Skills, Credentials, and the Workforce of the Future

The Promise of Technology and the
Role of the Public and Private Sectors

Executive Summary

Artificial intelligence and machine learning will change the world of work faster than earlier technological shifts.

- The last 60 years have seen a dramatic uptick in workplace automation, first through implementation of information and communication technologies, and more recently with intelligent technologies such as artificial intelligence (AI) and machine learning (ML). The economic expansion accompanying this shift has raced to outpace the associated job displacement. However, the rate of labor market change is increasing—and soon, traditional workforce development models will be unable to keep up.

- Our current employment system is straining under the weight of these shifts, with employers struggling to identify, develop, and match talent to opportunity. The rapidly changing nature of work that was already underway has been compounded by the swift and widespread economic disruption brought on by the COVID-19 pandemic in 2020. As the crisis both exacerbates existing workforce challenges and continues to upend labor markets in its own right, it will continue to accelerate the pace of workforce change and heighten the urgency of the task before us.

- Even prior to COVID-19, traditional models of skills acquisition had fallen behind, and evidence points to the existence of a global skills gap in which employees increasingly faced challenges in meeting new demands on how to perform their work. The economic impacts of the COVID-19 made these challenges more acute.

- The changing nature of work has increased demand for new forms of credentialing. As employees have turned to nontraditional sources such as online courses and non-degree higher education to keep up with shifting skills requirements, traditional credentialing systems such as diplomas and certificates fail to effectively document and evidence workers' skills.

Technology will help address these challenges by identifying skills needs and enabling credentialing.

- AI and ML tools can help employers identify their organization's skills profiles and gaps, match internal talent to projects and jobs, and support workers throughout their careers. Skills cloud, a machine-learning–powered universal skills ontology feature in Workday Human Capital Management (HCM), is an example of this technology in action.

- Other technologies such as blockchain can help modernize credentialing, allowing workers to instantly and nimbly prove their experience and skills, including those from nontraditional sources. The recently launched Workday Credentials offering, powered by blockchain, applies this approach to the credentialing challenge.

The private sector has a key role to play in addressing workforce challenges.

In the area of training and skills acquisition, employers should:

- Prioritize lifelong worker training and on-the-job skills development through increased investments and institutional adjustments

- Use innovative technologies such as ML to more accurately assess their skills gaps and hiring needs

- Partner with educational institutions to develop talent pipelines and establish online training platforms

In the area of credentialing, employers should:

- Embrace digital credentialing by supporting the development of open data infrastructure that can link different credentials systems and assure their quality

- Ensure credentialing benefits everybody by helping employees translate experience and skill sets into credentials, and safeguarding the portability of credentials so they serve workers throughout their career

Government has an indispensable role to play in workforce development.

- Government can improve workforce data collection and analysis by consolidating disparate sets of existing workforce data, incentivizing employers to improve and standardize their data collection, and facilitating the development of open data infrastructure to more deeply understand the nature of the workforce challenge.

- Governments should pursue policies that incentivize standardized and reliable credentialing. Rather than attempting to develop one universal credentials system, the public sector's ability to centralize and coordinate will be critical in developing credentials systems that are interoperable, built on open data, and based on quality assurance standards that guarantee their reliability.

- Governments should support training and skills acquisition programs that will prepare workers for current and future in-demand skills. Tax incentives, grant-matching programs, and publicly funded training initiatives are tools the government should consider in order to ensure their workforces do not fall behind.

Social considerations are also vital to any discussion of workforce development.

- Recent events have brought to light important examples of racial and social injustice that are too prevalent in our world today. Unfortunately, the rapidly changing nature of work can perpetuate these examples with disadvantaged communities facing the most rigid barriers to employment and, in many cases, have jobs that are most vulnerable to automation. Better data on skills gaps and the more targeted training programs that result can drive workforce equity, while modernized credentialing can open the door to new opportunities that previously seemed inaccessible.

- Despite the benefits new technology will bring into the workplace, it is inevitable in any workforce disruption that some workers will find themselves displaced. In light of this possibility and the ongoing worker displacement caused by COVID-19, governments should consider strengthening social safety nets to ensure that public healthcare, unemployment insurance, welfare, food stamps, and other resources are sufficient to support those in need.

- Data should be used to help workers target their training and learning and more effectively match their talents to open opportunities. However, just because a worker has a certain skill set does not mean that they should be precluded from exploring other areas. Data should play a constructive role in opening up new opportunities, rather than restricting workers to one particular trajectory.

I. Introduction

The nature of work is changing at an unprecedented rate. Disruptive technologies are transforming how jobs are being performed and shifting the skills employers need from their workers. As a result, the workforce must now be differently and better trained, and be able to adapt quickly to succeed.

Artificial intelligence—and in particular machine learning—is a leading driver of workforce transformation. While its full potential still remains untapped, ML technologies are becoming increasingly capable of performing sophisticated tasks. Among other things, ML can now recognize and respond to human speech, translate languages, determine patterns from large data sets, provide predictions to assist in decision-making, identify complex images (such as human faces), steer cars and trucks, and assist with medical diagnoses and surgical procedures.

Although new technologies have driven workforce changes throughout history, most notably the Industrial Revolution and twentieth-century automation, the pace of contemporary change is unprecedented. As a result, the related challenges of ensuring that new members of the workforce are adequately trained and credentialed and mid-career workers are meaningfully retrained and repositioned are proving more difficult now than in the past.

Combined with these challenges is a new uncertainty: the impact of COVID-19 on both the economy and jobs. The crisis has already upended the labor market in unprecedented ways, driving historic levels of unemployment, decimating family earnings, and weakening the economic shock absorbers that have traditionally undergirded economies in crisis. The economic fallout will exacerbate the shortcomings of contemporary workforce development models, both by accelerating the pace of change and dramatically increasing its scope. Critically, those who are most acutely feeling the brunt of the current crisis— mid-to-late-career workers and workers without a formal education—are also those who were already in need of a new approach to workforce development.

Given these rapid and far-reaching shocks, understanding the impact of intelligent technologies on the workforce is ever more critical. To the extent that ML and other technologies have driven labor market disruption, they also offer the tools necessary to improve outcomes for workers and employers alike. ML can be deployed across industries to identify opportunities, promote worker mobility, and facilitate the development of new skills and the enhancement of existing ones. With sufficient data, ML technology can identify skills needed by industry, demography, and geography, improving the precision of training and skills acquisition efforts. Advanced technology can also help tailor skills education to particular users.

