



The Workforce of the Future

Insights around disruption, transformation, and the role of AI

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Contents

- Executive summary 3
- The manufacturer’s dilemma 4
- The manufacturer’s opportunity 4
- The employee’s dilemma 8
- The employee’s opportunity 9
- The industry’s dilemma 10
- The industry’s opportunity 11
- Where do we go from here? 13
- Additional insights 14

Executive summary

For many decades, manufacturing has been on the frontlines of technology disruption, helping to fuel growth, enable agility, and redefine efficiencies. It is exciting to think about how much this industry has created—not just innovative products, but new jobs, new global supply chains, new business processes and even new economies.

Today, we are at a historical crossroads. New levels of connectivity, virtually unlimited compute power offered by cloud computing, and advanced technologies like IoT, artificial intelligence (AI), machine learning, mixed reality, digital twins, blockchain and more, are enabling us to process and reason over more and more data on a much larger scale, opening up new value networks.

Pervasive access to these digital services is changing every aspect of manufacturing—intelligent supply chains, product-as-a-service, factories of the future—and providing the catalyst for new business models, products, services and experiences. However, with this radical disruption also comes the need to transform and empower a changing workforce, equipping them with the new skills needed for the digital economy.

Of all the technologies reshaping our industry, I would say that AI plays one of the biggest roles here

in terms of the disruption—and resulting opportunity—for both our industry and our workforce. AI has made especially large strides in recent years and is poised to open up new types of employment opportunities. Senior executives from leading global companies see AI greatly contributing to their ability to attract top talent as well as boost output per worker.¹

But as we've witnessed over the past 20 years, new technologies, most notably AI, also raise complex questions and broad societal concerns. As we look to a future powered by a partnership between computers and humans, it is important that we address these challenges head on. How will AI impact employment and jobs? How do we ensure that AI is designed, used and governed responsibly? This is something Microsoft is deeply focused on as we work to democratize AI for every person and every organization.

With that backdrop, I would like to share a few thoughts on how the global workforce will be impacted by big disruptive forces including AI, as well as ideas around how three core groups—manufacturers, employees and the industry at large (IT companies, large enterprises, education institutions, policy makers, government, etc.)—can thrive during this massive transformation.



The manufacturer's dilemma

There is a growing talent gap and manufacturers are worried. There is a major risk with knowledge and experience going away with the retiring employee base. According to a Census report, by 2029, the majority of baby boomers will be 65 years and older, accounting for 20 percent of the population of the United States. This translates into a significant drop in the number of active workers in our economy, particularly in the manufacturing industry.² And a Deloitte/World Economic Forum report reveals that 10 million global manufacturing jobs are currently unfilled, further intensifying the manufacturing skills gap problem the United States.³

Another concern is the younger generation does not see manufacturing as something they want to do for a career.⁴ And while the pace of advanced technologies being introduced on the plant floor has been growing rapidly, many workers do not have the skills or proper training to keep up. It is estimated that this skills gap will result in two million manufacturing jobs going unfilled.⁵

Manufacturers have a great need to lure in tech-savvy talent—or upskill/reskill existing workforces—to harness new and disruptive manufacturing technologies. Companies should look for a new generation of employees that possess the hybrid skills and comfort with innovation to adopt new technologies and those not yet invented.

The manufacturer's opportunity

In this new era, we know that every industry and every business must reinvent itself and take advantage of the power of digital to innovate, accelerate, optimize, and become more agile and efficient.

We at Microsoft believe that all enterprises will become software or AI companies as technology will inform our business processes, our business models, and our customer and employee engagement. This is

a “be the predator or the prey” type of environment, whereby you either change and disrupt, or become obsolete as your competition disrupts your business. Manufacturers need to start immediately—take action today, experiment, fail fast, keep repeating, learning and changing.

It is clear that organizations that gain these digital competencies and capabilities will be quick to adapt to market changes, even drive them, and be a catalyst for new products, services and experiences. The rewards are clear: organizations that take these steps to embrace digital transformation generate an average of \$100 million more operating income each year than those who lag behind, according to a Keystone Strategy study.⁶ New jobs and economic growth will accrue to those who embrace new technology, not those who resist it.

