THE FUTURE OF SMART WORK IN CENTRAL OHIO

2020

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Foreward

By Smart Columbus

In 2015, the U.S. Department of Transportation (USDOT) issued the first-ever Smart City Challenge to accelerate the American smart cities movement. By challenging mid-size cities to use emerging transportation technologies to address their most pressing problems, the USDOT aimed to spread innovation through a mixture of competition, collaboration and experimentation.

Propelled by an application that committed to collaborating across the public and private sectors to improve resident quality of life through access to mobility, Columbus beat out 77 other cities to be named the winner of the Challenge. The win earned Columbus $50 million in the form of two grants, $40 million from the USDOT and $10 million from the Paul G. Allen Family Foundation, and the designation as America's Smart City. The win also presented the opportunity to understand and demonstrate what it means to become a smart city in a time when technology disruption is transforming the ways residents move, work and connect with one another and the urban environment around them.

Columbus has seen technology disruption of this magnitude before. The Columbus Buggy Company was founded in 1875 and, at its height, employed 1,200 people and manufactured 100 buggies a day. At one time, 1 in 4 buggies manufactured in America were made by Columbus workers. But disruption came quickly for the buggy and for Columbus. Ford introduced the Model T in 1908, and the buggy disappeared within a decade. By 1913, the Columbus Buggy Company was in bankruptcy.

A century later, connectivity, data, the Internet of Things (IoT) and sensing and computing technologies stand to create even larger disruption. Disruption to the ways we live and move. Disruption to the way cities make decisions and do business. Disruption to the ways we work. Disruption to the jobs we work in-- just like those 1,200 jobs at the Columbus Buggy Company.

As of 2019, we expected to attract another million people to the Columbus Region by 2050. In that context, we have an even greater responsibility to build a workforce that supports a thriving community, building ladders of opportunity for new and current

residents. To do so, we must question the challenges and opportunities this new era of smart cities will bring. What disruptions do we see on the horizon? How will those disruptions change the needs of business and industry? How will these disruptions affect our workers? What skills will our workers need as our city becomes 'smart'? How do our workers obtain those skills to be ready and competitive in our future job market? These are all questions that we are working to answer in "The Future of Smart Work in Central Ohio."

This study is both an assessment of the driver industries that fuel the Central Ohio economy in six key areas applicable to smart cities- electrification, intelligent transportation, IoT, data, healthcare and financial services – and evaluation of our training and education programs all in order to make recommendations about how those training and education programs may have to evolve in order to connect our workers to the jobs of the future as we grow as a smart city.

While this report was researched prior to the impact of COVID-19 on our economy, we would be remiss not to include mention of an event that has impacted our workforce unlike any other in history. Due to the impacts of tactics used to combat COVID-19, many businesses have been shuttered and we have seen a contraction in the labor market specifically, in the areas like the service industry where so many workers could benefit from new skills that will position them for jobs in a recovering economy.

As we learn from the impacts of COVID-19 and past examples, we have the opportunity to look forward and bring everyone along so they may grow through disruption and live their best lives.

Introduction

USDOT Smart City Challenge Win

In 2015, the U.S. Department of Transportation (USDOT) issued the first-ever Smart City Challenge to accelerate the American smart cities movement. By challenging mid-size cities to use emerging transportation technologies to address their most pressing problems, the USDOT aimed to spread innovation through a mixture of competition, collaboration and experimentation. The Challenge called on communities to do more than merely introduce new technologies onto city streets. It called on them to boldly envision new solutions that would change the face of transportation in cities by closing the gap between rich and poor, capturing the needs of both young and old, and bridging the digital divide through smart design so that the future of transportation meets the needs of all city residents.

In total, 78 cities applied, including Columbus and finalists Austin, Denver, Portland, Pittsburgh, Kansas City and San Francisco. As the winner, Columbus received a total of $50 million in the form of two grants: $40 million from the USDOT and $10 million from the Paul G. Allen Family Foundation. These dollars provided the seed funding for Smart Columbus—a region-wide smart city initiative co-led by the City of Columbus and the Columbus Partnership. Columbus earned the designation as America's Smart City, but this was no award or trophy, but a job to do – to understand and demonstrate what it means to become 'smart.' Critical to Columbus' success is understanding the impact of smart city innovation on the workforce of the future.

Study Overview

In the spring of 2019, the Ohio Education Research Center at The Ohio State University was selected by Smart Columbus and its partners at the Workforce Development Board of Central Ohio and the United Way of Central Ohio to conduct a study of the Future of Smart Work in Central Ohio.

The study was conducted in two phases. In the spring, the OERC conducted a literature review and benchmarking exercise, placing the Smart Columbus initiative within context and identifying emerging best practices among other cities undertaking smart initiatives. Next, the OERC engaged with Regionomics, a well-known local economic consulting firm, to conduct an analysis of regional workforce trends. Using the results of the literature review, benchmarking exercise and workforce analysis, the OERC developed a set of interview and focus group protocols to collect feedback from a variety of stakeholder groups, including employers, community leaders and local residents, through the summer and early fall of 2019.

This report presents the results of that study. It is both an assessment of the driver industries that fuel the Central Ohio economy, the future jobs in six key areas - electrification, intelligent transportation, the Internet of Things (IoT), data, healthcare and financial services - and an evaluation of our training and education programs. These analyses inform recommendations about how those training and education programs may have to evolve in order to connect our workers to the jobs of the future.

Introduction

Columbus Context

Cities and industries are facing accelerated technological disruption. This represents a significant opportunity for the Central Ohio Region, the 11-country region as defined by One Columbus, to secure a prosperous economic future. Today, the Central Ohio Region is home to a population of 2.1 million, and a potential workforce of 1 million, one of the youngest and most-educated populations in the country.

At the center of the Smart Columbus initiative is a commitment to embrace innovation in a way that builds a future *with* all, not *for* some. Today, Columbus is both the fastest growing city in the Midwest, but it is also the 2nd most economically segregated city in the nation. According to projections from the Mid-Ohio Regional Planning Commission's Insight 2050 study, the region will grow by about 1 million people and 300,000 jobs between 2010 and 2050. This presents an opportunity to not only "future-proof" the economy but be intentional when building up new systems and norms in the wake of disruption.
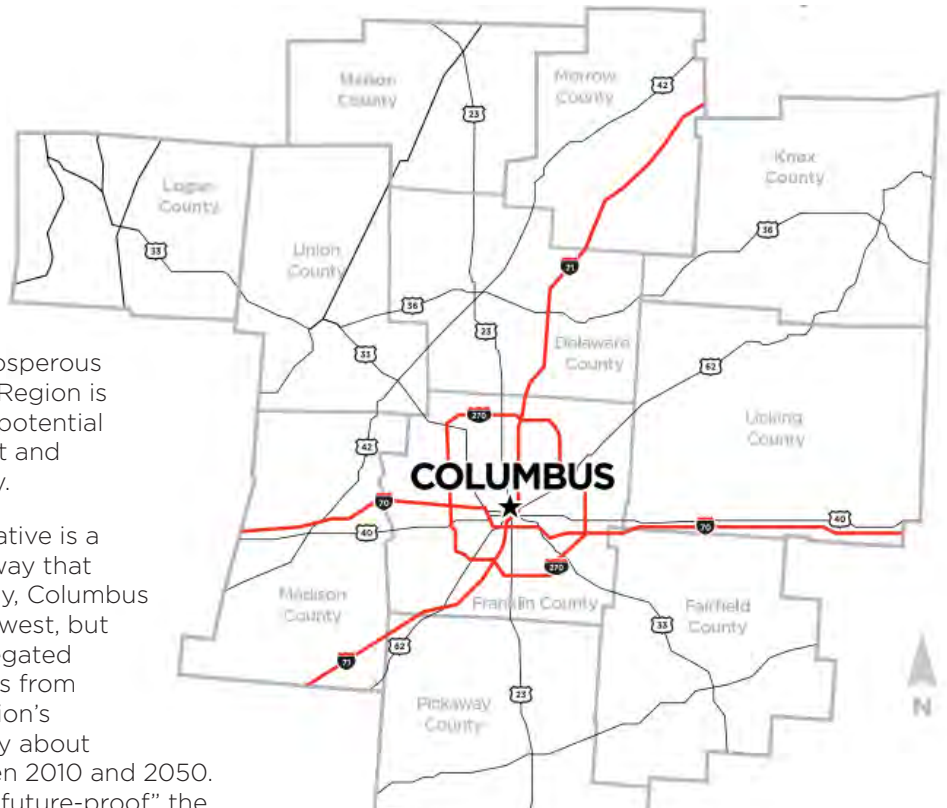
Smart Cities

Cities are in a period of transformation with the progression of the smart cities movement. According to "The urban optimist," an interview with Daniel L. Doctoroff, Chairman and CEO of Sidewalk Labs, cites have encountered three technological advances that fundamentally affected how modern cities developed. The steam engine enabled industrialization and modern sanitation, the electric grid lit up our cities 24 hours a day, and the automobile forced cities to reconceive space (Deloitte Review, 2017). All of these inventions transformed urban life into what we see today. Doctoroff goes on to share that connectivity, sensing and computing power – elements essential to the smart city - are shaping the cities of today and the future. An estimated two-thirds of cities globally are investing in smart city technology, with spending projected to reach $135 billion by 2021.

There are examples of smart cities all over the world, with the most advanced including Amsterdam, Barcelona, London, Stockholm and New York, which can serve as benchmarks for Central Ohio. Table 1 provides an overview of their overall smart strategies, as well as their workforce related successes, concerns and ongoing initiatives. Of the strategies outlined below, London's is most like that of Columbus.

> " *A smart city is one which ties together data, information technology, connectivity, interactivity, transportation, communications and other civic services into a more seamless living experience within a community. This approach holds powerful potential to create a positive impact on urban planning, economic development, delivery of services, utilization of resources and overall quality of life.*
>
> *— quote attributer*

Introduction

TABLE 1: *Smart Cities Workforce Initiatives*

CITY	PROJECTS AND STRATEGY	SUCCESS	CONCERNS	HUMAN AND SOCIAL CAPITAL ADVANCEMENT
Amsterdam, Netherlands	**Projects** • Smart mobility • Smart society (Smart Citizen Kit) • Smart areas • Smart economy (Climate Street) **Strategy** • Launched pilot programs before scaling to broader areas (Startup in Residence) • All projects include a community outreach strategy	High level of experimentation before scaling projects to broader areas	The complex web of policy agendas to align the smart city strategy and stakeholders' interests	• Collaboration among city's stakeholders to develop knowledge and innovation ecosystems—Open data and living labs initiatives • Bottom-up approach starting with small scale projects and scaling the ones with proven effectiveness
Barcelona, Spain	**Projects** • Energy (Buildings efficiency, smart lighting) • Smart water • Smart transportation • Smart governance • Smart waste management **Strategy** • Engagement of the private sector and citizens • Major organizational reform (Creation of the Smart City department) • Public and Private Partnerships	Facilitating legal framework to incentivize the creation of Public and Private Partnerships	Difficulties in defining stakeholders' roles and authority	Open data and living labs initiatives — The 22@Urban Lab launched pilot programs for city experimentation
London, England	**Projects** • Public transport management • Open data • 'Hear East'—Campus with space for start-ups, education, and post-graduate research **Strategy** • Smart London Plan • Creation of the Smart London Board (academics, businesses, and entrepreneurs)	The city targeted education and training in multiple levels to extend the population's digital skills	Difficulties in circulating innovative ideas between academia, industry, and government	• Physical and digital educational infrastructure for developing digital technology—'Tech City Institute.' • Education institutions as hubs of innovation in education • Pan-London digital inclusion strategy • Open data initiative • Pilot projects
Stockholm, Sweden	**Projects** • Online City Hall services • Real-time data about traffic and weather • Large-scale 'demonstrators'—'Kista Science City,' 'Royal Seaport.' **Strategy** • Testing environmental and information technologies on the city's infrastructure • Citizen-centric	Locals are well trained and early adopters of new technology	The high cost of living can potentially create disincentives to creating startups	• The city offers e-learning programs on environmental-friendly practices and green IT for employees, students and companies. • Universities play an active role engaging in R&D in smart city-related fields • Open data initiative • 'Demonstrators'—Large scale pilots to test technology solutions
New York, USA	**Projects** • Digital city • Career Pathways **Strategy** • Help job seekers/workers to build competitive skills • Provide training and education for job seekers and workers • Industry partnerships	Career pathways increase efficiency managing major workforce development funding	There is still not enough funding to realize the city's ambitious plan. There is not yet an effective mechanism to job referrals	• Building industry partnerships • Investing in bridge programs • Aligning with CUNY • Increasing system and policy coordination • Incentivize career success and advancement over rapid job placement
Rio de Janeiro, Brazil	**Projects** • Hosted the Olympic Games 2016 and the World Cup 2014 **Strategy** • Developed an Emergency Response System • Investment in sensor networks • Shared information among 30 agencies	High level of inter-agency coordination	Concerns about city management delegated to private companies	Lack of a bottom-up approach engaging citizens on the city's initiatives — People left behind

Introduction

Below are examples of U.S. smart cities, or emergent smart cities, with best practices targeting the workforce development needs of their communities. These examples are situated within domains used to classify smart city human and social capital advancement *(Angelidou, 2016)*.