But employers and governments alike must take proactive and coordinated approaches to fully leverage the capabilities of ML, particularly as they develop responses to the COVID-19 crisis. If together they provide the education, training, and resources that workers need to seize these new opportunities, they can accelerate positive outcomes for millions of workers. This is particularly true for vulnerable communities not only across the United States, but also worldwide.

Workday offers this paper to help guide the conversation about how to adequately account for these current and impending workforce changes.

- Part II begins by providing some historical context on technology-driven workforce shifts and traditional models of training and skills acquisition before showing how new technology has strained traditional workforce development models. The section concludes with background on the current skills gap, the importance of credentials, and the potential for AI and ML to overcome these challenges, providing foundational tools to help match talent to opportunity.

- Part III examines industry and other private-sector efforts to address training and credentialing, offering recommendations for improving skills acquisition and embracing digital credentialing systems fit for the new world of work.

- Part IV proposes ways the government can advance meaningful and forward-thinking workforce development policies that not only coordinate efforts in these areas but also incentivize private sector participation and support.

- Part V concludes by discussing the social implications of technology and workforce development, focusing on ways that emerging technologies can be used to foster a more inclusive and equitable labor market and bring about much broader workforce participation toward the goal of leaving no one behind.

II. Development of Skills in a Changing Labor Market

A. The Constant of Labor Market Change

Since the Industrial Revolution, the labor market has faced technology-driven disruption. Between 1765 and 1776, James Watt improved the efficiency of steam engines by three times, harnessing energy beyond that capable of being generated by humans or animals.[1] In more modern times, we've seen the impact of Moore's Law, where the number of transistors on computer chips doubled every two years.[2] As a result, today's iPhones have 100,000 times the processing power of the computer on Apollo 11, the spacecraft that sent men to the moon.[3] In contrast to Watt's advancement, this transformation is less related to the ability to harness energy—energy consumption did not increase as computer chips advanced—than about the ability to do faster and more complex computations. Today, AI and ML are enabled by a combination of processing power, data, and network capability that are growing even faster, at an exponential rather than linear pace.[4] All told, over the last 60 years, efficiency-created economic expansion stemming from computerization and corresponding workplace automation has accelerated the pace and scope of change.[5]

Even prior to the rapid changes ushered in by computerization, technological innovation has had uneven and unpredictable effects on the demand for skills. In the first part of the twentieth century, the rise of mass production saw skills premiums fall as craftsman workers were displaced by assembly line workers who held mostly routinized single-task jobs. As the century progressed, however, evolutions in assembly line technology reversed this trend, requiring workers to gain more skills to keep up with the growing capabilities of modern machinery.[6]

More recently, job growth has been faster in more highly skilled roles requiring more preparation. For example, between 1980 and 2015 in the U.S., jobs requiring high levels of preparation, such as training, experience, and education, grew by 68 percent, while lower preparation jobs only grew by 31 percent. And while employment growth for all U.S. jobs was 50 percent between 1985 and 2015, occupations requiring advanced analytical skills grew by 77 percent, and those

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[1] Georgios Petropoulos, J. Scott Marcus, Nicolas Moës and Enrico Bergamini, *Digitalisation and European Welfare States*, Bruegel (2019) https://bruegel.org/wp-content/uploads/2019/07/Bruegel_Blueprint_30_ONLINE.pdf

[2] Gordon E. Moore, "Cramming More Components onto Integrated Circuits," Proceedings of the IEEE (Jan. 1998) http://www.cs.utexas.edu/~fussell/courses/cs352h/papers/moore.pdf

[3] Graham Kendall, "Your Mobile Phone vs. *Apollo 11*'s Guidance Computer," *RealClearScience* (July 2019) https://www.realclearscience.com/articles/2019/07/02/your_mobile_phone_vs_apollo_11s_guidance_computer_111026.html

[4] Klaus Schwab, "The Fourth Industrial Revolution: what it means, how to respond," World Economic Forum (Jan. 2016) https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

[5] Conor McKay, Ethan Pollack, and Alastair Fitzpayne, "Automation and a Changing Economy: Part I: The Case for Action," The Aspen Institute Future of Work Initiative (Apr. 2019) https://assets.aspeninstitute.org/content/uploads/2019/04/Automation-and-a-Changing-Economy_The-Case-for-Action_April-2019.pdf?_ga=2.258459918.508065216.1578958080-436134758.1578958080

[6] Matthew F. Mitchell, "Specialization and the Skill Premium in the 20th Century," Federal Reserve Bank of Minneapolis and University of Minnesota (Jul. 2001) https://www.minneapolisfed.org/research/sr/sr290.pdf

demanding sophisticated social skills grew by 83 percent.[7] It is clear, though, that the final story of technology's effects on skills demand over time has not yet been written. While it is far too early to assess its aggregate impacts, the COVID-19 pandemic will almost certainly affect how technology interacts with in-demand skills, particularly as many higher skilled workers turn to telework, and lower-skilled jobs traditionally performed in-person become increasingly reliant on new uses of technology.

However, where technology's impact on the demand for skills has been historically unpredictable, it is relatively easier to see its effects on job growth in general. And while it is clear innovation can cause labor market turbulence in the short-term, long-run aggregate job growth almost always follows. John Maynard Keynes termed this concept "technological unemployment," and posited that while new technological advances could create job displacement in the short-term, the economic benefits from that innovation would create more jobs in the long run. As Keynes put it, technologically induced unemployment "is only a temporary phase of maladjustment."[8] Innovation can drive long-term employment growth in multiple ways. New innovations may increase demand for a product, thereby increasing required labor inputs. Innovations that create efficiencies can also produce cost savings that are passed on as increased hiring. Finally, technological innovations that are large enough to induce structural labor market shifts, such as AI and ML, can create entirely new industries and occupations that are large enough to absorb disruptions elsewhere in the economy.[9]

During the Industrial Revolution and the twentieth century—and into the twenty-first century—this was largely true. There were certainly job shifts and displacements from new technologies, and individual workers faced hardship as a result. But overall, new technologies generally benefited all segments of the workforce, and with time the labor market adjusted.[10] One illustrative example is the rise of the automobile in the United States. According to a McKinsey Global Institute analysis, that particular innovation eliminated over 600,000 jobs held by wagon and carriage manufacturers, railroad workers, horse breeders, message couriers, and many others. However, those dislocations were offset by the creation of entirely new industries and occupations. From new manufacturing and supply chain jobs to enabled industries such as insurance, dealerships, and