Manufacturers today have the opportunity to invest in innovations such as AI, 3D printing (or additive manufacturing), intelligent robots, mixed reality, and much more to enable completely new digital manufacturing automation and execution capabilities to further rationalize and improve overall processes and production and drive significant growth.

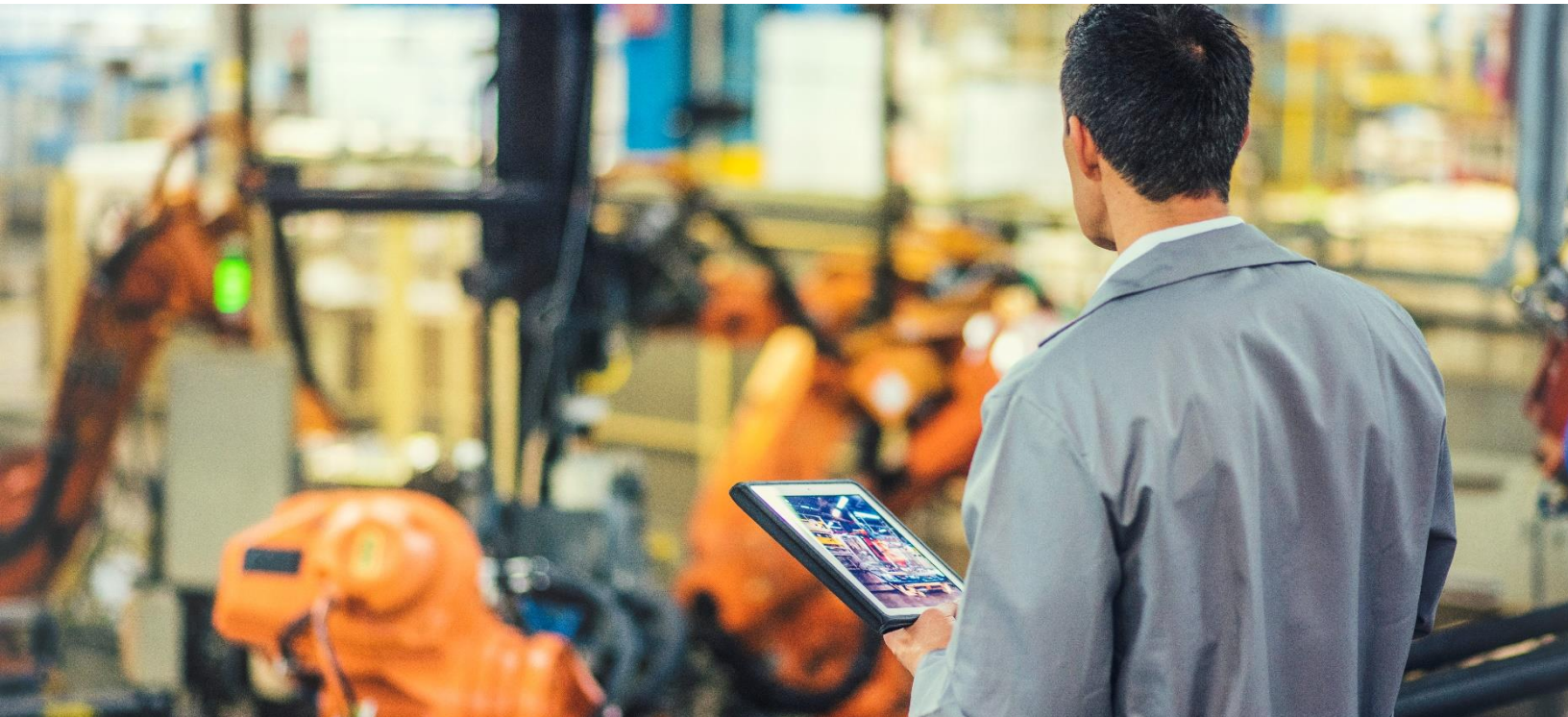


We must pay close attention to AI's impact here. A study by global management consultancy firm PwC states that the global gross domestic product (GDP) will be 14 percent higher by 2030 as a result of AI adoption, contributing an additional U.S. \$15.7 trillion to the global economy. That is more than the current output of China and India combined.⁷