EDUCATION AND TRAINING
Smart city strategies that promote infrastructures, institutions and programs for high quality and innovative undergraduate, postgraduate and vocational education.

- **Michigan Mobility Institute, Detroit, MI:** The Institute focuses on teaching adult students the skills they need to compete for the increasingly large number of open jobs in the mobility industry.
  Stakeholders: Universities, automotive industry, and advisory board.
  Priorities: Opening a Master in Mobility starting in 2021.
  Talent development programs: Programs that aim to close the skills gap between workers and in-demand jobs.
  https://www.michiganmobilityinstitute.org/mission

- **The New York Alliance for Careers in Healthcare (NYACH), NY, NY**: Identifies healthcare employers' needs. Helps education and training organizations to meet employers' needs. Provides access to career opportunities in healthcare to low-income and unemployed residents.
  Stakeholders: NYC Department of Small Business Services, NYC Workforce Innovation Fund, healthcare employers, JPMorgan Chase Foundation.
  website?

- **Per Scholas, Columbus, OH (7 other locations):** 15-week full time tech program designed based on employer's needs.
  *Stakeholders:*Corporate Partners (e.g., Citi, Goldman Sachs, T-Mobile), students.
  Priorities: Training in tech skills.
  https://perscholas.org

TALENT DEVELOPMENT PROGRAMS
Programs that aim to close the skills gap between workers and in-demand jobs.

- **Imagine Pittsburgh, Pittsburgh, PA:** Increases the number of local hires in the Pittsburgh area. Shows the career path of people who have chosen Pittsburgh region to build their lives. Gets regularly updated job posting data from multiple job searching tools.
  Stakeholders: Businesses with job openings and city residents.
  Priorities: High demand jobs
  www.imaginepittsburgh.com

SOCIAL & DIGITAL INCLUSION
Programs addressing the digital divide, accessibility and culture shift towards a tech-savvy and participatory society.

- **Tech Goes Home, Boston, MA:** Nonprofit that brings computers, internet, and training to students, adults and seniors without access to such technology.
  https://www.techgoeshome.org/

TOP-DOWN LEADERSHIP
In the context of the smart city, top-down leadership refers to strategies where the city or an economic conglomerate assumes a leading role in defining and driving a comprehensive vision of workforce development.

- **Rework America Business Network:** Private sector initiative to increase the number of US workers with better pathways to career success. Encourages employers to adopt skills-based practices.
  Stakeholders: Markle Foundation, 11 major US employers (e.g., Duke Energy, Microsoft, Kaiser Permanente).
  https://www.markle.org/RABN

BOTTOM-UP APPROACH:
Smart city strategies to involve stakeholders in all or some stages of smart city development.

- **COSMOS, Harlem - NY, NY**: Creating technology to collect the data and engaging the community to determine how this data will be used to solve problems.
  Stakeholders: University partnership (NYU, Columbia, Rutgers), NYC, IBM and NSF. Priorities: Technology deployment and access
  http://cosmos-lab.org/

EXPERIMENTATION
Pilot programs and living labs as platforms to assess the viability of specific solutions and services to engage citizens and stakeholders.

- **Campus Transit Laboratory (CTL) and The Ohio State Energy Partners, Columbus, OH:** The CTL develops research on sensors, data collection, and services regulation, among other areas. The OSU Energy Lab launched an experiment to manage the university's heating and cooling systems aiming for higher energy efficiency.
  https://transitlab.osu.edu/campus-transit-lab-0
  http://www.ohiostateenergypartners.com/academic-collaboration/

Introduction

Smart City Trends and Technology

No one industry or city department can be "smart." The definition inherently requires technical connectivity and a systems approach. Technologies that connect with other devices and generate data will be powerful tools to creating a smart city that serves its residents in real-time. Connectivity also enables some capabilities to exist outside of physical devices, in what is known as the cloud. The data collected from these products can be then analyzed to inform decision-making, enable operational efficiencies and continuously improve performance.

Smart technologies have resulted in changes across many industries with implications for the work environment. IoT capabilities have enabled machines to govern themselves which, in turn, frees human workers to achieve greater productivity. The expansion of smart technologies will have direct effects on employment – including job losses and gains in specific occupations. Fortunately, Industry 5.0 is reimagining the emergent human + machine interface to leverage the combination of cognitive computing. Advancements in this fifth revolution promise an expanded role for many workers. Work changes with the expanded role of technology.

The pace of these advancements is ever-increasing while the rate of adoption by smart cities, businesses and industry remains uncertain. Workers will need to acquire new capabilities to keep pace with the jobs of tomorrow. Human skills such as critical thinking, adaptability, the ability to work collaboratively in teams and communication skills are increasingly important. Beyond computer literacy, many workers will also require some knowledge of data analytics and computer programming.

Future of Work

The 10-year economic expansion since the last recession has strained the workforce. The pressure on employers is exacerbated by the demographic shifts the country faces. Fewer young people are entering the workforce, and older workers are spending more years in jobs because they are living longer and are saving less for retirement.

Fixing the workforce shortages in Central Ohio requires a coordinated effort among businesses, employers, educators, nonprofits and government. Many neighborhoods and groups face steep barriers to getting a good job. The geographic availability of jobs across the Columbus Region concentrates employment in specific neighborhoods. Because jobs are concentrated in high-cost areas, workers living in older inner-city areas are further from high growth neighborhoods and jobs. Subgroups, such as residents in public housing, are limited to jobs in neighborhoods they live within – unless the cities can create transportation solutions. Affordable housing is identified as a limit on job growth, especially for communities with obstacles to work such as individuals on public assistance or formerly incarcerated residents. There are other changes our communities will need to confront to ensure that the economic growth continues and is shared among different groups, including access to low- or no-cost education and training.

Workforce Trends

Central Ohio's workforce drivers have changed. Trends associated with demographic changes in Central Ohio are critical to the supply of labor. New industries such as intelligent transportation, grid modernization and electrification are emerging drivers in the region's economy, joining insurance, finance and healthcare. There are some specific technological changes that are relevant to the Smart Columbus ecosystem. For example, intelligent transportation increases the use of hybrid and electric vehicles. There is also potential to increase the use of autonomous vehicles in the region. Secondly, electrification has a major potential impact on the workforce overall. Jobs in battery technology as well as the underlying infrastructure such as charging stations exemplify the realization of Smart Columbus' vision. Shared service transportation also has implications for the broader society as the benefits of sharing electrified vehicles can be spread to different communities. Finally, grid modernization and decarbonization are a major focus for regional utilities. As communities move to alter the production and distribution of the electric grid, this creates opportunities for the workforce system.

Disruption

Industry 4.0 (today's digital, connected, industry) and the smart city create disruption, much like previous industrial and technological revolutions. Economic disruption also creates societal concerns. Today, cities face challenges related to climate, population growth, housing and poverty. New and emerging technology solutions are gaining traction but are still in the chaotic phase of evolution and disruption.

What sets Industry 4.0 apart from previous industrial revolutions? Some are already studying and preparing for Industry 5.0, the coming age of cognitive computing and customization at scale, when our policy, education and economic systems have not yet caught up to current gaps in skills and demographics. For example, electric cars require access to charging stations, such that consumers may wait until a reliable network of charging becomes available before purchasing an electric car. Conversely, automated customer service bots do not require any different or additional infrastructure, as most of society has access to internet-enabled devices, so companies are quickly implementing the technology now that it is more easily available.

The past decade has brought both the emergence of – and in some cases, domination by – companies like Amazon, Apple, Facebook, Uber and Airbnb. Companies must change how they do business or become obsolete in the wake of technological disruptions. The gig economy, the cloud and social media have already resulted in major shifts from traditional job functions and present urgent workforce challenges. One concern raised with rapid technological advancement and innovation is that technology will replace workers, and unemployment will rise. Although particular jobs or job functions may be replaced by technology, the economy as a whole generally responds to technology through growth in other areas.

> *Most new technologies and social innovations are disruptive on their own. The combination of them is even more powerful and creates a 'perfect storm' of disruption.*
>
> *— Deloitte, Smart Cities Report*

Workforce Trends

How Does Technology Impact the Workforce?

Locally, Columbus is using technology in grant program and in the development of the Smart Columbus Operating System, which is designed and built to collect data from a variety of inputs including public, nonprofit, and education-based and private sector contributors. These inputs may come from other systems, devices and people, but all are critical part of building an accessible ecosystem of innovation. To this end, the operating system offers data discovery tools of open data, data visualization and analytics, operational efficiency tools and application programming interfaces (APIs) for developers.

The tools for data-driven decision-making are being used more frequently by cities, non-profits and community members. This increasing use of decision support tools has the potential to increase efficiencies in service provision and the impact of real-time improvement. The specific technology changes that make up smart cities include everything from IoT to machine learning and artificial intelligence (AI) and intelligent transportation. Columbus is not alone in this effort; national leaders and peers, like the Open Mobility Foundation and City of Los Angeles, recognize now is the time for cities to improve the use of technology in the workforce. Cities must develop the data standards and policy environment to encourage the use of technology to improve government services.

IoT allows people to manage smart devices in their homes to make more efficient use of utilities and provide daily conveniences. Industry applications can create a more efficient supply chain, improve safety and equipment conditions and more. IoT allows for devices to communicate both with one another and/or a centralized system as necessary. As the internet becomes more accessible and the cost of technology decreases, the explosive growth of people and things sharing data has occurred.

The workplace has been transformed in complex ways as a result of IoT. For example, information and communications technologies (ICT) allow workers to be productive and connected from anywhere in the world, rather than one central location. Devices have become increasingly portable with cloud computing connecting 24-hours a day, seven-days-a-week. Applications are expanding to include more each day, promising

improvements in every aspect of personal and work lives – from transportation coordination and energy efficiency to healthcare and wearable technology.

What does all of this mean for workers? Individual workers who provide services that are increasingly in demand as part of IoT will thrive. Those workers include those with expertise and credentials in digital security and data analytics. Skills working with robots and artificial intelligence will become more vital. Machines have yet replicate skills such as critical thinking, creativity and social/emotional capabilities. Occupations that include critical thinking will continue to expand, despite the introduction of IoT – because they complement the technical skills. Education and training on how to interface with smart things and services using not only technical skills, but also "human skills," are critical for preparing tomorrow's workforce and the need for the skills will be accelerated by the COVID-19 impacts As businesses transitioned to no contact pick up for retail purchases and food, technology was deployed to minimize and in some cases eliminate interaction between people.

Workforce Trends

AUTOMATION

Automation is the deployment of machines, hardware or software that automates a function, action or process to eliminate the need for human intervention. Automation is happening across industry sectors to varying degrees. While there are well-documented applications and benefits of automation, in its varying degrees, from self-driving vehicle technology, drone delivery or self-check-out at the supermarket, there is cause for concern for the jobs falling by the wayside.

In addition, the demand for particular skills or tasks increases in response to automation. The development and deployment of technology will drive an increase in related jobs, including computer scientists, engineers and IT administrators[i]. Technology also drives a shift away from occupations most susceptible to automation, such as office assistants, accounting, travel workers and cashiers. Central Ohio education providers expect a labor shortage of IT (software development, privacy and security, IT infrastructure), healthcare and skilled trades within the next three years.

Tasks with well-understood procedures are more likely to be computerized[ii]. Tasks that are abstract, or that are manual and not regularized, are difficult to automate. This leads to wage polarization. Finding workers with skills to excel in abstract thinking is difficult, leading employers to pay high wages to those workers.

When planning for a shifting workforce, one important consideration is the pace of adoption for new and disruptive technologies. Technologies affecting multiple sectors generate substantial economic value after years, as innovators take time to adopt new technologies and reconfigure existing work, as well as develop complimentary technologies[iii]. The timeframe of the workforce impacts will depend on the timeframe for adopting new technologies, which depend on the required infrastructure improvements for adoption[iv].