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[7] Kyaw Khine, "A Greater Number of Jobs Require More Education, Leaving Middle-Skill Workers with Fewer Opportunities," Weldon Cooper Center for Public Service, University of Virginia (May 20, 2019) http://statchatva.org/2019/05/10/a-greater-number-of-jobs-require-more-education-leaving-middle-skill-workers-with-fewer-opportunities/

[8] John Maynard Keynes, *Essays in Persuasion* (1963)

[9] James Manyika et al., "Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation," McKinsey Global Institute (Dec. 2017) https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Future%20of%20Organizations/What%20the%20future%20of%20work%20will%20mean%20for%20jobs%20skills%20and%20wages/MGI-Jobs-Lost-Jobs-Gained-Report-December-6-2017.ashx. For more on the relationship between technology innovation, short-term labor, displacement, and long-term aggregate job growth, see David Autor and Anna Salomons report "Is Automation Labor Share-Displacing? Productivity Growth, Employment, and the Labor Share," Brookings Institution (Spring 2018)

[10] Robert D. Atkinson and John Wu, "False Alarmism: Technological Disruption and the U.S. Labor Market, 1850-2015," Information Technology & Innovation Foundation @Work Series (May 2017) http://www2.itif.org/2017-false-alarmism-technological-disruption.pdf?_ga=2.220773264.943012136.1579216872-1070064553.1579216872

gas stations, the advent of the automobile created 6.9 million net new U.S. jobs between 1910 and 1950.[11]

The rise of computing offers another illustrative example of technological innovation's impact on long-run job growth. The trend toward computerization that began in the 1960s led to the demise of occupations such as typists, bookkeeping clerks, office-machine manufacturers, and other analog back-office roles, ultimately resulting in the loss of about 3.5 million jobs. However, research suggests that this technological shift also produced entirely new industries and roles, ranging from semiconductor and microchip manufacturing to the software and computer-enabled services industries—ultimately creating over 19 million net new jobs.[12] Importantly, this research shows the indirect effects that new technologies have on job creation. In the case of computerization, research found that of newly created jobs, only about 4 percent came directly from the computer manufacturing and supplier industries. Much larger shares of those new jobs came from professions enabled by the computer, such as the software industry (18 percent) and from occupations that simply use computers (over 75 percent).[13]

B. Traditional Models of Training and Skills Acquisition

Throughout these prior periods of technological innovation and shifting skills requirements, the model for skills acquisition remained relatively consistent. Traditionally, workers have acquired marketable skills through formal education (including secondary education and postsecondary education), apprenticeships, vocational training, and on-the-job training. In fact, the emphasis on formal education—the heart of traditional skills acquisition models—has grown considerably in the twentieth and early twenty-first centuries. Between 1940 and 2015, the percentage of 25 year olds in the U.S. with a high school diploma rose from around 25 percent to over 80 percent, and those with college degrees from under 5 percent to just under 30 percent.[14] This trend is expected to continue in future decades: jobs around the world are demanding higher educational requirements, albeit often as proxies for skills that could be gained in other ways that are less costly and more inclusive. As a consequence, demand for workers with secondary education or lower will decline in advanced economies.[15]

Two decades into the twenty-first century, the pace at which the nature of work is changing is accelerating dramatically—driven by both the COVID-19 crisis, as well as technological innovation and globalization more broadly.[16] Continued automation, fueled now by ML and other AI technologies, is changing how tasks are completed in the workplace and what skills workers need to complete

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[11] Id.

[12] McKinsey, "Jobs Lost, Jobs Gained"

[13] Id.

[14] Camille L. Ryan and Kurt Bauman, "Educational Attainment in the United States: 2015," U.S. Census Bureau (March 2016) https://www.census.gov/content/dam/Census/library/publications/2016/demo/p20-578.pdf

[15] McKinsey, "Jobs Lost, Jobs Gained"

[16] Pew Research Center, "The Future of Jobs and Jobs Training," (May 3, 2017) https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2017/05/PI_2017.05.03_Future-of-Job-Skills_FINAL.pdf

them.[17] At the same time, competition for jobs is more intense as trade barriers decline, supply chains become global, and more jobs relate to information rather than production of goods.[18] Further compounded by the rise of remote work en masse due to COVID-19, the net result is that location is less of a constraint on where many jobs can be performed, increasing the pool of available talent—even as changes to the labor market have placed a premium on specialized skills, often to the exclusion of many workers.

C. The Impact of ML

ML and other AI technologies will turbocharge the trend of increased workforce transformation, and traditional models of workforce development will strain to keep up. The precise manner in which ML will impact the demand for skills remains uncertain. On one hand, workers may needmore digital literacy skills to use ML technologies and creative reasoning skills that are hard for machines to replicate.[19] On the other hand, if systems provide more expert predictions and recommendations, it might benefit lower-skilled workers more by reducing the gap in abilities.[20] It is important to acknowledge that AI and ML encompass a wide variety of specific tools and uses, and their impact on skills requirements is likely to be equally uneven. The question of whether ML will favor particular skill segments largely depends on the type of ML tool used and the way it is deployed in the context of existing job tasks.

One possibility that does seem ever more likely is that there will be increased demand for digital skills. According to a Brookings Institution study that indexed the prevalence of digital content in 545 occupations employing 90 percent of the American workforce, in the first two decades of the twenty-first century the number of U.S. jobs requiring high levels of digital skills has more than quadrupled, from 5 percent to 23 percent of total employment—about 32 million jobs—while the number of jobs requiring little in the way of digital skills has fallen from 56 percent to less than 30 percent.[21] This trend is even more pronounced in the European Union, with estimates that 90 percent of the jobs will require some form of digital skills.[22] [23] These figures show that the trend toward increasing digital literacy skills was pronounced even before the outbreak of COVID-19. Now, early evidence shows a dramatic increase in telework, the

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[17] *Id.*

[18] Uri Dadush and William Shaw, "Globalization, Labor Markets, and Inequality," Carnegie Endowment for International Peace (Feb. 2, 2012) https://carnegieendowment.org/2012/02/02/globalization-labor-markets-and-inequality-pub-4702

[19] "Looking Ahead to the Future of Work Around the Globe," Mastercard Center for Inclusive Growth (Dec. 20, 2020) https://www.mastercardcenter.org/insights/looking-ahead-to-the-future-of-work-around-the-glob.