To look at the future of work and the potential impact of AI, Microsoft launched a study called *Future Computed*. We found that much of the technology we are building is intended to increase productivity and collaboration and enable better and

drop, which will also have a significant impact on a number of industries. PwC predicts industrial robots to reach 2.6 million in 2019⁸, and research company ARK suggests that prices will drop by 65 percent in the next seven years. ARK analyst Sam Korus tells us that "Combined with advances in machine learning and computer vision, this drop in costs should cause an inflection point in the demand for robots as they infiltrate new industries with more provocative use cases."⁹

Because robots are now capable of more physically taxing work—handling and moving tons of weight—



faster decision-making for workers. AI is at the center of this. But we must ask ourselves if AI will create more jobs than it will eliminate? Or will it be the other way around? Economic historians have pointed out that each prior industrial revolution created new jobs. There are many reasons to think this will also be the case with AI. AI will be useful wherever intelligence is useful, helping manufacturers to be more productive and efficient.

AI is enabling cobot environments—a collaborative bot and human environment within manufacturing that will change the nature of work. The number of robots is expected to spike as prices continue to

they are also taking over repetitive, complicated or sensitive tasks, such as what we see with cutting-edge [ABB robots](#). As these increased levels of automation and intelligence take hold in the manufacturing environment, we know that jobs will be replaced, but we should expect that new ones will emerge.

In its 2018 Future of Jobs report, the World Economic Forum says that the rapid evolution of machines and algorithms in the workplace could create 133 million new roles in place of 75 million that will be displaced between now and 2022.¹⁰

McKinsey & Co. agrees, saying that while individual sectors and companies will experience layoffs due to automation, it is expected that most economies will generate net new jobs in the years ahead in terms of different types of careers, new sources of demand and reskilled workforces.¹¹

For our aging workers, it is not hard to imagine that we can help keep them in the workforce longer with the affordability and efficiency of robots. Add the fact that communication, collaboration and messaging technologies are now accessible by everyone and easy and intuitive to use for all ages and workgroups.



Recent data from the World Economic Forum forecasts that by 2025, machines will perform more current work tasks than humans, compared to 71 percent being performed by humans today.¹² With these new levels of automation, manufacturing will move from a mass-production paradigm to a mass-customization paradigm that I like to call “one size fits one.”

These increased levels of automation will also help with the talent gap problem as it relates to the aging workforce. According to the U.S. Bureau of Labor Statistics, a larger share of people 65 and older are staying in or returning to the workforce, a trend that has been on the rise since the late 1990s.¹³ The European Commission also estimates the number of people in the United Kingdom aged 55 to 64 will increase by 24 million between 2005 and 2030.¹⁴