As we learned from COVID-19 crisis, manufacturing and food processing facilities have very close quarters. As businesses prepare resiliency strategies, automation may play a key role in creating social distance between workers while maintaining production capacity.

> *McKinsey predicts that in 60% of occupations, at least one-third of job duties could be automated. The World Economic Forum predicts an increase in freelance work to more than half the workforce. The OECD predicts that those in their teens will be the most at-risk for being put out of work by automation.*
>
> *— Dr. Christine Gulbranson, University of California*

Workforce Trends

ARTIFICIAL INTELLIGENCE, MACHINE LEARNING & DEEP LEARNING

Automation and AI are often used synonymously, but there are key differences between the two. Robotics is a prime example of automation in the workplace, with the term robot referring to "a programmable machine that operates with some element of autonomy and can move around its environment" (International Organization for Standardization, 2012). Increasingly, robots are working with people to perform collaborative tasks; this is called cobotics. Automation, as discussed, aims to create systems or machines that require little to no human intervention. Microsoft defines AI as is a technique that enables computers to mimic human intelligence. AI includes machine learning, which includes deep learning. Machine learning is best applied to tasks that require making a certain decision based on substantial data. Capabilities include image classification, face recognition, document analysis, customer service, forecasting and machine translation. Machines will replace specific tasks, rather than entire occupations[v]. Those occupations that depend on skills can be documented by the use of social intelligence as well as hard skills[vi].

One example of a local firm that focuses on AI is the Columbus start-up Olive, *"the only operational AI technology designed specifically for healthcare. Olive automates healthcare's most robotic processes, so your employees don't have to.* (CITE)" Applying this technology is meant to give employees across the healthcare system time to focus on the quality of care they provide their patients. There is still much to learn about the long-term implications of AI and machine-learning on workforce.

The technologies examined here have broad workforce implications. Disruption is evolutionary, which requires cities to be proactive and agile to stay competitive and serve residents. Rapid advancements in cobotics, machine learning and AI ensure that most jobs will involve some computer-based or automated component. Focus groups and interviews with Central Ohio employers, community leaders and residents revealed that technological disruptions have implications for everyone in both their work and personal lives.

Mechanisms for Big Data to Improve Labor

The following five mechanisms illustrate ways illustrate ways "big data analytics" complement and replace labor[vii]:

- Machines are replacing labor within a variety of physical processes. The most well-known is robots replacing workers in manufacturing, but it also includes things such as check-out kiosks replacing clerks, surveillance equipment replacing security guards and autonomous vehicles replacing drivers.

- Data scientists and software algorithms will replace workers hired for their knowledge or expertise. For example, weather apps are replacing meteorologists, and paralegals can be replaced by legal databases. In fact, machine learning has performed as well or better than pathologists at detecting certain diseases, such that technology could replace tasks of physicians as well[viii].

- Changing infrastructure requirements, such as seamless connectivity, network security, bridge vehicles, and IoT[ix].

- Removal of barriers to entry for many tasks and products have led to mass amateurization, such as journalists being replaced by bloggers.

- Finally, digital is replacing analog, leading to decline of print media and similar industries[x].

> " *We're looking for talent that has the ability to process huge amounts of data. How can we leverage AI in our day-to-day business operations? How do we keep that workforce engaged [and committed to reskilling], knowing that [those jobs might be] just temporary?*
>
> *— Transportation and Electrification Focus Group*

Workforce Trends

INTELLIGENT TRANSPORTATION SYSTEMS

The Smart Columbus initiative accelerates the adoption of new technologies within the regions' transportation sector, creating intelligent transportation systems. These changes will have a distinct impact on the workforce. Electrification of transportation includes a push to replace traditional internal combustion engines with electric motors. Although autonomous vehicles are still rare, cars are becoming more automated including having self-driving capabilities. There are related impacts on the workforce given the need to install sensors that import data to the autonomous vehicle, and the need to develop and maintain the databases and algorithms that use big data to steer or stop based on information generated by sensors.

Electrification

Transitioning vehicles from traditional engines to electric will have a substantial impact on the workforce in the supply chain[xi]. Auto manufacturing requires significant numbers of skilled workers that may not be needed to produce fully electric vehicles. For example, conventional powertrains have as many as 2,000 components, while electric vehicle powertrains have many fewer (17 in the Tesla). Moving to electric vehicles, although a benefit to the environment, may result in fewer workers needed along the supply chain.

While there may be fewer production jobs on automobiles, many of the jobs related to mechanical and materials engineering could be replaced by jobs related to electrification, such as chemical, battery, and software engineering[xii]. Retraining will be required since these jobs have substantially different skill sets. In addition, there are very few university programs that train workers in battery engineering, a skill that is already in short supply.

Finally, there will be a shift in infrastructure, moving from traditional gas stations to developing a network of charging stations[xiii]. The labor force supporting the current infrastructure of gas stations would also need retrained to maintain and support charging stations.

Automation of Transportation

Automation of vehicles impacts the workforce. For a vehicle to operate autonomously, it needs carefully calibrated sensors positioned around the car. Calibration is sensitive, and may be impacted by not only fender benders, but by routine engine repair[xiv]. This advanced skill set will require a shift in job tasks and skills in automotive repair across the board.

In response to the increase in data collected from cars currently on the road in the U.S., "computer systems software engineer" has been the most advertised job opening in the auto supply sector[xv]. This highlights the fact that autonomous vehicles are just an example of IoT and machine learning that is permeating many facets of our economy.

In addition, with the growth in autonomous vehicles, there will be a decrease in taxi, bus and rideshare drivers, but a technician may still be required to monitor autonomous vehicles[xvi].

Shared Service-Centered Transportation

Transportation shifts to either autonomous or shared mobility will create other impacts on services, making space in the market for new goods and services such as advertising and entertainment in-transit. In addition, there will be workforce shifts to support changing infrastructure. For example, smart tolls, traffic flow management, and dynamic road usage pricing represent opportunities to improve services offered under more automation. Finally, mobility management becomes more important where transportation is a service rather than a car. Intermodal travel requires a smooth payment process and in-transit experience[xvii].

> *What is changing so quickly now is that the rapid evolution of mobility models, including business models, and is making it so that the auto companies are re-thinking of themselves as being providers of mobility, not of cars alone, not that cars are not an important part of mobility, they still are.*
>
> *— Transportation and Electrification Focus Group*

Workforce Trends

GRID MODERNIZATION AND DECARBONIZATION

As Smart Columbus and others in Ohio work toward their collective transportation electrification goals, utilities are working to improve and expand the existing electrical grid infrastructure. Utilities are central to ongoing efforts to build a clean energy ecosystem. Technological advancements play a central role in these efforts with implications for the future workforce. In Ohio, the PowerForward initiative provides a roadmap to guide utilities toward a secure and open access platform to interface with customers' applications. Smart grid conversion is a key component of this effort.

A smart grid is an electrical grid that uses various energy and operation measures, including smart appliances, smart meters, and energy efficient and renewable resources. The conversion to smart grid technology uses computing power to improve automation, communication, and connectivity of power network components. American Electric Power (AEP)

Ohio is major partner in the Smart Columbus initiative and committed to investing $175 million to infrastructure improvements. Smart metering is included, as well as expanding EV charging stations, renewable energy options, smart street lighting, and more.

As is the case with most sectors, the energy industry workforce will need to evolve to support new technologies associated with grid modernization, renewable energy work, and innovative power generation and distribution. The industry employs workers with a broad range of education and expertise, from welding to construction trades to engineering. There is a growing demand for computer, HR and engineering talent in our region in this sector, as well as across all industry groups. Expanding the pipeline of available talent in these fields is essential for meeting future demand.

Workforce Trends

Regional Labor Force Trends

The labor force in Central Ohio is expected to shrink over time because of demographic changes. Baby Boomers are retiring. The number of high school graduates is stagnating, and college graduates as a percentage of the population are increasing slowly. The demographic problem is particularly acute in Central Ohio, because the above-average employment growth during the first six years of the most recent expansion far exceeded the growth of the core working-age population. In other words, the total number of working-age people employed in Ohio has increased, while, at the same time, major cohorts of working-age people are exiting the workforce without being replaced. With a limited amount of people left to fill jobs, the region's employment growth has fallen below the national average for the first time in more than a decade. A full explanation of how labor force status is measured is available in Appendix C.

Workforce supply challenges are explained, in part, by trends in labor force participation rates, employment growth, and shifts in the working-age population. The regional trends of historical and projected growth of the working-age population from 2000 to 2035 are shown in Figure 1. Central Ohio's labor force participation rate is higher than the national rate – likely because citizens are younger and more educated on average. However, the pattern of decline in the national rate is mirrored in

Central Ohio's rate, which fell roughly four percentage points between 2000 and 2017[xxi] Total employment in the Columbus MSA increased 21 percent compared to growth of 16 percent nationally in the last decade, but, at the same time, Columbus MSA's population between 16 and 64 years old has only grown by one percent per year on average.

Over the longer term, the baseline projections suggest strong employment demands. However, the consequences of technology are likely to strengthen as well. Many of the occupations with the highest demand are the most likely to be affected by automation, such as customer service representatives, material movers, truck drivers, and team assemblers. The slow growth of the labor force (a nationwide phenomenon, but acutely severe in Ohio) will make automation even more important and cost-effective. Consequently, large-scale disruptions to work and workers are likely. The reskilling of these workers to accommodate emerging workforce needs should thus be a critical priority.

The industries Smart Columbus focuses on in this study includes intelligent transportation and logistics, technology and data centers, healthcare, finance and insurance, grid modernization and decarbonization and others related to smart cities. The breakdown of current employment in these sectors is shown in Figure 2.

FIGURE 1: *Historical and Projected Growth of the Working-Age Population, 2000-2035*
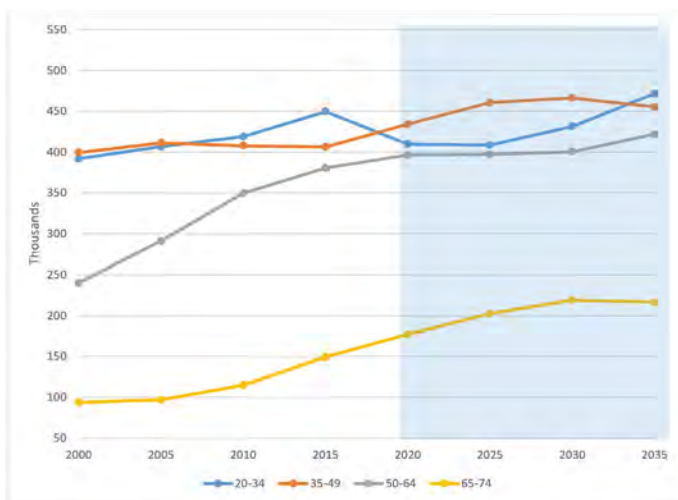
Note: Data points in the shaded area are projections.
Source: Ohio Development Services Agency (2018).

FIGURE 2: *Percent Employment by Industry Group*
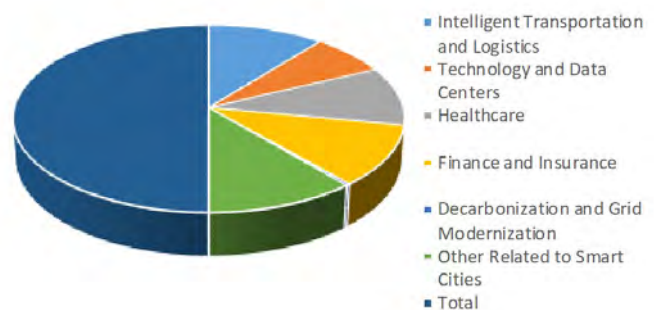
Workforce Trends

DRIVER INDUSTRIES & EMPLOYMENT PROJECTIONS

The economic analysis completed for this project identifies Central Ohio's high concentration industries, the occupations that make up those industries, and the employment outlook at both the industry and occupation level over the next three, five, and ten years. Industry-level employment data for the 11-county One Columbus region were analyzed to identify economic drivers among the 59 industries in transportation, technology, healthcare, finance and insurance, among other important sectors. The analysis identified drivers with increasing concentration and with high and stable concentration, challenged drivers whose concentration is slipping, and one emerging driver that will become a full-fledged driver if its concentration continues to increase.