[20] McKinsey Global Institute, "Skill Shift: Automation and the Future of the Workforce," (May 2018) https://www.mckinsey.com/featured-insights/future-of-work/skill-shift-automation-and-the-future-of-the-workforc.

[21] Mark Muro, Sifan Liu, Jacob Whiton, and Siddharth Kulkarni, "Digitalization and the American Workforce," Brookings Institution (Nov. 2017) https://www.brookings.edu/wp-content/uploads/2017/11/mpp_2017nov15_digitalization_full_report.pdf

[22] Financial Tribune, "After 2020, 90% of Jobs Will Require Digital Skills," (May 28, 2018) https://financialtribune.com/articles/world-economy/87298/after-2020-90-of-jobs-will-require-digital-skills

[23] Julie Avrane-Chopard, Jaime Potter, and David Muhlmann, "How to develop soft skills," McKinsey (Nov. 11, 2019) https://www.mckinsey.com/business-functions/organization/our-insights/the-organization-blog/how-to-develop-soft-skills

potential that telework outlasts immediate public health requirements, and growing public opinion against returning to the office.[24] [25] Together, these changes are likely to further emphasize the importance of digital literacy skills in the future.

Given these rapid changes driven by both new technology and COVID-19, the traditional models for skills acquisition will continue to fall short, affecting many workers throughout their careers. The population most obviously affected by these changes is experienced and older workers. Historically, changes in the nature of work happened more gradually, allowing experienced workers to retrain with less disruption, or retire, before changes had fully taken effect.[26] Now, new technologies can reorient the workplace in a way that leaves little time for adjustment. For workers who have received minimal or no technological training, even low-wage jobs (which constitute a large portion of jobs held by older workers) can be transformed in a way that leaves those workers unable to adapt.[27] With the potential for COVID-19 to push this type of mid-career disruption beyond historic precedent, skills acquisition will become an even more critical piece of the workforce development puzzle.

D. The Skills Gap

The collective result of these developments is a phenomenon known as the "skills gap." Increasingly, research shows that a gap exists between the skills that employers need and the skills that workers possess. The skills gap appears to be an issue across the globe, with developed and developing economies reporting both a lack of qualified workers and a surplus of overqualified workers. In the European Union, for example, research suggests that over 20 percent of workers over the last 10–15 years have received either more or less formal education than is required for their job, relative to the actual skills needed.[28] And a 2013 survey by McKinsey found that respondents from Brazil, Germany, India, Mexico, Morocco, Saudi Arabia, Turkey, the United Kingdom, and the United States could find adequately skilled entry-level workers only 43 percent of the time.[29] Unsurprisingly, the growing skills gap may become a costly crisis, with one estimate suggesting that failing to close the gap could result in $11.5 trillion in lost economic growth in G20 countries by 2028.[30]

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[24] Katherine Guyot and Isabel V. Sawhill, "Telecommuting will likely continue long after the pandemic," Brookings Institution (Apr. 6, 2020) https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-likely-continue-long-after-the-pandemic

[25] Jessica Snouwaert, "54% of adults want to work remotely most of the time after the pandemic, according to a new study from IBM," Business Insider (May 5, 2020) https://www.businessinsider.com/54-percent-adults-want-mainly-work-remote-after-pandemic-study-2020-5

[26] Pablo Illanes, Susan Lund, Mona Mourshed, and Magnus Tyreman, "Retraining and reskilling workers in the age of automation," McKinsey & Company (Jan. 2018) https://www.mckinsey.com/featured-insights/future-of-work/retraining-and-reskilling-workers-in-the-age-of-automation. For example, the early 20th century shift from agricultural labor to manufacturing in Europe and North America took place over the course of decades.

[27] Allana Akhtar, "3 million older Americans can't find high-paying jobs, and it has nothing to do with skills. Here's the one barrier they face that no one's addressing," Business Insider (May 7, 2019) https://www.businessinsider.com/retraining-doesnt-help-older-workers-find-jobs-because-of-ageism-2019-5

[28] *Skill Shift*, McKinsey.

[29] *Id.*

[30] Accenture, "It's learning. Just not as we know it."(Sept. 18, 2018) https://www.accenture.com/us-en/insights/future-workforce/transforming-learning

In the future, the skills workers will need fall into two distinct but related categories.[31]

- Technological and digital skills, both basic and advanced, will increase in demand. Basic technological skills will be necessary to adapt to increasing automation and machine learning in the workplace, and advanced technological skills will be valuable to develop, regulate, and innovate technologies that are likely to continue developing rapidly. One estimate suggests that the need for technological skills could grow as much as 90 percent between 2016 and 2030.[32] As noted above, COVID-19 promises to accelerate this trend further.

- Effective workers will need to possess strong social, emotional, cognitive, and leadership skills—core human functions that are nowhere close to being replaced by machines. These so-called "EQ" skills include advanced communication and negotiation, empathy, leadership and management, entrepreneurialism, adaptability, and teaching and training, and they will become increasingly important as technology automates more rote workplace functions.[33] Demand for these skills is already growing and will likely continue to rise as changes to the nature of work continue to unfold. And while some employers have taken the initiative to assess the nature of their EQ skills gap and develop relevant training modules, dedicated attention to this issue is still in early stages.

E. Credentialing

The Rise of Credentialing. Changes to the nature of work will also affect how we document and evidence the skills that workers already possess. With the pace of change in the labor market driving both skills-based hiring by employers and the need for demonstration of skills mastery by workers, credentialing is poised to take the place of more traditional paths. Employers increasingly understand that looking at proxies for skills might exclude potential candidates that have nontraditional educational paths. And workers seeking to reskill on an ongoing basis in their careers are unlikely to take time out from their jobs to obtain another degree.

Instead, workers will take advantage of online courses, non-degree higher education programs, and other skills acquisition programs that are accessible, affordable, and efficient so as not to disrupt the worker's current employment while they pursue new opportunities.[34] Many workers will also develop competitive, marketable skills entirely on their own. Silicon Valley stands as a prime example, where one survey has found that 69 percent of developers were entirely or partly self-taught.[35]

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[31] *Skill Shift*, McKinsey; "The Future of Jobs," Pew Research Center; Accenture, "It's learning"

[32] *Skill Shift*, McKinsey.

[33] McKinsey, "How to develop soft skills"

[34] Pew Research Center, "The Future of Jobs"

[35] Cory Althoff, "The Rise of the Self-Taught Programmer and Why You Should Join Us," Medium (Feb. 8, 2017) https://medium.com/the-self-taught-programmer/the-rise-of-the-self-taught-programmer-3c87b4d9a2ea. Interestingly, the survey results also found that the second most common form of education among respondents was on-the-job training, ranking almost 10 percentage points higher than a formal degree.