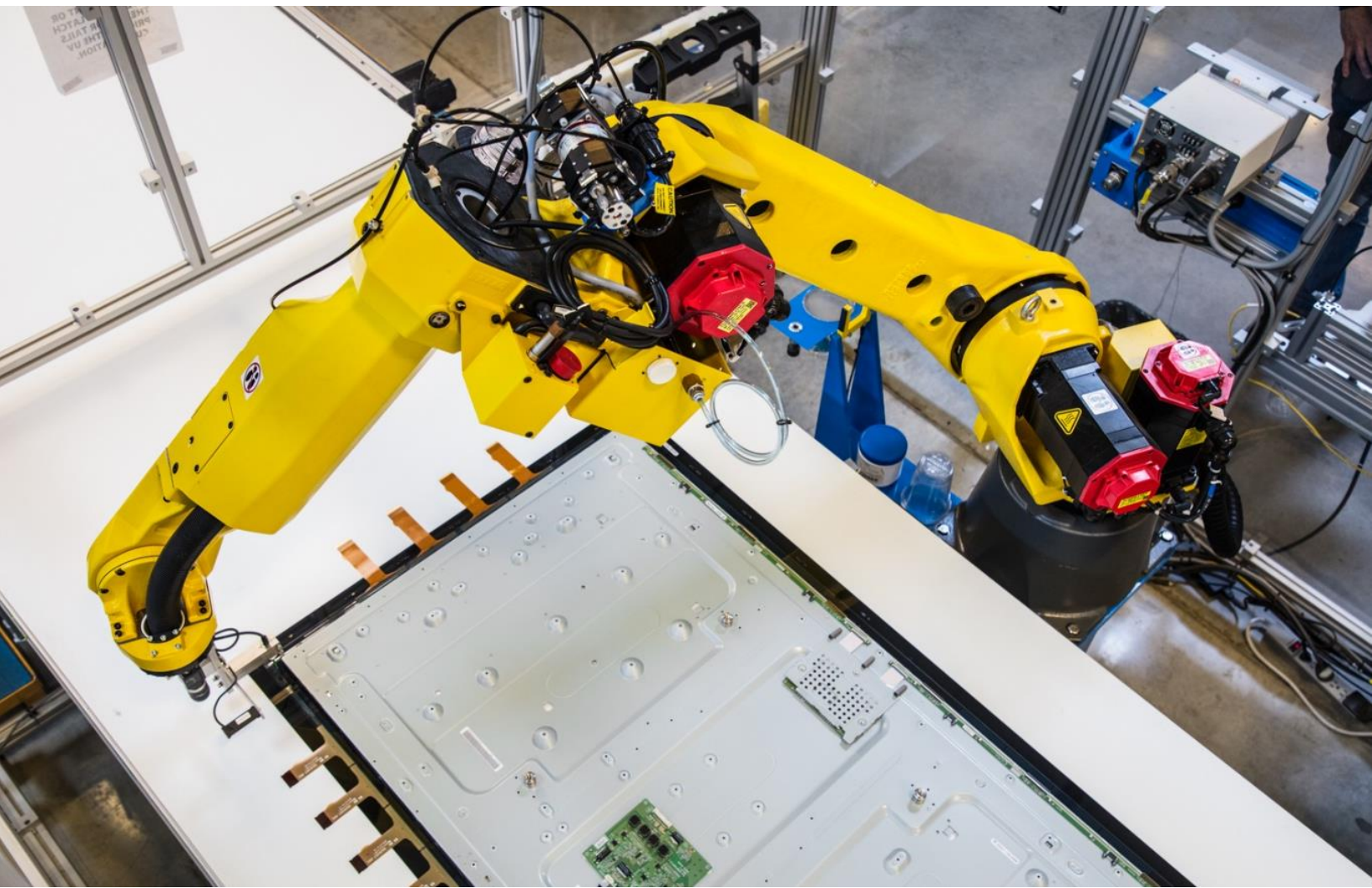
The Microsoft cloud and tools like Teams and Office 365, or Remote Assist, support a “digital worker” vision to increase productivity and enable employees to work from anywhere, at any time.

Using technologies like Skype, Skype Translator, and Microsoft HoloLens, experienced workers can be readily available to anyone around the global enterprise, offering verbal, even visual, help. These capabilities can help us keep our older workers on the job longer by leveraging their intelligence, knowledge, expertise, and experience through less physically demanding—yet vital—roles. Just take the work that [Honeywell is doing to use HoloLens to redefine training and skills transfer from boomers to millennials](#). This kind of immersive on-the-job training has meant that staff can be educated much faster, and they can retain information much longer.

Mixed reality is also enabling workers to perform complicated tasks, such as maintenance on aircraft engines, in a reliable and compliant way, with remote aid from experienced employees, as well as train new workers. For example, using PTC's Thingworx Studio software, [BAE Systems](#) easily created interactive mixed reality experiences for HoloLens in hours and at a tenth of the cost. Using guided step-by-step work instructions, first-line workers were able to assemble battery cells in less time and BAE was able to train new people 30-40 percent more efficiently. And [ZF Group](#), a German car-parts manufacturer headquartered in Friedrichshafen, is using Microsoft Remote Assist and Microsoft Layout to increase efficiencies on the shop floor. HoloLens and Microsoft Remote Assist enable maintenance engineers to fix equipment faster with the help of remote experts, decreasing factory floor downtime. Planning engineers use HoloLens and Microsoft Layout to view spatial planning designs in the real-world shop floor environment, saving hours of work.

As technology advancements trigger increased levels of automation, chances are advanced economies will do less outsourcing and offshoring, even potentially bringing jobs back into their own countries, as inexpensive labor will no longer be an important factor in terms of cost of manufacturing. It is also realistic to think—to further support that hypothesis—that political stability, predictable energy supply, and reliable cyber-security infrastructure will become extremely critical factors in determining the geographies for manufacturing production.