For industries identified as drivers, Central Ohio is the best place in the country to thrive, and industries related to these driver industries are also likely to grow. A baseline projection of needs for workers in specific occupations within high concentration industries was developed. This analysis is based on national-level, 10-year projections of occupational needs within specific industry groups in the United States Bureau of Labor Statistics (2017). Employment is projected for every occupation in each of the high concentration industries. Projections include three, five, and ten-year timeframes and give estimates of annual job openings by occupation. Table 2 on the following page summarizes the employment forecast and driver industry trends.

> " *Economic drivers are industries with high and increasing employment concentration. This high and increasing concentration of the drivers suggests that the firms in those industries benefit from economic and environmental characteristics that make the firms in that industry more successful than their counterparts elsewhere.*
>
> *— quote attributer*
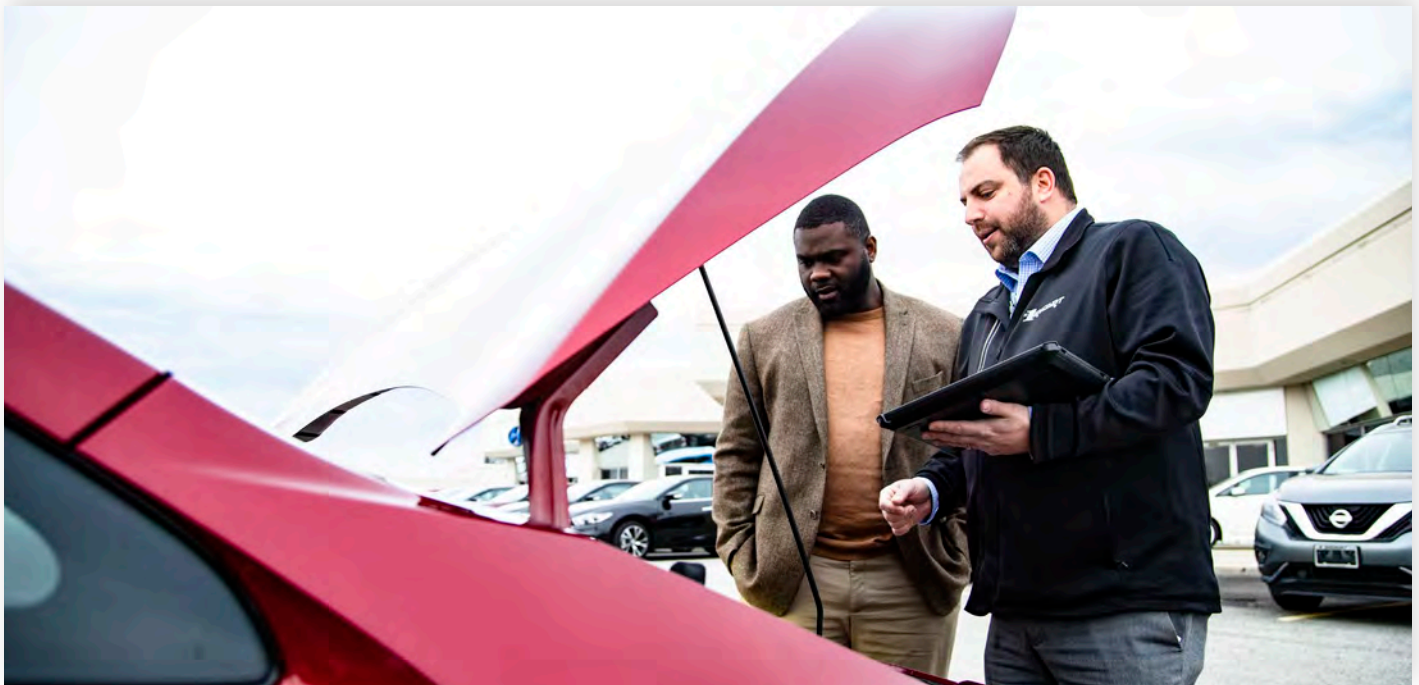
Workforce Trends

TABLE 2: *3-, 5- & 10-Year Employment Forecast for Key Industries*

INDUSTRY	EMPLOYMENT 2017	EMPLOYMENT CONCENTRATION		PROJECTED GROWTH		
		LQ 2017*	TREND**	2019/2022	2019/2024	2019/2029
INTELLIGENT TRANSPORTATION AND LOGISTICS						
General freight trucking	16,313	2.10	1.00	-1%	2%	4%
Warehousing and storage	14,335	1.81	1.00	-7%	2%	4%
Motor vehicle parts manufacturing	11,033	2.41	1.00	-7%	-1%	-1%
Nonscheduled air transportation	4,197	12.44	0.50	-5%	3%	5%
Freight transportation arrangement	2,007	1.19	-	-6%	1%	3%
Motor vehicle manufacturing	9,844	5.68	-	-4%	-1%	-1%
Couriers and express delivery service	5,456	1.18	0.79	-8%	-1%	-2%
Urban transit systems	1,243	0.66	0.79	19%	34%	79%
TECHNOLOGY AND DATA CENTERS						
Scientific research and development services	7,188	1.41	1.00	-4%	3%	6%
Specialized design services	2,256	2.07	1.00	-3%	5%	11%
Telecommunications	12,452	2.06	0.50	-7%	-6%	-12%
Data processing, hosting, and related services	2,693	1.11	-	-4%	5%	10%
Computer systems design and related services	13,375	0.84	-	-3%	6%	12%
HEALTHCARE						
General medical and surgical hospitals	44,912	1.24	1.00	-4%	2%	5%
Offices of physicians	20,750	1.04	-	-1%	17%	38%
FINANCE AND INSURANCE						
Activities related to credit intermediation	8,212	3.43	1.00	-5%	1%	2%
Insurance carriers	23,981	2.63	0.50	-3%	2%	4%
Direct insurance (except life, health, and medical) carriers	16,036	3.80	0.50	-4%	2%	4%
Agencies, brokerages, and other insurance-related activities	12,083	1.37	0.50	-4%	2%	4%
Direct life, health, and medical insurance carriers	7,923	1.69	0.50	-4%	2%	4%
Depository credit intermediation	14,021	1.06	-	-4%	1%	2%
OTHER RELATED TO SMART CITIES						
Employment services	39,576	1.44	0.50	-2%	6%	12%
Management of companies and enterprises	36,748	2.08	-	0%	4%	9%
Business support services	8,015	1.14	-	-4%	3%	7%

Concentrations are measured by location quotients (see Appendix)
*** Trend of employment concentration compared to the national average using location quotients*

Driver Industries: High and increasing employment concentration	Stable Industries: High but stable employment concentration	Challenged Industries: High but declining employment concentration	Emerging Industries: Low but increasing employment concentration	Others

Workforce Trends

DRIVER INDUSTRIES & EMPLOYMENT PROJECTIONS (CONT.)

Table 3, below, presents the results of an analysis of the distribution of occupations by industry group—including some not featured in Table 2—and the potential for disruption from automation by occupation. It shows the top ten most common occupations by employment percentage for the following industry groups: Intelligent transportation and logistics, technology and data centers, finance and insurance, management of companies and enterprises, healthcare, and other industries related to smart city economies. Each occupation's probability of computerization[xvii] is indicated, which estimates the degree to which an occupation's tasks and responsibilities could be automated using new technologies.

Gray shaded cells in the table represent occupations whose probability of computerization is above 50 percent. Twenty-nine of the 60 occupations, which represent the highest share of employment in the six industry groups considered, have above a 50 percent chance of computerization. This includes more than half of the top ten occupations in intelligent transportation and logistics, finance and insurance, and other industries related to smart cities industry groups. The intelligent transportation and logistics industry group appears most at risk with eight of 10 cells shaded gray, while healthcare and technology and data centers groups seem to be the most insulated from automation with only two of 10 cells shaded gray. Table 3 makes it clear that changes in technology and advances in automation will impact the demand for skills and workers, especially in Central Ohio.

TABLE 3: *Top 10 Occupations by Industry Group*

OCCUPATION	PROBABILITY OF COMPUTERIZATION	% OF TOTAL EMPLOYMENT
INTELLIGENT TRANSPORTATION AND LOGISTICS		
Heavy and tractor-trailer truck drivers	0.79	14.0%
Laborers and freight, stock, and material movers, hand	0.85	7.2%
Light truck or delivery services drivers	0.69	3.3%
Industrial truck and tractor operators	0.93	3.1%
Cleaners of vehicles and equipment	0.37	2.6%
Retail salespersons	0.92	2.4%
Office clerks, general	0.96	2.0%
Stock clerks and order fillers	0.64	1.8%
General and operations managers	0.16	1.4%
Bus and truck mechanics and diesel engine specialists	0.73	1.3%
% of sector's total employment		**39.2%**
TECHNOLOGY AND DATA CENTERS		
Software developers, applications	0.04	5.3%
Telecommunications equipment installers and repairers, except line installers	0.36	4.4%
Customer service representatives	0.55	4.1%
Sales representatives, services, all other	n.a	3.8%
General and operations managers	0.16	2.9%
Computer systems analysts	0.01	2.7%
Computer user support specialists	n.a	2.6%
Software developers, systems software	0.13	2.5%
Office clerks, general	0.96	2.3%
Business operations specialists, all other	0.23	2.0%
% of sector's total employment		**32.5%**
FINANCE AND INSURANCE		
Customer service representatives	0.55	11.1%
Insurance sales agents	0.92	7.1%
Insurance claims and policy processing clerks	0.98	6.5%
Claims adjusters, examiners, and investigators	0.98	6.1%
Tellers	0.98	4.3%
First-line supervisors of office and administrative support workers	0.01	3.3%
Securities, commodities, and financial services sales agents	0.02	3.3%
Loan officers	0.98	2.9%
Insurance underwriters	0.99	2.7%
Financial managers	0.069	2.7%
% of sector's total employment		**50.1%**

OCCUPATION	PROBABILITY OF COMPUTERIZATION	% OF TOTAL EMPLOYMENT
MANAGEMENT OF COMPANIES AND ENTERPRISES		
Customer service representatives	0.55	4.3%
Accountants and auditors	0.94	4.1%
General and operations managers	0.16	3.9%
Bookkeeping, accounting, and auditing clerks	0.98	3.3%
Business operations specialists, all other	0.23	2.9%
Financial managers	0.069	2.9%
Computer systems analysts	0.01	2.3%
Market research analysts and marketing specialists	0.61	2.3%
First-line supervisors of office and administrative support workers	0.01	2.2%
Software developers, applications	0.042	2.0%
Office clerks, general	0.96	2.0%
% of sector's total employment		**32.2%**
HEALTHCARE		
Registered nurses	n.a	18.9%
Medical assistants	0.3	5.4%
Medical secretaries	0.81	4.4%
Nursing assistants	n.a	3.9%
Receptionists and information clerks	0.96	3.8%
Physicians and surgeons, all other	n.a	3.0%
Office clerks, general	0.96	2.0%
Licensed practical and licensed vocational nurses	0.06	1.9%
Medical and health services managers	0.01	1.9%
Radiologic technologists	n.a	1.7%
% of sector's total employment		**46.9%**
OTHER RELATED TO SMART CITIES		
Laborers and freight, stock, and material movers, hand	0.85	11.4%
Customer service representatives	0.55	7.0%
Office clerks, general	0.96	3.5%
Packers and packagers, hand	0.38	2.5%
Human resources specialists	n.a	2.0%
Helpers--production workers	0.66	1.9%
Secretaries and administrative assistants, except legal, medical, and executive	0.96	1.9%
Telemarketers	0.99	1.6%
Production workers, all other	n.a	1.5%
Registered nurses	n.a	1.3%
% of sector's total employment		**34.7%**

Workforce Trends

Future Work: Listening to Stakeholders

The OERC conducted interviews and focus groups with more than 50 stakeholders representing employers, community leaders, and educators from throughout the region to learn more about the future of work from their unique perspectives. OERC also held community listening sessions to hear from residents and those working in two communities considered to be at risk of being left behind – the Linden neighborhood in northeast Columbus and the Reeb-Hosack neighborhood on the city's Southside. Knowledge and insights gained from nine focus groups and additional individual interviews inform the key findings and policy recommendations contained within this report. Framing questions for this effort addressed topics ranging from anticipated disruptions, how the region will attract and retain talent, core competencies and career paths for future workers, and who is at risk of being left behind. The interview and focus group protocols are available in Appendix D.

The common themes that emerged from all groups are detailed below. There was consensus that the ability to work collaboratively on teams is increasingly critical to ensuring quality in systems that increasingly rely upon artificial intelligence, machine learning and data analytics to make decisions and increase productivity and efficiency. Overall, stakeholders believe that it is much less likely that machines will replace workers in most workplaces than it is that they will provide support that will boost positive outcomes, increase quality, and open possibilities for advancements. The shared hope is that smart city advancements will earn the region a reputation for being highly innovative and competitive, while having strong values that strive to leave no one behind. Stakeholders envision that a smart city will benefit the entire community – not just those working in certain occupations.