Likewise, a focus on credentialing will enable employees to benefit even more from employer-instituted robust internal educational programs, tuition assistance, or other educational benefits for their workforces. Armed with more relevant information about the particular skills their workers need, employers are in a position to implement effective training programs and educational opportunities in the workplace. Via benefits offerings, they can also steer workers toward relevant external training programs. Unfortunately, such educational programs have largely fallen behind the rate of change in skills requirements.

The Need for More Robust Credentialing Systems. As skills acquisition takes new paths, credentialing systems have lagged behind. There is no standardized credentialing system for skills learned from nontraditional programs. As a result, skills that workers develop on the job are often viewed as less valuable and employers bear the burden of trying to understand the nature of alternative credentials.[36] Put simply, without a standardized and widely adopted credentialing system accommodating nontraditional learning avenues, employers may never be able to determine the difference in quality between two online courses that, say, teach the same coding language, even where real differences exist.

In addition, people are often somewhat ineffective and inexact at communicating the scope of their professional experience; they often do not know the full extent of their skill sets—an ironic fact at a time when the global workforce is likely more skilled than it has ever been before. The nature of work is complex and varied, and modern workers often carry out numerous tasks in the course of their jobs. AI and ML may be able to capture and properly classify those skills that workers currently fail to articulate or notice.

Overall, the gap between actual professional skill sets and the credentials used to validate those skill sets hinders both employers and workers: employers are left with fewer tools to identify candidates who fit the needs for their organizations, and workers have less exposure to career opportunities because they are unable to market their full skill sets. Twenty-first-century workforce development will need to account for and remedy this gap in order to facilitate improvements to the job market.

F. Aligning Talent with Opportunity

Fortunately, AI and particularly ML technologies offer a variety of powerful tools to help bridge this gap.

Training and Skills Acquisition. In particular, the unparalleled ability of ML tools to rapidly sift through millions of data points can enable employers to more quickly identify their needs and enable employees to identify opportunities that otherwise may not have surfaced. ML tools can help organizations identify skills that are missing within a particular position or within an organization more

Example Use Case: Nursing

Currently, when nurses pursue new jobs, they typically update their resumes or complete job applications, manually inputting credentials. After submitting, they may face waiting periods of a few weeks as the prospective employer verifies each and every license, certification, and work experience. Even after getting the job, ongoing verification is still needed to ensure compliance—often requiring additional annual verification checks by employers to ensure standards have been met and the license is still active. If a nurse falls out of compliance, it can lead to steep penalties for the employer, and unproductive time for that nurse.

As we look to the future, we envision a more frictionless credentialing process that could proceed as follows: Using a trusted professional profile containing verified credentials, that same nurse could digitally apply for a new job, with credentials being verified at the point of application. With education and licensing credentials automatically updating over time, any additional proof regarding renewal or certification is already confirmed, eliminating the need for the employer to manually check a database or call the board for validation. The nurse's credentials would act as the single source of truth: trusted, up-to-date, and instantly authentic.

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[36] Pew Research Center, "The Future of Jobs." Amy Ellen Duke-Benfield, Bryan Wilson, Kermit Kaleba, and Jenna Leventoff, "Expanding Opportunities: Defining Quality Non-Degree Credentials for States," National Skills Coalition (Sept. 2019) https://m.nationalskillscoalition.org/resources/publications/file/9.18-NSC_QNDC-paper_web.pdf

broadly. These tools can also scan internal data sources and present employees with potential opportunities.[37] Using ML tools for internal sourcing also enables a company to seek out passive candidates or those who might not have known about the position but who may be best suited for the job.[38]

The skills cloud technology in Workday HCM is one example of applying ML tools to the skills acquisition puzzle. Skills cloud unifies worker skills data from disparate internal worker-provided sources and leverages ML to recognize and identify related skills, consume new skills, and continuously learn. One fundamental challenge skills cloud set out to solve is that to effectively match talent to opportunity, organizations must first address skills data problems at the core of their workforce technology: that there are numerous ways to describe every skill, and skills—now more than ever—are constantly changing. The skills cloud ML relies on proprietary data, aggregated and deidentified customer-contributed data, and additional seed data from public sources, which allowed Workday to reduce 200 million skills down to 55,000 canonical skills and 100,000 synonyms. With the skills cloud foundation, Workday customers can use features such as talent marketplace, which provides managers with skills-based talent matching and recommendations, tailors training materials to individual worker skills, and allows leaders to seamlessly deploy talent across their organization for short-term gigs and projects.[39]

Credentialing. Workday has been building the world's most advanced network of verified credentials, powered by a new blockchain-based digital credentialing platform that allows verified credentials to be both issued and verified. In addition, new technologies such as blockchain, along with advancements in mobile security, have enabled Workday to imagine a new form of digital credential—one that puts individuals in control of their data via a mobile app and is portable, authentic, and secure. While credentials are issued by organizations and educational institutions, held by individuals, and shared with employers or prospective employers that need to verify them, blockchain provides a common trust layer, allowing each of these parties to independently verify their authenticity. As the common source of verification, blockchain enables data to move between parties, and its distributed ledger can prove that the credentials are still valid.[40] In this way, workers are able to build their own verified career capital as they move through their employment journey and gain new skills and experiences. Furthermore, by enabling a user to share only certain credentials with specific entities—for instance, an employer—blockchain enables a user to avoid having to share other aspects of their identity, thereby enhancing privacy.

Example: Skillshare

The online platform **Skillshare** offers a promising example of a way to broaden access to skills development. Skillshare is a U.S.-based online learning community that connects individuals with expertise in dozens of creative and entrepreneurial disciplines with others who wish to learn from them. In addition to taking classes, members can also use the site to receive feedback on projects, connect with others in their industry, and discover new career opportunities. The Skillshare community has reached more than 5 million members, of whom 6,000 are teachers, delivering courses from more than 100 countries around the world.