We are already starting to see a trend in that direction, as in 'insourcing' manufacturing back to advanced, mature economies. According to Harry Moser, the founder of the Reshoring Initiative, in 2017, 171,000 jobs were announced to come back to the United States—this is about 90 percent of the entire increase of manufacturing employment in 2017.¹⁵



The employee's dilemma

Despite this trend in the right direction, the manufacturing workforce still remains very worried about unemployment¹⁶, given that more than 50 percent of manufacturing companies outsourced jobs over the last decade.¹⁷

Workers also worry about how they will access and afford the training they need to gain the right skills to match today's rapidly evolving technology job roles. By 2030, as many as 375 million workers globally will have to develop new skills as their current jobs evolve alongside the rise of automation and robots.¹⁸ And many may need several cycles of reskilling throughout the course of their careers as technology progresses. Often graduates find that their education did not properly prepare them for the skills needed for fast-changing industries such as manufacturing. Or, they are already so burdened by student loans that investing in acquiring new skills is not even an option.

In addition, the workforce profile is changing rapidly and looks different than a few generations ago. Long gone is the era of staying in the same job for the span of your career. Today's millennials are used to working multiple jobs, even while at school. They are driving Uber cars, babysitting, waiting tables, exploring internships in the summer, working contract jobs or one-time projects, and doing volunteer work.

The world is constantly changing, and millennials are coming to the workforce with a very different set of expectations than previous generations. According to MIT research, for employees across age groups from 22 to 60 years old, the vast majority want to work for digitally enabled organizations.¹⁹



The employee's opportunity

There has never been a more exciting time to be part of the future of the manufacturing workforce, as the workplace has evolved to a highly technologically advanced environment. Employees need to understand what the new professions are and seek out those roles through things like continuing or advanced education.

Employees have the opportunity to focus their contributions more around digital, intelligence and technology-focused types of roles. Currently, millennials are already exposed to digital innovations like chatbots and are the most knowledgeable about AI; nearly a third of millennials understand AI and have some experience with it.²⁰ This makes millennials more likely to embrace and be comfortable working with AI capabilities.

It is almost a sure bet that those who acquire these new skills will be gainfully employed. After all, we already established that every enterprise will become a software or AI company and that means the world will need more software and more developers to write them—many, many more. Employees that clearly understand the benefits that advanced technologies like AI bring to their jobs will be well positioned for the careers of tomorrow.

Large enterprises are also moving toward recognizing and respecting the millennial's preference for work-life balance. Markets are moving to more flexible work arrangements, such as job-sharing programs and work-from-home opportunities.



The industry's dilemma

As we've discussed, while technology innovation can help create different types of jobs, when it comes to the new professions, automation has the potential to take away more jobs than it will create—at least for the near term. According to McKinsey & Co., by 2025, digitization is expected to contribute \$2 trillion to U.S. GDP—and displace up to 12 million middle-skill workers.²¹

PwC says that nearly 40 percent of jobs in the United States may be vulnerable to replacement by robots in the next fifteen years. Other advanced economies have fewer jobs at risk. PwC estimates that 30 percent of jobs in the United Kingdom could be threatened by technical advancements in automation from AI and robotics, compared to 35 percent in Germany and 21 percent in Japan.²²

This is a warning that while digitalization brings many benefits, it also signals the beginning of a major socio-economic structural change in our new world of work. From the industry's perspective, the dilemma is around how to keep everyone, even high-skilled workers, employed, as well as how to deal with the social and social security implications.

However, while reducing the number of actual workers, the new levels of automation for advanced economies will actually create more productivity and growth by opening up opportunities for an entirely new range of occupations. Those economies that embrace advanced manufacturing and automation will become more prosperous, even though they will have fewer human jobs. This is because technology and automation can help industries and businesses lower costs and increase efficiency, according to PwC.