IDENTIFYING NEEDS

The stakeholder engagement portion of the study began with gap analysis conducted by the study team (see Appendix E for detailed results). The analysis reveals that the workforce development system will be challenged to meet a wide range of education, training, and credentialing needs within the region over the next 10 years. Programs that deliver software development, nursing, truck driving (CDL), insurance sales representative and medical assisting are needed, as well as basic-level training for low-skill jobs. These include job readiness and skills training for business operations specialists, front line supervisors (nonmedical), and customer service representatives. In the counties surrounding Franklin County in the region, the manufacturing industry currently struggles to find the skilled labor needed to fill vacancies. These findings were shared with stakeholder groups, who reported that strengthening the education and training pipeline preparing future workers is a major priority for all industry sectors considered. Stakeholders report that innovative new public-private partnerships are showing positive outcomes and serve as promising practices for achieving this goal. Various grant funding sources are helpful in getting programs off the ground, but stakeholders recognize the need to build programs with sustainable designs so that they can thrive even after initial funding expires.

The analysis found that eight of the 25 occupations having the greatest demand over the next decade require little more than a high school diploma or

GED. Most of these jobs are highly vulnerable to labor market disruptions that may result from technological advancements and innovation. Given the expected rapid pace of these disruptions occurring from the combined effects of a possible recession, and the impacts of IoT, machine learning and artificial intelligence in the workplace, stakeholders identified a critical need, that the current system of education and training connect affected workers with transitional resources to ensure their resilience and continued employment. Stakeholders, particularly employers, recommend scaling up successful programs, such as career pathways, and implementing low- or no-cost upskilling and reskilling options to proactively ensure that all residents in the region benefit from future opportunities, will help to ensure a strong regional workforce.

Workforce Trends

CENTRAL OHIO IDENTITY

Stakeholders shared a wide range of ideas when asked what will attract and retain talent needed to meet the future workforce demand in our region. There was consensus that the Smart Columbus initiative and its related activities are an asset to the region's brand. The "Columbus Way" was also highlighted as an underlying spirit or culture that provides a foundation for collaborative action necessary for reaching common regional development goals.

What are the things that can drive us forward that makes us unique? The collaborative nature of Columbus or the Columbus Way... [this] collaborative nature is a real thing - and that's unique.

— Visionaries Focus Group

The effective use of "big data" (administrative data) and predictive analytics to improve the effectiveness and efficiently leverage the resources of our region's human resources, human services, and workforce development system was also a common theme in group discussions. The Ohio State University was recognized as a major asset and is recognized for increasing the number of doctoral level workers in our community, many of whom have secured patents for their inventions. The region's growing reputation for fostering entrepreneurism as a hub for innovation was highlighted as a trend that will bode well for the region. Rev1, Columbus Idea Foundry, and The Point at Otterbein are all examples of the expansion of maker spaces and incubators available to support those hoping to turn their innovative ideas into new products or businesses.

I think a capability is to be recognized as being able to be fertile soil and an incubator that has all the infrastructure that can allow the next thing to spring forth.

— Other Industries Focus Group

So, if you look at the benchmark report that comes out every two years for Central Ohio comparisons against 20 some other peer cities, we're always in the top third, and usually right at the top for research doctorates and other indicators of smart people here."

— Visionaries Focus Group

Workforce Trends

NEW CAREER PATHWAYS

All stakeholder groups recognized the importance of scaling up current efforts to build strong, collaborative, public- private partnerships to create career pathways programs. This is a critical strategy for expanding programs available in the region to prepare the future workforce for in-demand jobs. As well, stakeholders believe that career paths should focus on the progression of building skills, rather than acquiring credentials. They believe that it is critical to foster a culture that motivates students to pursue in-demand career paths that provide long-term return on their investment, rather than jobs that emphasizes short-term income gains achieved at lower education attainment levels.

> **Skill progressions, or knowledge pathways, are non-traditional pathways where employers and workers establish employment relationships based on skills.**

Liberal arts-related career pathways are also considered to be essential for preparing tomorrow's workforce and will require specific training in technical skills, such as coding certificate programs. Looking ahead, opportunities requiring uniquely human skills (not easily replicated by machines) will include education, mental health, social work, marketing, internet content development, product experience design, management, and medical careers. Stakeholders identified a need for a multidisciplinary approach in designing effective education and training programs. Future jobs will require the integration of knowledge from various fields of study.

I think we want to start to think about where can we be most efficient at providing individuals with those skills. Is it most efficient to in the classroom through formal education and training - train on the soft skills or the people skills? Or is it more efficient to be in the classroom training on the hard skills and allow the experience to develop the non-technical skills? I think where a lot of progress is being made is where we're looking at those four categories, kind of as a continuum. And we're blending training, education, and experience, knowing that you're going to pick up pieces of the technical skills and in the soft skills from both your formal training and from your on-the-job experience.

— *Other Industries Focus Group*

Training the medical students as the future doctors and researchers and scientists, we also are looking more holistically... So building curriculum that allows a medical student to focus on public health policy specifically, or dual degrees, and multiple of those health sciences areas and social work. And... those are really how we're thinking about training our next generation.

— *Other Industries Focus Group*

Workforce Trends

BUILDING A RESILIENT WORKFORCE

We learned that stakeholders believe that careers will no longer be built around the traditional model of obtaining a four-year college degree then staying on a single career path for the entire career trajectory - culminating in retirement from a single firm after 40 years. Stakeholders shared the belief that the new workplace reality requires adaptability, continuous learning, cross training, and social skills for working collaboratively on interdisciplinary, diverse teams. All workers will require a baseline level of technical and computer competency with transferrable skills to increase resiliency when disruptions occur that require job or industry changes. The growth of the app-driven gig economy requires flexible approaches to upskilling and reskilling rather than the current, more fixed approach.

> *There's an opportunity to think about having more bite-size, follow-up training. So particularly people [who] are looking to shift in what sort of business sector that they're working in [they] don't need to have a full two-year degree or a four-year degree or a master's degree, but that there's smaller chunks of retooling that you can do that's available from advanced education institutes to meet that need.*
>
> *— Visionaries Focus Group*

Stakeholders emphasized the importance of destigmatizing skilled trade careers and encouraging students, especially underrepresented minorities, to pursue vocational education when their interests and abilities are well aligned with these career opportunities.

> *I think...the adage, 'you can't be what...you don't see,' is...clear and present in what's happening in the trades... And when we start messaging with our actions that we want these folks, then it will start to tell a different story about [trades] being a real pathway.*
>
> *— Community Leaders Focus Group*

> *One of the biggest things during the Linden planning process that we heard directly from students was that they want to see more career-ready opportunities while in high school.*
>
> *— Community Leaders Focus Group*

Workforce Trends

BUILDING A RESILIENT WORKFORCE (CONT.)

Stakeholders identified core competencies or skills that all workers will need to ensure success in the future workforce. Some of these are commonly referred to as "soft" skills but have become essential to fulfilling the uniquely human contribution to the workplace. They believe that rapid advancements in cobotics, machine learning and AI ensure that most all jobs will involve some computer-based or automated component. Socializing workers to this new reality will require reducing fear of obsolescence and job destruction and increasing their familiarity with the benefits and increased productivity that are to be gained. Specifically, the "human skills" that stakeholders identified as those the workforce of tomorrow must have are:

- Adaptability/resiliency
- Business operations
- Creative thinking
- Coding and programming, with continuous updates
- Communication/information technology
- Communication skills
- Critical thinking
- Data analytics
- Digital literacy
- Emotional intelligence
- Evidence-based decision making
- Interpersonal skills
- Lifelong (continuous) learning and skills development
- Mental agility
- Numeracy
- Personal finance
- Problem solving
- Professional agency/skills (build resumes, cover letters, interview, elevator pitch, networking)
- Teamwork/collaboration
- Virtual Applications

Employers report that project teams are often comprised of interdisciplinary groups that bring diverse perspectives to find evidence-based solutions to complex problems. Employers value liberal arts majors for their critical thinking, communication, leadership, and creative skills and abilities, and are often found leading highly technical teams in business and industry. Some basic coding, data analytics, and problem-based learning will also be needed to prepare these graduates for success in high-demand occupations across industries. Likewise, providing STEM (Science, Technology, Engineering and Math) majors with basic communication, leadership, and project management skills improves their performance on workplace teams. Both STEM career paths and liberal arts career paths are required in the future workforce.

Employers report using individualized skills assessments for workers whose jobs are at risk of becoming obsolete when disruptions occur will help to identify promising careers that fit best with their interests, values, and capabilities. Employer-supported programs that connect workers with opportunities for reskilling and upskilling, both in-house and in partnership with education and training providers, are critical. Removing structural barriers to facilitate these efforts is also key.

> *Staying exclusively in that technical track is not going to be putting us at the table as the leaders, but being able to bring in those links tohuman and social behavior, the sociology aspects, the policy pieces, is really a critical part of the training so that, we're bringing, well rounded, technologically savvy people to the workplace.*
>
> *— Education & Training Providers Focus Group*

Workforce Trends

AT RISK OF BEING LEFT BEHIND

Stakeholders largely agreed that the following groups are at the greatest risk of being left behind as workforce disruptions occur in the wake of innovation and technological advancements:

- Communities of color
- Disengaged youth - not working or in school Homeless
- Economically disadvantaged; especially those with barriers to transportation and childcare
- Ex-offenders (especially felons and females)
- High school dropouts
- Immigrants and refugees (non -English speakers)
- Incarcerated individuals
- Individuals who are illiterate or have low literacy skills
- Mature workers (50+ years of age)
- Students in under-funded, under-resourced K-12 school districts Technology/computer illiterate
- Those who are not "adaptable" to new workplace demands
- Those with barriers to work that are hidden or difficult to assess

Across groups, a key strategy identified for strengthening the region's future workforce is to provide support systems and access to opportunities for those who are disadvantaged and lack work-based benefits. This includes removing barriers created by the lack of affordable and convenient transportation, childcare, housing, healthcare, food, and other basic needs.

Benefits cliff effect occurs when work support eligibility levels cut off in way that makes pay increases negatively impact the family's total income level.

Sliding eligibility scales and wraparound services are recommended to combat the benefits cliff effect. For example, a pay increase of a nickel an hour can lead to the loss of childcare assistance benefits. Many workers turn down opportunities for promotion or advancement because they "know their numbers" and cannot afford to lose income needed to pay for childcare and other benefits.

> *Are we leaving people behind? Yes. Is that an issue? Absolutely. And It's both. It's both an issue but an opportunity...How can we work together [...] and address those issues for re-entry populations? How much of it is breaking down... stereotypes about those populations? How much of it is removing systematic barriers? How much of it is, you know, policy change? Or, is it just a mindset change? It's probably all of those things.*
>
> *— Transportation and Electrification Focus Group*

There was a recognition that many workers struggle to meet basic needs and save for retirement. They believe that more "real opportunities" are needed with jobs paying a living wage and providing benefits. Moreover, efforts to remove stigmas associated with targeted programs and investments will help to advance these populations in the workforce. Educating employers about the benefits of hiring "non-traditional" workers such as mature workers, disabled workers, ex-offenders, and others struggling to enter the workforce is recognized as a key strategy to meet future workforce demand.

> *...As governments and communities, [we] have to think about...our real responsibility to folks through this transition to keep them whole. What is our real social contract with people through a revolution like we're about to go through? What is our responsibility to the workforce?*
>
> *— Community Leaders Focus Group*

Workforce Trends

REACHING UNDERSERVED COMMUNITIES

Community listening sessions in traditionally under-served communities were a critical component of the stakeholder feedback portion of the study. These sessions were designed to engage people of color, and individuals living in poverty and the inner city. The Smart Columbus initiative aims to improve quality of life for these residents in particular, by improving their access to mobility so that they may better access opportunity in the form of jobs, healthcare, education, and more. Having access to these innovations and advancements is a matter of equity and an opportunity to narrow current disparities.

Many community stakeholders voiced their frustration over the focus on credentials as the only measure of skills, knowledge and abilities. Not having a GED or high school diploma is often a barrier to success.

