of approach to addressing those challenges (collaborations with educators).

The pattern of responses suggests that certain industries and regions have a high level of concern about the skills gap. The vast majority of responses came from regions other than New York City and Long Island. This is perhaps not surprising, given the population trends and resulting workforce pressures described in the report. The highest numbers of responses were received from Western New York (25 percent), the Southern Tier (21 percent), and the Capital Region (18 percent). The remainder of upstate responses came from the Finger Lakes (10 percent), Central New York (9 percent), the North Country (8 percent), and the Hudson Valley (7 percent).

Almost one-quarter of survey responses came from the manufacturing sector. Nine percent came from the health care sector, and another nine percent from the professional, scientific, and technical services sector. Six percent came from the finance and insurance sector, and another four percent from the real estate sector. Together, these five sectors made up more than half of all the responses we received. The remainder were spread broadly across accommodation and food service, agriculture, construction, management and public administration, retail and wholesale trade, transportation, utilities, and other services.

Close to half of the responses came from businesses with fewer than 50 employees in New York. Another 44 percent came from businesses with between 50 and 500 employees in the state, and the remaining eight percent came from businesses with 500 or more employees in New York.

To view the survey questions, please visit: https://www.surveymonkey.com/r/5T6DJV2

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