For example, AI and robotics can help businesses make better use of their existing capital stock and increase margins. This in turn could create further demand for traditional forms of investment, such as

warehouses and machinery. The price of goods and services could also drop—or increase more slowly—if businesses pass on these productivity gains to consumers through lower prices, which they should do so long as markets are competitive.²³

The United Kingdom, meanwhile, is looking for a productivity boost in the post-Brexit era. Artificial intelligence, along with other digital technologies, has a big role to play, according to Juergen Maier, chief executive officer of Siemens UK, who was appointed by the UK government to determine how UK manufacturing might be transformed by the adoption of industrial digital technology. Mr. Maier believes that industry and government must work

together to upskill workforces and unlock the benefits of digitalization. "It's going to take a massive rethink and a radical shift in economic and education policy," he says.²⁴

A recent study of 25 industrialized nations by the Economist Intelligence Unit and ABB found that in most countries, vocational training is not up to the challenges posed by intelligent automation. Germany's system of vocational and technical education has long been held up as

a model for other countries. Its system, along with those of South Korea and Singapore, help these three countries share leadership around labor market policy.²⁵

Political and business leaders in these countries know that the "world of work" is changing and they must act quickly to keep up. AI, robots and systems of automation are re-defining the workplace as we know it. As such, we are facing an overhaul in terms of the way social security, unemployment, and other subsidies are planned, managed and executed.

As we look beyond technology and automation as they relate to the basic preparation of our workforce, today's schools and vocational education institutions



AI, robots and systems of automation are re-defining the workplace as we know it.



The industry's opportunity

are simply not keeping up with the demands of the new digital enterprise. We need different types of education and training programs. It is not just governments and educational institutes; only a small number of forward-thinking enterprise companies are doing enough to help skill the next generation.



As we look to the opportunity ahead, we must remember that this kind of massive disruption on the workforce has happened before. As an example, if we go back to the 1800s, more than 50 percent of the population in countries including France, Poland, Italy and the United States were employed in agriculture; as of 2012, that percentage drops down between 12 and two percent.²⁶

What happened was that the industry adapted and evolved. As our world moved from agriculture to industrial, new jobs were developed; new skillsets were identified; new professions were created; and new opportunities were opened for innovation, growth, and prosperity.

With evolving industries and changing technologies, it is clear there is now another opportunity for leaders in our industry to drive that same kind of workforce transformation today to continue to advance the future of our economies and industries. The question becomes: Are we able to support these new professions and expectations with our existing education, learning systems and institutions, and more likely the existing mindset?

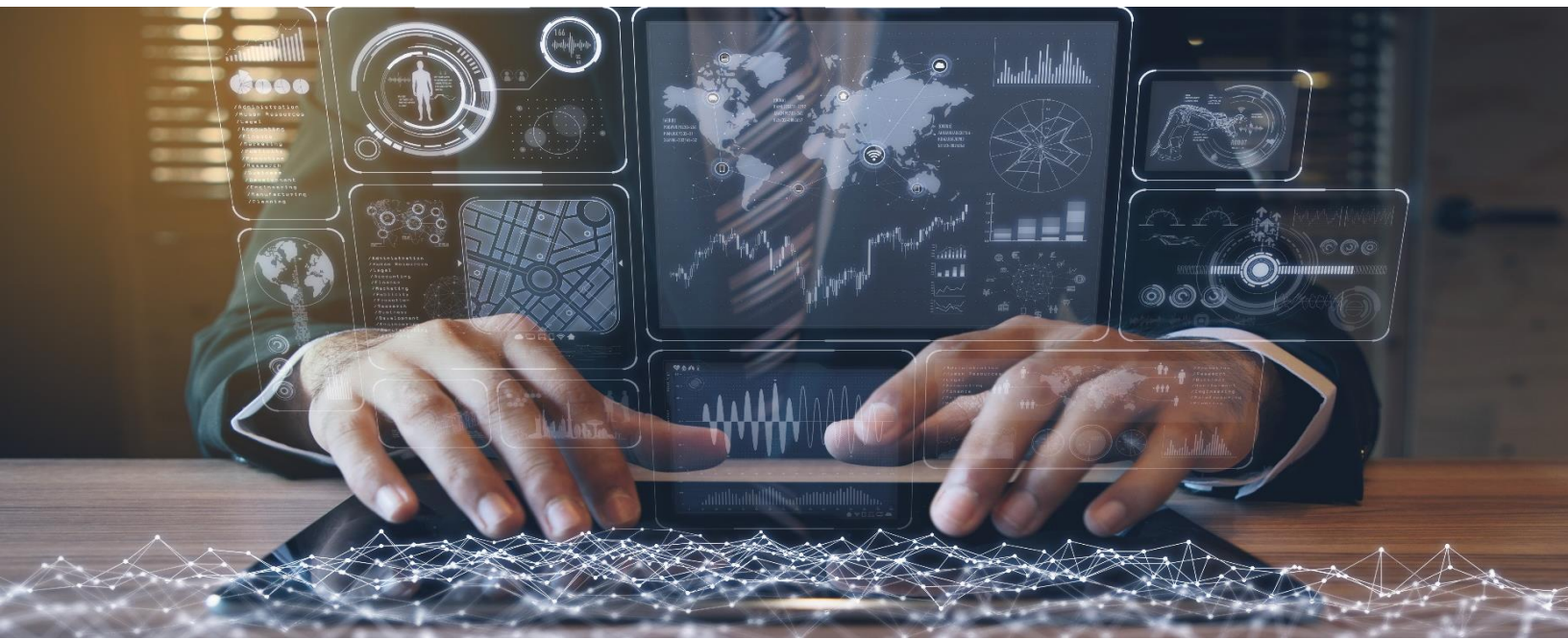
To support our new millennial workforce, as well as our current workforce that needs to remain relevant, we will need to rethink high schools, colleges, vocational education, industry training, and on-the-job readiness activities to ensure the next generation is ready for the future of work with more specialized skills like software development, data and analytics.