> *All people really want is to earn money to provide for their families which gives them dignity, self-worth, and earns them respect. If there are opportunities to do this legally, they likely will.*
>
> — *Linden Neighborhood Focus Group*

> *You go on the computer, [and the] first thing it says: "Give me your GED or high-school diploma." [I] do not have it. So, what's…OhioMeansJobs got? Because, if I ain't talking to you face to face, person to person, and [then] you know I [(have knowledge and experience working machinery], then it's not worth a damn in your life.*
>
> — *Southside Neighborhood Focus Group*

Leveraging trust relationships within the community and using word of mouth rather than television and print media to spread the word about available smart city resources is recommended by those we spoke with in disadvantaged communities. We learned that many residents who are the target audience do not engage with these information sources. These stakeholders believe that using trusted community members as intermediaries will increase residents' engagement with available employment and education opportunities.

> *It's about trust before you can bring anything. If you bring something into a community and people don't understand what you're bringing, that brings fears to anybody. The first thing they do is get defensive and I don't know if I want to be a part of this, I don't know if I want to be a part of that. So before you can bring in any information, you have to get an avenue, get some trust for the people to expect that you're really trying to help or trying to bring them into something that's going to help.*
>
> — *Linden Neighborhood Focus Group*

Workforce Trends

REACHING UNDERSERVED COMMUNITIES (CONT.)

Development and a lack of affordable housing threatens residents' ability to balance housing costs with the costs of other basic needs. This need was recognized across focus groups as a threat to the continued growth and development of the region. Residents feel cut off from opportunity by both geography and "red tape." Limited public transportation limits access to health services as well as employment and educational opportunities. Complex processes, assessments, and information that is not communicated in a way that residents can understand prevent community members from accessing services. This includes those services that would improve employment prospects.

> *They're raising the rent, kicking good people like us out, because we can't afford it, and the drug dealers and thugs are moving in, because they can afford it. Good people like us that don't do drugs is out here on the street.*
>
> — *Southside Neighborhood Focus Group*

> *You are doing economic development, but the economic development does not include lifting the people up that live here. And, in order to have hope for Linden, you have to provide them something that is only to keep the residents, whether educated or not.*
>
> — *Linden Neighborhood Focus Group*

> *When they're talking about housing affordability, and we know it's a real issue, they're looking at it not just as an issue that we make sure everyone has affordable housing. Of course, we're interested in that. But, looking at it from an economic development perspective, that this is something that could constrain our success as a region. And, we don't have enough housing to pay for workforce employees to afford reasonable housing. And, if people feel like they are paying too much for housing, it's going to be a reason not to move here and to move to more affordable markets."*
>
> — *Visionaries Focus Group*
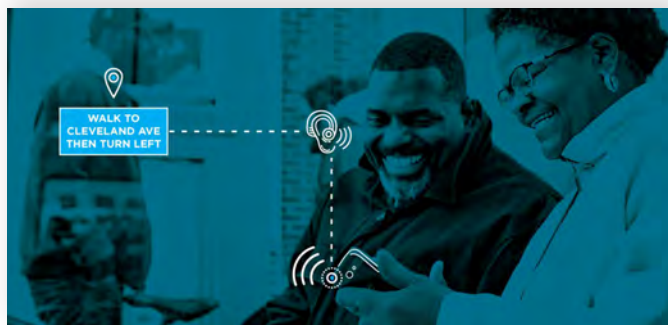
Many residents expressed that their basic needs (housing, food, healthcare, transportation, and safety) must be met before they, and others in their communities, are prepared to succeed in their pursuit of education and employment opportunities. Expanding available resources for those struggling with mental health and addiction issues was also mentioned as a critical factor for improving workforce outcomes. They also see the need for positive community activities for engaging residents as alternatives to turning to drugs and alcohol as sources of entertainment.

> *Some people are ex-drug addicts that can't get a job. A lot of [drug addicts] that told me…'we would go to rehab and get methadone…if we had a ride to it, but they will not provide us a ride.' If you try to use your Medicaid for it – they'll give you a ride to any other doctor's appointment, but they will not give you a ride to the methadone clinic. That is a very big issue. I've heard a lot of people…say, 'I would get off drugs if I had a ride there every day.*
>
> — *Southside Neighborhood Focus Group*

> *"[Despite all of the development], you've got to clean up the inner part of this neighborhood. I see drugs when I open my door. I see people getting shot when I open my door. I do not want my children to see this. I was raised here; I want my children to be raised here…I don't want to leave, because my heart is here.*
>
> — *Southside Neighborhood Focus Group*

Policy Recommendations

This report offers policy recommendations in two areas: the education system and workforce development. Ensuring that the overall education system improves access and achievement in the larger education system is a precursor for more specific advances for the workforce development system. The Workforce Development Board must grapple with difficult issues that are central to K-12 education, such as school funding and achievement, as well as complexities that arise when adults lack basic skills or have significant barriers to education. This perspective might be thought of from the lens of community improvement broadly as opposed to just workforce development. Ensuring that workers have access to housing and overcome barriers to employment is just as important as the narrower goal of skills development. Becoming successful for the Future of Smart Work requires a wide range of strategic changes.

Education System

1. Improve access to short-term credentials designed to speed the "on-road" for both education and undereducated workers.

2. Expand opportunities for employers to meet needs for new credentials through competency-based training.

1. Develop the institutional infrastructure to integrate learning with work for the entry-level workforce, through apprenticeships or work-based learning in career and technical education.

2. Build additional youth exposure to work, further reducing the stigma of education for careers.

Workforce System

1. Engineer the workforce development system to focus on both incumbent and new workforce by expanding partnerships with K-12 sector and building on work with firms.

2. Increase the deliberate use of education and workforce data to make decisions about the effectiveness of local policies designed to improve the workforce system.

3. Establish workforce development programs that deliberately train for future career opportunities.

Conclusion

An extensive survey of best practices among workforce development system initiatives in smart cities around the world reveals that such initiatives are not very common. Of those that do exist, the strategies they employ tend to be concentrated on extending population's digital skills, inclusion, and awareness of the public and developing their hard infrastructure in the form of educational and social facilities, and not on talent development for individuals affected by ICT implementation.

The economic analysis results suggest that several industries that have been mainstays of Central Ohio's growth for decades, such as corporate managing offices and motor vehicle manufacturing, have lagged recently in employment growth, as shown in Table 1. Meanwhile, other industries, such as those in insurance, are achieving only average growth. Although no industry can grow at an above-average rate forever, the reasons *for* these shifting patterns of growth should be explored in more detail.

A number of projects in U.S. smart cities, including Columbus, are identified as having workforce development-related best practices. These smart cities provide platforms for engaging citizens and stakeholders, and for evaluating services' viability in real-life contexts. Overall, smart cities benefit widely from the development of inclusive communities that face the challenges of technological change. Specially, the skills gap between future jobs and the available workforce.

Knowledge and insights gained from stakeholder engagement activities informed key findings and policy recommendations addressing a range of workforce issues. Core competencies future workers must acquire to ensure resiliency in the face of constant change resulting from technological advancements and innovation were identified. These so-called human skills require an interdisciplinary approach that ensures that STEM-based programs teach liberal arts basics, while liberal arts, humanities, and social science students are equipped with coding and data analytics skills. The future workforce does not require a focus on either STEM or non-STEM knowledge, skills and abilities (KSAs), but rather both. The ability to work collaboratively on teams is increasingly critical as humans strive to ensure quality in systems that increasingly rely upon artificial intelligence, machine learning, and data analytics to make decisions and increase productivity and efficiency. The conclusion reached is that it is much less likely that machines will replace workers altogether in most workplaces than it is that they will provide support that will boost positive outcomes and increase quality in a manner that opens up endless possibilities for advancements. The hope is that these advancements will earn the region a reputation for being highly innovative and competitive, yet having strong values that strive to leave no one behind and use these advancements for the benefit of the entire community – not just those working in certain occupations.

The results of the gap analysis completed in the second phase of this project reveal that the workforce development system must meet a wide range of education, training, and credentialing needs within the region over the next 10 years. Programs that deliver software development, nursing, truck driving (CDL), insurance sales representative, and medical assisting skills are needed, as well as basic level training for low-skill jobs. These include job readiness and skills training for business operations specialists, front line supervisors (nonmedical), and customer service representatives. In the counties surrounding Franklin County in the region, the manufacturing industry currently struggles to find the skilled labor needed to fill vacancies. Strengthening the education and training pipeline preparing future workers is a major priority for all industry sectors considered. Innovative new public-private partnerships are showing positive outcomes and serve as promising practices for achieving this goal. Various grant funding sources are helpful in getting programs off the ground, but stakeholders recognize the need to build programs with sustainable designs so that they are able to thrive even after initial funding expires.

Eight of the 25 occupations having the greatest demand over the next decade require little more than a high school diploma or GED. As well, the majority of these jobs are highly vulnerable to disruptions in the labor market caused by automation and technological advancements. Given the accelerated pace of labor market, disruptions expected to occur from the combined effects of a recession and exponential growth of IoT, machine learning, and artificial intelligence in the workplace, it is critical that the system connect at-risk workers with transitional resources to ensure their resilience and continued employment. Scaling up successful programs, such as career pathways, and implementing low- or no-cost upskilling and reskilling options to proactively ensure that all residents in the region benefit from future opportunities, will help to ensure a strong regional workforce.

Definitions

Big Data: Generation of infinite, unstructured data from different sources that possess diverse characteristics (Okwechime, Duncan, & David, 2018).

Connected and Autonomous Vehicles: These fall under the umbrella of intelligent transportation systems. Connected vehicles share data with infrastructure and other vehicles electronically. Automated vehicles take connected technology a step further by using the data collected by sensors to control the vehicle, eliminating or modifying the need for a human driver.

Decarbonization: Strategy for reducing carbon emissions and their harmful outcomes by replacing fossil fuels with renewable sources of energy.

Electrification: Transforming heating, water heating, and transportation to electric power. In concert with decarbonization efforts at the energy source, electrification is also a decarbonization strategy.

Grid Modernization/Smart Grid: The U.S. Department of Energy has a very specific definition of the goals of grid modernization[1]. However, a smart grid is a result of grid modernization that enables achievement of sector goals and sustainability goals. Typically, a smart grid includes improved intelligent electronic devices that enable efficient energy distribution. Further, upgraded technology often allows automatic and remote operation of distribution equipment.

Intelligent Infrastructure: Public infrastructure that includes sensors and smart devices (IoT) that capture data and use that data in an intelligent infrastructure management system. These government systems seek to monitor infrastructure such as roads, drainage systems, or even the grid in real time, as well as predict the need for improvements in the future (Forbes, 2019).

Internet of Things: In its most basic form, this means connecting any device to the Internet. The decreasing cost of connecting to the Internet, as well as general decreasing technology costs, allows the explosion of people and things sharing data (Morgan, 2014).

Intelligent Transportation: Transportation that includes sensors and smart devices in vehicles and other transportation infrastructure. It is a specific example of intelligent infrastructure, but also includes collecting data from individual vehicles. The U.S. Department of Transportation has a specific definition of what they call "Intelligent Transportation Systems."[2]

Knowledge Ecosystem: "A complex and many-faceted system of people, institutions, organizations, technologies, and processes, by which knowledge is created, interpreted, distributed, absorbed, and utilized. It is a specific community of interacting individuals in a particular environment or habitat" (Angelidou, Gountaras, & Tarani, 2012).

Living Lab: Open and real-life environments involving citizens in the co-creation of user innovation of products or services. It is employed for learning, conducting tests and research for the implementation of new technologies and services of organizations in large-scale real-life environments (Bakıcı et al., 2013).

Machine Learning: Specific subset of Artificial Intelligence that trains a machine how to learn by using training data sets. All of the data collected from IoT, Intelligent Infrastructure, Intelligent Transportation, and other sources can be used by computers to predict future needs and make decisions.

Smart city: One which ties together data, information technology, connectivity, interactivity, transportation, communications, and other civic services into a more seamless living experience within a community. This approach holds powerful potential to create a positive impact on urban planning, economic development, delivery of services, utilization of resources, and overall quality of life (Smart Columbus, 2019).

Startup Accelerator: "Accelerator programs are programs of limited-duration—lasting about three months—that help cohorts of startups with the new venture process. They usually provide a small amount of seed capital, plus working space" (Cohen, 2013).