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[37] Falon Fatemi, "How AI Is Uprooting Recruiting," *Forbes* (Oct. 31, 2019) https://www.forbes.com/sites/falonfatemi/2019/10/31/how-ai-is-uprooting-recruiting/#73bda92046ce

[38] *Id.*

[39] "Workday Delivers Machine Learning-Powered Skills Cloud to Unlock Untapped Workforce Potential," Press Release (Oct. 2018) https://www.workday.com/en-au/company/newsroom/press-releases/press-release-details.html?id=1588881

[40] Jon Ruggiero, Workday Blog, Our Vision to Digitize Credentials in the New World of Work, (July 8, 2019) https://blog.workday.com/en-us/2019/our-vision-to-digitize-credentials-in-the-new-world-of-work.html

We are also taking this blockchain application one step further with our approach to openness. Technology is most powerful when it's open and interoperable, and this is especially the case with blockchain. Open standards have been a core part of our vision from the start of this project. Workday is actively engaged with organizations such as W3C and the Decentralized Identity Foundation (DIF) to ensure that credentials are compatible with other standards-based platforms. Developing our platform with open standards will enable the growth of a credentialing ecosystem, adding more value and opening up additional use cases for our customers and their employees over time. Workers should be able to earn verified credentials from different sources, import them into mobile wallet applications of their choice, and use those credentials broadly across different ecosystems. For instance, they could use them to apply for a job, be matched to a new opportunity, demonstrate skills in order to receive a promotion, or receive college credit for past achievements and experiences. Workers should have control over their credentials and should be able to use them to connect to opportunities and jobs in as many ways as possible.

III. Private Sector Initiatives and Recommendations

The private sector has already moved to address these pressing workforce development issues head-on. This has been particularly true in the context of industry responses to the COVID-19 crisis. Yet significant steps remain to be taken, both during the recovery and in the long-term, to align the labor market with the modern realities of work. Below are some key recommendations about how to begin this journey.

A. Training and Skills Acquisition

Adjust corporate mind-set with respect to training, talent development, and skills acquisition. The rapid pace of change to the nature of work shows no signs of slowing. As a result, there needs to be a shift toward a culture of continuous learning and skills development so workers can continue the educational process throughout their careers. Workers understand this—87 percent of workers polled in a recent survey believe that new job skills training will be an essential component of their careers.[41] However, to effectively incorporate these expectations into action, institutions must act boldly to embed a learning, development, and training mind-set into institutional culture.

Employers are uniquely positioned to play a role in creating and facilitating skills learning opportunities. They should consider whether training and skills development are represented in senior leadership and key functions within the organization. Commitment to these training goals should be broadcast to employees, with specific plans and policies for improving the training process. Additionally, research suggests that employers can change perspectives on lifelong learning by shifting to a more flexible corporate structure.[42] Reducing hierarchy and allowing for more cross-collaborative and organic teams to grow within an organization can facilitate an easier transfer of lessons and skills

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Example: Skillful

In partnership with Microsoft, LinkedIn, the state of Colorado, and many others, the Markle Foundation launched the **Skillful** initiative, which brings together key players across the labor market, including employers, state and local government officials, educators, and workforce centers, to help job seekers, workers, businesses, and educators adapt to the changing workplace and secure in-demand jobs. Its objective is to help job seekers access a variety of choices to achieve lasting career success, employers find the skilled talent they need to grow, and educators train people with the skills required to compete in today's economy. Skillful provides data, tools, and resources that enable businesses to define the exact skills they seek and turn those insights into a skills-based hiring process that allows job seekers and workers to articulate the skills they can bring to an organization.

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[41] Pew Research Center, "The Future of Jobs"

[42] McKinsey, "Skill Shift."

development, creating a process that becomes more organically integrated with a worker's existing job rather than standing as a separate obligation outside a worker's core duties.

Use emerging technology to inform decisions about reskilling. Emerging technology such as ML can help employees identify which particular skills are in demand, particularly when coupled with a unified approach to how we refer to skills. With sufficient data, ML can assess skills needs within a specific segment of a business, a business as a whole, an industry, or an entire geography. Experts have acknowledged that the effectiveness of targeted training programs can be increased when employers work together to find synergies between their relative strengths and training programs.[43] Currently, huge amounts of data exist related to workforce development, but those datasets are unrefined, separated, and incapable of being used for more broad-based analysis.[44] As employers begin to look at ways to modernize their training programs, they must also consider how they can utilize data to make informed and smart decisions with respect to industry-wide or workforce-wide initiatives that are strategically targeted to needs and enable all involved to benefit from shared information. Of course, such data sharing should be on an aggregated or anonymized basis to protect individuals' privacy.

Expand investments in training and retraining the workforce. Research suggests that while employers are aware of the widening skills gap, they have been slow to respond in a meaningful way. In a 2016 survey, only about 60 percent of employers reported that training and skills development were high-priority action items, with an equal number reporting an intention to invest in reskilling of current employees.[45] And only half of chief human resources officers were reasonably or highly confident that their organization was prepared for these labor market shifts.[46] Even if employers embrace the concept of training and skills acquisition, however, they cannot be successful if adequate resources are not directed at the issue and workers are not encouraged and incentivized to take advantage of those programs.

While the decision to increase investment in skills development is relatively straightforward, employers should not blindly invest in training without assessing their precise needs and developing programs accordingly. Despite significant writing about the future of worker training, employers and employees today still largely assess skills requirements through traditional processes such as performance reviews, informal research, and feedback from peers.[47] Targeted skills development strategies will require a modern approach that embraces

Visa University is a prime example of how a private enterprise can effectively adjust its internal approach to training, talent development, and skills acquisition and expand investments in training and retraining its workforce. Visa implemented a program to help track and evaluate how employees were learning and from what sources, which key learning moments contributed to exceptional leadership experiences, and how exceptional leaders were learning compared to their peers.

To create an enhanced learning culture, Visa established physical learning hubs and a digital learning ecosystem. Visa's Digital Campus, which consists of enterprise and functional colleges, offers a unified learning space where employees can create learning paths and develop skills to help them grow professionally. All individual and group progress is tracked by software, which measures and analyzes learning data across the organization. The Digital Campus' outcomes include improved communication, helping to better engage with learners regarding strategic business and organizational needs; improved user experience, encouraging learning through personalized recommendations; and analytics that support and enhance the user experience, helping Visa understand trends, correlations, and moments of need during an organizational learning slow-down. Six months after launch, more than 80 percent of the company had interacted with the digital campus.

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[43] World Economic Forum, "The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution," (Jan. 2016) http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

[44] Accenture, "It's learning." Aside from being siloed and unrefined, the authors point out that current workforce data is closed off, preventing external organizations from performing more advanced analyses such as combining disparate data sets and incorporating national government statistics.