Broadening the pipeline of diverse talent flowing into the industry is also critical. The good news is that many communities and countries have developed new innovations to address this issue, and there are opportunities to learn from these emerging practices. Some are new approaches to longstanding programs, like Switzerland's successful youth apprenticeships. Others are more recent innovations spurred by entities such as LinkedIn and its online

tools and services, and nonprofit ventures like the Markle Foundation's Skillful initiative in Colorado.²⁷

To get students on the path of Science, Technology, Education and Math (STEM) programs, education investments need to start early, beginning with elementary school. Microsoft is an example of a company working to expand the pipeline for the next generation of technology leaders, including programs such as our YouthSpark global initiative that has created new opportunities for more than 227 million young people in 100 countries, and our

we also need to think beyond coding and computer science to data science and other fields that are growing in importance as we journey through the world's Fourth Industrial Revolution. I believe these roles should be particularly focused around AI and data analytics, including professionals such as software developers, data scientists and chief digital officers (CDOs) who have the skills to draw actionable insights from the unprecedented wealth of information that AI systems now give us. The World Economic Forum confirms this trend, finding



[DigiGirlyz](#) program that has reached more than 26,000 young girls around the world with technology career education.

We also offer our [Microsoft Professional Program in AI](#), a publicly available program that provides job-ready skills and real-world experience to those looking to improve their skills in AI and data science through a series of online courses that feature hands-on labs and expert instructors. The program is part of a larger corporate effort that also includes the enterprise developer-focused [AI School](#), which provides online videos and other assets to help developers build AI skills and use offerings such as [Microsoft Cognitive Services](#) and the [Azure Bot Service](#).

As we plan for the new roles that need to be filled,

that the skills required to perform most jobs will shift significantly in the next few years, with the top emerging roles focused on Data Analysts/Scientists, AI/Machine Learning Specialists and Digital Transformation Specialists.²⁸

Lastly, we will need to adapt employment laws and labor policies to address the new realities of advanced technologies like AI. Many of our current labor laws were adopted in response to the innovations of the early 20th century. Now, 100 years later, they are no longer suited to the needs of either workers or employers. For example, employment laws in most countries assume that everyone is either a full-time employee or an independent contractor, making no room for people who work in the new economy for Uber, Lyft or makers in manufacturing, and other similar services that are emerging.²⁹

Where do we go from here?

As we can see, the nature of how we work—and the workplace itself—is undergoing a dramatic transformation. I agree with Barret Kupelian, Senior Economist at PwC, who has said: "Technological breakthroughs are a disrupting force for businesses and workers. But for those businesses that can adapt fastest to new technologies, and for workers with characteristics that machines do not currently have—such as creativity and empathy—improvements in technology could deliver substantial gains."³⁰

As we have already established that every enterprise will become a software or an AI company and will need to adopt "digital" to avoid becoming obsolete, there is a ton of new software to be developed and virtually unlimited data to be reasoned over. We have also acknowledged the important role that AI has to play here. The transformational possibilities of AI for manufacturers, employees and the industry-at-large are enormous. Skilling-up for an AI-powered world involves more than science, technology, engineering and math. As computers behave more like humans, the social sciences and humanities will become even more important. Languages, art, history, economics, ethics, philosophy, psychology and human development courses can teach critical, philosophical and ethics-based skills that will be instrumental in the development and management of AI solutions. If AI is to reach its potential in serving humans, then every engineer will need to learn more about the liberal arts and every liberal arts major will need to learn more about engineering.³¹

Microsoft's call to action to technology companies, enterprise customers, education institutions, policy

makers, industry leaders and political decision-makers is to work collaboratively and take steps quickly to re-skill the workforce and transform the education system to ensure we have the right roles in place to take us to the next industrial revolution and beyond.