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[1] "The Grid Modernization Initiative (GMI) works across the U.S. Department of Energy (DOE) to create the modern grid of the future. A modern grid must have:
- Greater RESILIENCE to hazards of all types
- Improved RELIABILITY for everyday operations
- Enhanced SECURITY from an increasing and evolving number of threats
- Additional AFFORDABILITY to maintain our economic prosperity
- Superior FLEXIBILITY to respond to the variability and uncertainty of conditions at one or more timescales, including a range of energy futures
- Increased SUSTAINABILITY through energy-efficient and renewable resources."
https://www.energy.gov/grid-modernization-initiative

[2] "Intelligent Transportation Systems (ITS) technologies advance transportation safety and mobility and enhance American productivity by integrating advanced communications technologies into transportation infrastructure and into vehicles. ITS encompasses a broad range of wireless and traditional communications-based information and electronic technologies."
https://www.its.dot.gov/factsheets/benefits_factsheet.htm

Appendices

Appendix A — Research Methods

ECONOMIC ASSUMPTIONS AND INDUSTRY EMPLOYMENT PROJECTIONS

The analysis requires projections of industry employment for 2019, 2022, 2024, and 2029 from the 2017 employment totals in Table C-1. Because only the drivers are analyzed, projections are only needed for these industries. However, three other non-driver industries with especially high employment totals are also included. These are depository credit intermediation (NAICS 5221), computer systems design, and related services (NAICS 5415), and offices of physicians (NAICS 6211). The 2019 projections are derived by calculating the growth in each industry during 2017 and projecting this growth forward based on the 2018 preliminary regional employment growth of 1.3 percent from United States Bureau of Labor Statistics (2019e) and the 2019 employment growth of 1.2 percent in the Regionomics (2019) forecast.

The 2029 employment projections are derived by applying the 10-year projections for the Central Ohio JobsOhio region from the Ohio Department of Job and Family Services (2017b), supplemented by projections for the Columbus MSA from the Ohio Department of Job and Family Services (2017a) in cases where the JobsOhio regional projections were not reported. The base 2022 and 2024 projections assume a constant annual rate of growth.

Economists generally consider a recession likely within the 3-year time period; this would impact the at least the 2022 employment totals. Although the length and severity of a recession cannot be forecast, a recession can be modeled. Economists surveyed by the Federal Reserve Bank of Philadelphia (2019) on average assign less than a 20 percent probability to a down quarter in gross domestic product before the second quarter of 2020, and only a 23 percent probability in that quarter. Thus, a recession before late 2020 is not likely based on current conditions. Thus, a recession is assumed to begin in 2021. It is possible that this recession will be driven by overcorrection of monetary policy to cost-push inflation arising from labor cost increases and perhaps tariff impacts. The most direct analogue among recent recessions is the moderate recession of 1990-1991. A comparable recession is assumed to affect 2021 and 2022 employment, with employment returning to trend in 2023. National-level employment changes in 1990 and 1991 in specific industries were reduced

(declines were increased) to reflect the lower rates of employment growth before and after this recession than those prevailing in the late 1980s and 1990s. Because a return to trend is assumed in 2023, the 2024 projections are not affected by the recession. Employment projections for the 23 industries to be analyzed are shown in Table C-2.

Occupational Projections

The Bureau of Labor Statistics' 10-year employment projections (the source for occupational needs within industries) include annual replacement rates for each occupation; see United States Bureau of Labor Statistics (2017a). These are used directly in the occupational analyses; there is no reason to suspect that turnover in the region is faster or slower than it is elsewhere. However, turnover rates typically decline in recessions. Replacement rates for the recession period can be derived by comparing recession turnover rates with those for expansion periods. Turnover rates are available from United States Bureau of Labor Statistics (2019a), but the only recession included is the severe 2007-2009 downturn. The total average separation rate for 2008 and 2009 was approximately 10 percent less than the average rate for 2014 and later, so all turnover rates are reduced by this percentage for the three-year projections.

The process to generate projections of regional occupational employment given the industry employment projections is as follows. Assuming that the current and future local occupational distributions within industries are equal to the comparable national distributions, estimated 10-year current and future employment is calculated for each occupation in each industry using the national occupational distributions and the local industry employment projections. The three-year and five-year distributions assume a steady rate of change in the employment distributions. Occupational employment across all 23 industries are then combined to obtain an employment total for all occupations in all industries. The result is the local occupational growth need. The replacement need for each occupation is calculated using the national replacement rates from the employment projections. Finally, the growth and replacement needs are combined to give the total number of workers needed in each occupation over the relevant period.

Appendices

LITERATURE REVIEW APPROACH

This review of the literature is a narrative review, gathering literature in relevant subject areas and synthesizing it for the team. The workforce demand portion of this study concentrates on research that has been central or pivotal to understanding the impact of technology change on workforce. Of particular interest are those studies examining the impact of smart technology on the workforce. This approach included an effort to identify studies, reports and other online resources exploring the impact of Smart Columbus strategies on the Central Ohio workforce specifically, those related to technology shifts in the transportation sector, including electrification and automation.

This research focuses on two types of cities. The first type is cities recognized in the literature as 'smart cities' that provide evidence-based justification of their implementation of good practices on their use of technology-based solutions to solve urban problems. The second group of cities is those that aspire to become 'smart' and are currently implementing a concrete smart city plan that defines a vision and a methodology based on incorporating smart and digital technologies to improve urban functions. (Angelidou, 2016)

Photo from focus group session?

STAKEHOLDER ENGAGEMENT

Phase two of this research effort features extensive stakeholder engagement activities with a diverse cross section of visionaries, community leaders, residents, industry leaders, and education, training, and credentialing providers. A complete list of participants and their affiliate organizations is included on the following page. Established engagement protocols (Appendix D) guided all stakeholder communications and interactions. Seven focus group sessions with more than 50 individual stakeholders comprising of CEOs and Executive Directors, HR leadership, workforce development providers, and other key community leaders were convened. Important input from Central Ohio residents was gathered from four community listening sessions.

The questions covered topics addressing future workforce demand, observed and expected trends, and challenges anticipated in the next three, five, and ten years. The results of the phase 1 literature review, economic analysis of driver industries and occupational projections for the region were also validated based upon what was learned. Community Listening sessions were held in the Linden and Southside areas of Columbus and included the following events:

- Columbus Metropolitan Library Linden Branch – August 26, 2019; 6:00-7:30 pm
- Linden Big Table, Salem Baptist Church – August 28, 2019; 6:00 – 7:00 pm
- Godman Guild Career Bridges, Reeb Avenue Center – August 30, 2019; 1:00 - 2:00 pm
- Mid-Ohio Food Bank Southside Roots Café, Reeb Avenue Center – October 24, 2019; 6-7:30 pm

The research team analyzed trends and patterns observed in the resulting data to identify and define critical elements of the future of work in the region. The framework used examines key areas including education and training, talent development programs, social and digital inclusion, top-down leadership, grassroots approaches, and innovative, start-up experimentation. Critical insights into the regional workforce development system's readiness for future work demands were gained. These results inform the policy recommendations provided for decision makers, employers and other leaders working to design solutions for closing the gap between the supply of workers and future demand in Central Ohio workforce. The ultimate goal of this phase was achieved - to provide actionable recommendations for strengthening and preparing the workforce development system to meet the future needs of Central Ohio.

Appendices

TABLE A1: *Stakeholder Engagement - Focus Group and Interview Participants*

NAME	ORGANIZATION
VISIONARIES – GROUP 1, SESSION 1	
Aaron Schill	MORPC
Alex Bandar	Columbus Idea Foundry
Archie Williamson	Diversified Systems Inc.
Bill LaFayette	Regionomics
Carrie Almasi	United Way of Central Ohio
Cheryl Hay	JobsOhio
Cory Tressler	Office of Distance Ed & eLearning, OSU
David White	Columbus 2020
Jeffrey Lyttle	JP Morgan Chase
John Magill	Ohio Department of Higher Education
Kelly Wallace	WDBCO consultant
Mark Birnbrich	OhioMeansJobs
Mark Lomax II	The Columbus Foundation
Mark Patton	Smart Columbus – The Columbus Partnership
Matt Habash	Mid Ohio Food Bank
Mike Snider	Ohio Association of Community Colleges
Rocky Parker	Nationwide Insurance
Steve Dackin	Columbus State Community College
TRANSPORTATION AND ELECTRIFICATION – GROUP 2	
Amanda Roraff	PlanetM (Michigan's Economic Development Group)
Giorgio Rizzoni	Automotive Research Center OSU
Mark Bernhardt	Burgess & Niple
Maryn Weimer	Transportation Research Center
Mike Stevens	Smart Columbus – City of Columbus
Quinten Harris*	City of Columbus
Rich Granger	DriveOhio
Scot McLemore	Honda
Tim Bethel	AEP

NAME	ORGANIZATION
OTHER INDUSTRIES – GROUP 3	
Alicia Oddi	Rev1
Alison Mincey	OSUMC, HR
Brian Worth	Cardinal Health, Inc.
Jane Abell	Donatos
John Sherwood	Ohio Governor's Office of Workforce Transformation (OWT)
Rick Platt	Heath-Newark-Licking Co. Port Authority
Rocky Parker	Nationwide
Scott Osborne	Economic & Corp Engagement, OSU
Tom Poole	Huntington
Zach Dowley	Econ Dev Delaware Co. Commissioners
WFD PROVIDERS – GROUP 4	
Allison MacKay	Civil Engineering, OSU
Cathie Smith	Translational Data Analytics Inst, OSU
Erin Bender; Ryan Brechbill; Eric Lloyd	The Point Executive Director, Center for Career & Professional Dev, ED; MBA Program Director, Otterbein University
Joyce Malainy	C-TEC
Latoya Sands	Per Scholas
Michael Evans	Ohio Assoc. of Community Colleges
Nicole Nieto	Outreach and Engagement, OSU
Tom Goodney	Educational Service Center of Central Ohio
COMMUNITY LEADERS – GROUP 5	
Art Hurst	Columbus Urban League
Brad Lamone	Engineered Profiles
Council President Hardin	City of Columbus
Ellen Moss	Godman Guild - Workforce Development
Erika Jones	Celebrate One
Kolt McDaniels	Delaware Co. Jobs & Family Services
Nick Bankston	City of Columbus, Dept. of Neighborhoods
Nick Davis	Mid Ohio Food Bank
Quinten Harris*	City of Columbus

Appendices

Appendix B — Future of Smart Work: Review of Literature

Available online here or contact the Ohio Education Research Center at 614.292.8696.

Appendix C — Economic and Workforce Forecasting Results

Available online at here or contact the Ohio Education Research Center at 614.292.8696.

Appendix D — Stakeholder Engagement Protocols

FOCUS GROUP PROTOCOL

Future of Smart Work, Phase Two: Stakeholder Engagement Guide

FOCUS GROUP SESSIONS
DIRECTIONS TO THE GROUP

Overview
The purpose of the Future of Smart Work Project is to explore the ways in which technology and demographic changes will impact work in Columbus—America's Smart City.

This research will help to identify gaps that may exist between the careers that the current system of education, training, and credentialing programs support and the opportunities that will exist given anticipated disruptions caused by rapidly advancing technology and innovation in driver industries in the region. Insights gained will inform how the existing workforce development system might evolve to reduce current and future gaps to support the future success of Central Ohio communities.

This regional initiative focuses on the current and future impacts of technology and innovation on workforce development. Economic and occupational analyses conducted in the first phase of this study provide insights into anticipated changes over the next decade in industry sectors important to the regional economy, including Information Technology, Intelligent Transportation, Intelligent Infrastructure, Insurance, Finance, and Healthcare.

Also of interest is how artificial intelligence (AI), robotics, IoT, machine learning (ML), and virtual reality are changing work environments. As well, this study investigates how the workforce development system providers, including educational institutions, workforce training programs, apprenticeship programs, and other credentialing programs, prepare learners with the knowledge, skills, and abilities (KSAs) needed to ensure their success.

For the purposes of this research, the Central Ohio region is defined as the One Columbus eleven county economic development region.

(Show PPT slide of One Columbus Central Ohio Region).

In this session, we will share with you some of the key findings about the future of work in Central Ohio over the next decade. We look forward to hearing your reactions to our preliminary findings and hear your perspective on how to prepare today's workers for tomorrow's jobs. Before we begin, let's review the goals and purpose of the project, in general:

Our Goal
Actionable policy recommendations will be informed by the following outcomes of this research effort:

An assessment of industries driving job occupational change with three, five and ten year projections;

A Catalogue of Career Paths that connect today's workers to tomorrow's jobs.

A better understanding of any misalignment between the workforce development provider network (education/training/credentialing programs) and the needs of employers.

Better knowledge of current and future technology changes affecting the Central Ohio economy.

Stakeholders in the region will benefit from an increased awareness of how the Workforce Development Board of Central Ohio, Smart Columbus and their partners can effectively leverage limited resources to prepare for changes occurring in the next decade. Knowledge gained from this session will inform strategic planning and decision making related to future economic and workforce development in the region.