[45] World Economic Forum, "The Future of Jobs."

[46] *Id.*

[47] The Adecco Group and The Boston Consulting Group, "Future-Proofing the Workforce: Accelerating Skills Acquisition to Match the Pace of Change," (2018) https://future-skilling.adeccogroup.com/downloads/Adecco_-_Future_skilling_report__2018.pdf

data, AI, and related technologies in order to design programs suited to each institution.[48] Technology can also enhance the training process itself through the use of emerging platforms such as smartphone apps, gaming, and augmented/virtual reality, which are shown to be increasingly effective in imparting long-term capabilities to workers.[49] In fact, research shows that virtual-reality–based experiential learning is significantly more effective than reading or lecture-based learning on the same topic.[50] Whether the traditional learning, self-learning, or experiential program is best will depend on the nature of each particular employer's operations, but an effective data platform will allow employers to identify the skills they most need and the workers best-suited to fulfill that requirement.

Consider incorporating external training and skills development efforts.
Worker training should not only be an internal-led initiative. Especially as it relates to technical skills, employers can better orient worker capabilities by partnering with educational institutions to develop talent pipelines.[51] Despite changes to the nature of skills acquisition, many experts believe that educational institutions, including colleges and universities, will continue to thrive in the future, because no educational experience can match the immersive nature of a focused instructional program.[52] By partnering with educational institutions, employers can develop mutually beneficial relationships where educational institutions are able to point to real-world employment outcomes, and employers can develop and identify talented workers early in their careers. These partnerships can involve both targeted classroom learning as well as experiential learning at the employer-partner worksite. Studies have suggested that experiential learning like this is one of the best ways to develop in-demand skills such as complex reasoning, critical thinking, creativity, and emotional intelligence.[53]

Beyond traditional educational institutions, most experts expect that online learning platforms will be a significant factor in worker training going forward. While some employers have already implemented some form of internal online training platform, they may also want to consider turning those programs outward and offering them to the public at large. In order to remain competitive in the job market, workers are looking for self-teaching opportunities, and employers who make that process easier and more accessible have the opportunity to orient that skills development in a beneficial way.[54] As more employers develop external-facing training programs, the collective result will be a more robust workforce composed of highly skilled, specialized, and agile workers, resulting in an expanded pool of candidates fit for jobs that have been challenging to fill with existing talent.

Example: Lumina Foundation

The Lumina Foundation is an instructive example of an organization designed for the primary purpose of broadening opportunities for learning beyond high school to all members of the workforce, including those from underrepresented communities. Lumina focuses on improving credentialing and works with governmental, nonprofit, and private-sector organizations to meet the nation's need for talent through a broad range of credentials. The foundation focuses on five priorities: a system for learning beyond high school that assures equitable access to affordable pathways and quality credentials; a new, national system of transparent, quality credentials beyond high school; a national expansion of competency-based learning; pathways to workforce certificates, industry certifications, and other initial credentials for adults; and an integrated quality assurance system for learning beyond high school.

Working in conjunction with Business Roundtable and JPMorgan Chase & Co., Lumina launched the nonprofit Credential Engine. In building this suite of web-based services to establish the first-ever centralized Credential Registry in a common description language, Lumina is making strides in the standardization of credentials.

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[48] *Id.*

[49] Pew Research Center, "The Future of Jobs."

[50] Accenture, "It's learning."

[51] World Economic Forum, "The Future of Jobs."

[52] Pew Research Center, "The Future of Jobs."

[53] Accenture, "It's learning."

[54] Pew Research Center, "The Future of Jobs."

B. Credentialing

Embrace digital credentialing. The key to overcoming credentialing limitations will be the ability to collect, analyze, and communicate information about worker competencies. Digital credentialing is an ideal tool for achieving that goal. There are currently numerous digital credentialing initiatives that vary in structure and approach.[55] An effective digital credentialing system should facilitate the transfer of credentials information between employers and industries so that workers can identify the full scope of jobs for which they are qualified. Such a digital credentialing system would maximize worker mobility and dramatically improve the ability of workers to find suitable positions within their industries and geographic areas.

Fundamental to an effective digital credentialing system is an open data infrastructure that allows different credentialing platforms to communicate with one another. Data on worker competencies will only be truly useful when it can be analyzed alongside other data encompassing entire industries, geographies, or the workforce writ large. ML can collect, compare, assess, and interpret divergent data sets to identify patterns and increase worker mobility. Workday products have already begun centralizing data, and the broader adoption of these types of tools will enable a deeper understanding of workforce composition.

A report from the European Commission recognizes the potential for improved credentialing through the use of blockchain.[56] In its 2017 report analyzing blockchain in education, the European Commission explains that blockchain technology holds the potential to dramatically update credentialing systems by accelerating the end of paper-based certification systems. Rather than issuing physical copies of these certifications or saving records about them on internal computer systems, blockchain would allow workers to log specific qualifications and records of achievement into a permanent, reliable, and secured database. In the future, advances to blockchain technology could be used to better track lifelong learning, log achievements, and assess competencies. This is just one example of a potentially complex and robust system for storing, analyzing, and interpreting credentials throughout the workforce.

Ensure digital credentialing benefits everybody. Employers are the primary entities that will both generate and collect data on worker credentials. But employees will also be beneficiaries. Employers should assist workers in identifying their credentials along whatever standardized metrics are being used. Portability of credentials benefits not only workers but also employers who seek to fill open positions with qualified candidates.

Along similar lines, employers should consider partnering with educational institutions to standardize credentials data and classifications early, both

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[55] Lumina Foundation, "Connecting Credentials: Building Learning-Based Credentialing Systems," http://connectingcredentials.org/resources/

[56] Alexander Grech and Anthony F. Camilleri, "Blockchain in Education," European Commission (2017) https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108255/jrc108255_blockchain_in_education(1).pdf

within the traditional academic/technical context, and as applied to emerging nontraditional credentialing. If workers can develop a credentials blueprint through their education prior to joining the workforce, they will be better primed to target jobs that need their skill sets. Additionally, students who are pursuing certain professional goals can assess their credentials as they develop or adjust their academic and work experience plans to better prepare themselves for the careers they intend to pursue.

IV. Public Policy

While efforts by the private sector will be indispensable in tackling these emerging workforce development issues, no discussion on how to manage the transition is complete without a robust focus on the role of government— its ability to serve as a central coordinator, incentivize forward-thinking workforce development practices, and connect emerging technologies across the globe means it can play a unique and powerful role. This has become especially apparent as governments around the world have turned to policy as a primary tool in their response to the COVID-19 pandemic and its effects on the workforce. This section describes some of the most important actions governments can take now to position global workforces for success as the nature of work continues its rapid evolution.