This means opening up to a new societal mindset in terms of how we think about preparing our future workforce—an integrated approach that leverages advanced technologies like AI and automation, while still focusing on empowering employees to reach their full potential with new skills. Similar to the culture change we are driving here at Microsoft, our industry, as well as our workforce, needs to become continuous, agile learners.

Change is constant. Change is fast. Change is disruptive. Transforming from a fixed mindset to a growth mindset that is open to continuous learning will move us in the right direction—and quickly. Thinking big, starting small, and moving fast very much applies to our global workforce transformation opportunity as well.

The future of manufacturing is in the hands of our current leaders. We need to transition to a state of a digital leadership, which means rather than simply reacting to the disruptive changes that technology is creating all around us, we are proactively embracing change to eagerly pursue the digital transformation opportunity for our workforce.

And that opportunity is here. It is now. Let us lead with "opportunity," not with "risk."



Technological breakthroughs are a disrupting force for businesses and workers. But for those businesses that can adapt fastest ...improvements in technology could deliver substantial gains.



Additional insights

- Çağlayan Arkan's blog
- Twitter: [@Caqlayan_Arkan](#)
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¹[Intelligent Economies: AI's Transformation of Industries and Society](#)

²[The Baby Boom Cohort in the United States: 2012 to 2060](#), Sandra L. Colby and Jennifer M. Ortman, May 2014

³ World Economic Forum and Deloitte Touche Tohmatsu Limited, "Global Skills Gap: Millions of Manufacturing Positions Unfilled," 2012

⁴[ThomasNet's annual Industry Market Barometer® survey of North American manufacturers](#), November 2014

⁵[Manufacturing Sector Industry Profile](#), First Research, January 2016

⁶[Keystone Strategy interviews Oct 2015 – Mar 2016](#). Based on interviews with 340+ leading enterprises comparing data platform maturity with business performance, controlling for company size and industry. Incremental operating income of \$100M is based on median company revenue of \$3.4B.

⁷[PwC's Global Artificial Intelligence Study – Exploiting the AI Revolution](#)

^{8, 23 & 30}[Rise of the robots – good news or bad for business and society?](#) PricewaterhouseCoopers, October 2016

⁹[Industrial Robot Cost Decline](#), Sam Korus, ARK Analyst, August 2017

^{10, 12 & 28}[World Economic Forum](#)

¹¹[Right-skilling for your future workforce](#), McKinsey & Co. August 2018

¹²[Older Workers](#), U.S. Bureau of Labor Statistics, July 2008

¹⁴[Europe's changing population structure and its impact on relations between the generations](#), European Commission, March 2005

¹⁵[Reshoring Initiative Focuses on Increasing U.S. Manufacturing by 40%](#), Candace Roulo, September 2018

¹⁶[Poll: Most Workers More Concerned About Outsourcing than Automation](#)

¹⁷[27 US Outsourcing Statistics and Trends](#), Brandon Gaille, May 2017

¹⁸[Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages](#), McKinsey & Co.

¹⁹[Strategy, Not Technology, Drives Digital Transformation](#), 2015 Digital Business Global Executive Study and Research, MIT Sloan Management Review, July 2015

²⁰[AI-Ready or not: Artificial Intelligence here we come!](#) Weber Shandwick and KRC Research

²¹[Infographic: The Accelerating Digitization of the US Economy](#), McKinsey & Co.

²²[The U.S. will be hit worse by job automation than other major economies](#), April Glaser, March 2017

²⁴[Who is ready for the coming wave of automation? The automation readiness index, 2018](#)

²⁵[Employment in agriculture Our world in data](#)

^{26, 28 & 30}[The Future Computed – Artificial Intelligence and its role in society](#)