(Inform participants of the primary stakeholder perspective represented by their group session)

Appendices

Focus Group Questions

Please consider the summary of the key findings from the first phase of this project. *(Infographic and one page overview provided)* This information provides you with some context for our discussion today. We will pose some framing questions for this discussion with the hopes that all of you will contribute your unique knowledge and insights to this conversation.

- Given the rapid pace of innovation and technological advancements driving growth in Central Ohio, what will give the region a unique identity in the decade ahead?

- What is the role of the region's talent development in establishing this identity?

- What new career pathways are needed to support driver industries?

- Our employment projections assume that there will be a recession.

- How do you think the next recession will play out?

- How might it affect workers?

- Our economic projections represent our *best guess* about the future. What changes might occur that are not predicted based on current data?

- What knowledge, skills, and abilities will increase the resilience of future talent?

- What new education, training, and certification programs are needed, or how do current programs need to change?

- Are we leaving people behind?

- What does this mean for Central Ohio?

Post Focus Group Survey*

We invite you to share additional insights regarding the Future of Smart Work in a brief post survey. The information you provide will all a more in-depth analysis of the workforce supply and demand dynamics over the next decade. *(Demonstrate how to access the survey, provide link to survey and answer any questions they may have about completing it).*

*See attached Post Focus Group Survey

COMMUNITY LISTENING SESSIONS

Sessions will be held in the Linden and Southside neighborhoods to gain knowledge of the perspectives on the future of work of residents currently engaged with the workforce development system or employment.

DIRECTIONS TO THE GROUP

In this session, we will listen to your thoughts about the future of work in Columbus over the next ten years. We look forward to hearing your ideas about how the education and training programs available in this area can help to support workers to be successful. We are also interested in how the OhioMeansJobs centers (One Stops) can support people looking for jobs. Before we begin, let's review the goals and purpose of the project, in general:

Our Goal

The industries expected to have the most jobs created in the next 10 years.

The Career Paths that connect today's workers to tomorrow's jobs.

A better understanding of any gaps between education and training programs and the needs of employers now and in the future.

Better knowledge of current and future technology changes affecting the Central Ohio economy.

Policy makers and other stakeholders in the region will benefit from an increased awareness of how the Workforce Development Board of Central Ohio, Smart Columbus and their partners can use limited resources to prepare for changes occurring in the next ten years. What is learned from this session will inform strategic planning and decision making related to the region's future economy.

Appendices

FOCUS GROUP PROTOCOL (CONT.)

Questions
- Think about how advancements in technology and innovations will change Central Ohio over the next decade. What would make it a special place to live, work, and raise a family?

- What's the role of those living here in bringing about this change?

- What are your hopes and fears about working here in the future?

- Many are expecting a recession to occur in the next few years. If it does happen, what are your biggest concerns about working and supporting yourself/your family?

- If you could go back to school right now, tuition free and with full pay and benefits, what do you think would be important for you to learn or skills for you to develop?

- Would this help your employment situation?

- Do you or others you know use OhioMeansJobs – Columbus/Franklin County or other workforce service providers?

- If not, why?

- What have been the benefits or challenges?

- Are people being left behind in your community?

- How does this affect your community?

POST FOCUS GROUP SURVEYS

Surveys were developed for use in following up with members of each of the stakeholder groups after their participation in the focus group events. The brief survey is designed to provide more granular information to supplement the data gathered during the one and one half hour sessions. Questions explore a range of topics related to the workforce development system in Central Ohio, as well as the relationship between technology and work, changing knowledge, skills, and abilities (KSA) required for the jobs of the future, and the value of work for employers and employees. The surveys were developed using Qualtrics and distributed by email. Links to all surveys are provided, below.

Industry Stakeholder Survey
https://osu.az1.qualtrics.com/jfe/form/SV_enzKVs3z73sT8UZ

Visionaries Stakeholder Survey
https://osu.az1.qualtrics.com/jfe/form/SV_6gjUCzsnsa1Ub0p

Providers Stakeholder Survey
https://osu.az1.qualtrics.com/jfe/form/SV_0GwPXAdSxi6x7Xn

Community Leaders Stakeholder Survey
https://osu.az1.qualtrics.com/jfe/form/SV_cSyXaBEYxAj6hAp

Appendices

Appendix E — Workforce Development System Gap Analysis

The second phase of this project draws from extensive stakeholder feedback to identify how the current workforce development system of education, training, and credentialing programs will prepare the workforce with the knowledge, skills, and abilities (KSAs) required to perform the most in-demand jobs. Building off of the economic analysis and occupational projections completed in Phase one, the research team complied input data from stakeholders to extend what historical data could not represent – programs currently under development or planned for the next decade. As well, they gathered industry input to extend the in-demand jobs list to include emerging occupations that are expected to be available to future job seekers.

Table E1 on the following page displays the top 25 occupations projected for the region over the next decade (from Table 2) with the results of an analysis of how well the current education, training, and credentialing provider network supports workforce preparation. In particular, it indicates the number of providers offering the programs that provide workers with required KSAs, whether they are approved by the Workforce Investment Board to serve recipients of WIOA training funds (per the Workforce Inventory of Education and Training - WIET)[xviii], and the likelihood that the occupation will be disrupted by computerization. These factors, combine with data gathered from stakeholders in focus groups, interviews, and surveys, to inform the qualitative assessment of whether the capacity of available programs will be sufficient to supply enough completers to meet the employment needs of employers in the region. Green plus icons indicate estimated supply meeting or exceeding demand while red minus signs show those occupations for which available programs do not support the expected demand.

It is worth noting that several occupations do not require high school diploma or postsecondary credentials. As well, it is notable that eight of the occupations listed are considered to be highly susceptible to automation (>90 percent likelihood). This fact reduces the chance that providers will be interested in investing in developing programs to meet employers' needs, which may shift the education and training burden to employers. These findings are useful for highlighting where employers, providers, and policy makers must focus their resources to reduce identified gaps. This proactive approach to addressing future disruptions in the labor market will pay dividends by ensuring a strong talent pool that supports employer's needs.

The findings of this workforce development system gap analysis indicate that there is a wide disparity between two types of occupations that will be most in demand in the coming year: those requiring a high level of KSA preparation and those that require only low skills and no postsecondary credential. The former includes registered nurses, medical assistants, nurse assistants, general and operations managers, software developers, insurance sales agents, and accountants and auditors. Mid-range education requirements apply to those pursuing medical secretary, bookkeeping, accounting and auditing clerk, and industrial or tractor trailer truck driving jobs. Preferred high school diploma or GED, or short-term certificate training, is the only requirement for those seeking employment in available the remaining occupations listed.

While at least one provider offers programs in all occupations for which postsecondary education and training is needed, the volume of successful completers is likely to be inadequate to meet the demand for five occupations including heavy tractor-trailer truck drivers, registered nurses, medical secretaries, insurance sales agents, and software developers. Attraction and retention of students in these areas may also be challenging, given that all except truck driving require foundational math and science skills and abilities that traditionally serve as gatekeepers to success. It is assumed that there is a deficit in the provider network for those occupations with no available programs. However, stakeholders did not indicate a need for programs to prepare workers for these occupations, and new hire training needs may be met by employer-based training programs. While data analytics programs were not specifically considered in this analysis, stakeholders consistently indicated this as a gap in the current system that is expected to widen with time. Several universities in the region have recently added these programs, but more are needed. Recruitment and retention of students in these programs to scale up the number of graduates to meet the growing demand will continue to be a challenge in the region.

Additional research is needed to investigate how accurately the program curricula aligns with the content necessary to prepare learners for the jobs they desire when they complete the program. Colleges and universities have mechanisms in place, including the use of program and department advisory committees, which encourage ongoing communication with business and industry partners about changes in their work requirements and overall environments. The next phase of this research aims to extend the findings of this analysis to include a full workforce supply and demand analysis using quantitative data analysis methods to gain a better understanding of how the identified gap. As well, this more comprehensive study will consider more complex factors that impact workforce dynamics as the complex system experiences future disruptions.

Appendices

TABLE E1: *Gap Analysis Results for Top 25 Occupations Projected for 2019-2029*

OCCUPATION	AVG ANNUAL NEW OPENINGS 2019-2029	AVG ANNUAL TOTAL OPENINGS 2019-2029	EXISTING POST SECONDARY PROVIDERS	WIB APPROVED PROGRAMS	POST SECONDARY PROVIDERS WITH >10 GRADS/YR	PROBABILITY OF DISRUPTION FROM COMPUTERIZATION	WDS GAP
Customer service representatives	14.9	2099	N/A	2	N/A	0.55	–
Laborers and freight, stock, and material movers, hand	130.1	1856	N/A	0	N/A	0.85	+
Heavy and tractor-trailer truck drivers	61.3	1343	4	2	0	0.79	–
Registered nurses	207.8	1181	17	6	15	N/A	–
Team assemblers	-29.7	1106	N/A	0	N/A	N/A	+
Office clerks, general	1.4	769	N/A	7	N/A	0.96	+
Medical assistants	167.3	680	15	5	7	0.3	+
Insurance sales agents	46.9	624	4	2	1	0.92	–
First-line supervisors of office and administrative support workers	10.7	573	N/A	0	N/A	0.01	–
Sales representatives, services, all other	7.8	513	1	0	0	N/A	–
Tellers	-23.5	510	0	0	0	0.98	+
Receptionists and information clerks	63.1	489	0	0	0	0.96	–
Packers and packagers, hand	33.1	484	0	0	0	0.38	–
Insurance claims and policy processing clerks	34.9	480	0	0	0	0.98	–
Nursing assistants	23.9	469	9	6	5	N/A	+
Secretaries and administrative assistants, except legal, medical, and executive	-28.4	458	4	3	1	0.96	+
General and operations managers	42.8	437	20	8	12	0.16	+
Software developers, applications	112.9	436	11	3	5	0.13	–
Medical secretaries	77.5	431	6	0	1	0.81	–
Bookkeeping, accounting, and auditing clerks	-4.1	428	5	2	1	0.98	+
Industrial truck and tractor operators	8.7	388	0	0	0	0.93	–
Helpers--production workers	73.3	380	0	1	0	0.66	–
Accountants and auditors	32.5	349	14	3	6	0.55	+
Business operations specialists, all other	25	342	0	0	0	0.23	–
Light truck or delivery services drivers	17.7	340	0	0	0	0.69	–

+ = Supply > Demand   **–** = Supply < Demand

End Notes

[i] Manyika, J., Lund, S., Chui, M., Bughin, J., Woetzel, J., Batra, P., . . . Sanghvi, S. (2017). Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation. McKinsey & Company. Retrieved from https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages

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[v] Brynjolfsson, E., Mitchell, T., & Rock, D. (2018). What Can Machines Learn and What Does It Mean for Occupations and the Economy? AEA Papers and Proceedings, 43-47.   (Brynjolfsson, Mitchell, & Rock, 2018)

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[vii] Loebbecke, C., & Picot, A. (2015). Reflections on Societal and Business Model Transformation Arising from Digitization and Big Data Analytics: A Research Agenda. Journal of Strategic Information Systems, 149-157.

[viii] In 2016 and 2017, Grand Challenges in Biomedical Image Analysis (CAMELYON 16 and CAMELYON 17) were run to encourage the development of programs to detect cancer metastasis in lymph nodes. https://thepathologist.com/inside-the-lab/pathologist-centric-ai

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[xii] Canis, B. (2019). Electrification May Disrupt the Automotive Supply Chain. Washington, DC: Congressional Research Service.

[xiii] Rea, B., Stachura, S., Wallace, L., & Pankratz, D. M. (2017). Making the Future of Mobility Work. Deloitte. Retrieved from https://www2.deloitte.com/insights/us/en/deloitte-review/issue-21/transportation-ecosystem-future-of-mobility-reshaping-work.html

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[xv] Rea, B., Stachura, S., Wallace, L., & Pankratz, D. M. (2017). Making the Future of Mobility Work. Deloitte. Retrieved from https://www2.deloitte.com/insights/us/en/deloitte-review/issue-21/transportation-ecosystem-future-of-mobility-reshaping-work.html

 (Rea, Stachura, Wallace, & Pankratz, 2017, p. 189)

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 (Rea, Stachura, Wallace, & Pankratz, 2017)

[xvii] Source: Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerization?. Technological forecasting and social change, 114, 254-280.)

[xviii] Educational institutions, approved by a local Workforce Investment Board (WIB) and the Ohio Department of Job and Family Services, are eligible to receive Individual Training Account (ITA) funds under the Workforce Investment Act.