Facilitate improvements to workforce data collection and analysis. As previous sections make clear, Workday believes that technology holds the key to achieving positive workforce development outcomes. Two factors are critical to this outcome: useful data, and open data platforms. The government's centralized position makes it an ideal entity to facilitate both.

For AI and ML to most effectively help us understand and improve workforce development, it is critical that data be continuously collected across all metrics. Government can encourage and even incentivize employers to collect relevant data and provide best practices for how to do so. Coordination with private companies or related organizations already operating in this space will be necessary in order to identify the most effective data collection methods. Some government-affiliated databases already exist. For example, in the United States, the Occupational Information Network commonly known as O*NET is a free online database containing data on occupational requirements and worker attributes, open to businesses, workforce development professionals, job seekers, and students.[57] A similar database has been developed by the European Commission.[58]

These databases provide useful longitudinal datasets. However, given the lag-time associated with a survey approach and emphasis on persisting occupational roles, they are ill-suited for the kind of demand signals needed to effectively assess and classify worker competencies and emerging in-demand

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[57] O*NET OnLine, Employment & Training Administration, U.S. Department of Labor,
https://www.onetonline.org/

[58] European Skills, Competences, Qualifications, and Occupations, European Commission,
https://ec.europa.eu/esco/portal/home

roles across the labor market. A good first step would be for the U.S. government to bring together disparate datasets, such as its O*NET database,[59] based on survey data and Bureau of Labor Statistics data sources,[60] based on both survey and claims data, into a single data pool for use by the private sector. In addition, congress can play a role by directing the Department of Labor to convene a collaborative process involving government, industry, and advocacy stakeholders to study what an O*NET 2.0 could look like. Just as the print-based Directory of Occupational Titles of the 1930s evolved into the online O*NET database of the 1990s, new technologies such as artificial intelligence yield benefits in tackling the task of providing broad and timely occupational information economy-wide[61] While maintaining the longitudinal nature of the O*NET data, new public-private tools should be developed that support the standardization of existing government and private sector data sources, modernize data collection mechanisms, deepen the breadth of included roles, and expedite the reporting of analysis and projections.

Once generally accepted standards of data collection have been adopted, the government can also help to harness the breadth and power of that data and continue its partnership with the private sector in order to better understand that information and set workforce training and skills acquisition policies based on real need. Even if relevant data is collected, private employers must commit to working with the government to pool resources, map skills demands, and identify deployment opportunities across industries and geographies.[62] In turn, this will require private companies and other employers to submit their data on open platforms for shared analysis. The government will be a critical player in bringing industries together and facilitating the open sharing of workforce data. As a first step, the government can establish and seek to incentivize the use of voluntary data reporting systems for government and industry alike that would enable real-time data transfer to create a data pool of occupations and skills.

Pursue policies that incentivize standardized and reliable credentialing. Like its potential to improve the collection and analysis of workforce data, the government can also play an important role in promoting modern credentialing systems. As described in previous sections, a single digital credentialing system is not necessary to achieve standardization in classifying worker credentials. Rather, open platforms that permit AI and ML to analyze and translate data are the key to modernizing the credentialing process. To the same extent that the government should generally incentivize the collection and coordination of workforce data, it should do the same with digital credential systems. One example of a potential private-public partnership in this area is the American Workforce Policy Advisory Board's proposal for the Interoperable Learning Records system, which would contain and manage credentials communications

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[59] O*NET OnLine.

[60] Bureau of Labor Statistics, U.S. Department of Labor, ""Databases, Tables & Calculators by Subject." https://www.bls.gov/data/

[61] RTI International, "Occupational Information Network (O*NET)." https://www.rti.org/impact/occupational-information-network-onet

[62] World Economic Forum, "The Future of Jobs."

reflecting an individual's skills and achievements.[63] Within the U.S., the Department of Education and Department of Commerce should continue the convening role they are playing in support of an interoperable credentialing ecosystem. Similarly, congress can support the uptake of digital credentials by highlighting their benefits to the government and private sector workforces (for example, passing a resolution that supports secure, verified, digital credentialing technology) as well as calling on the National Institute for Standards and Technology (NIST) to assist with promoting interoperability, including where valuable work is already being done by the World Wide Web Consortium (W3C) with its Verifiable Credentials Data Model.[64]

In addition to incentivizing a standardized approach, governments should consider implementing certain quality assurance standards for credentialing. While much of the discussion about credentialing assumes that AI, ML, or related technology will perform the analysis, some proposed systems would merely provide credentials on a permanent digital platform. In that context, the government has an interest in imposing minimum quality assurance standards on the credentialing systems to ensure some level of reliability. Some jurisdictions, including several states in the United States, have started to study and implement quality assurance standards for certain non-degree credentials, namely certificates, apprenticeship certificates, industry certifications, and licenses.[65] Building on this, the Department of Labor could recognize accreditation bodies for credentials, much like the Department of Education does for accreditation bodies for educational institutions.[66] This would help increase acceptance of credentials and give those obtaining them confidence in their quality. Similarly, the EU should accompany its work on the Europass Digital Credentials infrastructure to include accreditation and recognition of digital credentials so they can be shared across Member States.[67]

Lead the charge on training and skills acquisition. Governments across the globe have played an active role in facilitating and incentivizing training and retraining programs for individuals in the workforce. In the United States, for example, the Department of Labor's Education and Training Administration oversees numerous training programs aimed at helping workers develop the skills they need to become or remain competitive in the labor market.[68] In addition, the National Council for the American Worker was created in 2018 by executive order and is comprised of senior federal officials charged with creating

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[63] American Workforce Policy Advisory Board, "White Paper on Interoperable Learning Records," (Sept. 2019) https://www.imsglobal.org/sites/default/files/articles/ILR_White_Paper_FINAL_EBOOK.pdf

[64] World Wide Web Consortium (W3C), "Verifiable Credentials Data Model 1.0," https://www.w3.org/TR/vc-data-model/

[65] National Skills Coalition, "Expanding Opportunities." The National Skills Coalition identified six specific states in the U.S. that have made strides in credentialing quality assurance standards: Alabama, Iowa, New Jersey, Tennessee, Virginia, and Washington.

[66] U.S. Department of Education, "Accreditation: Postsecondary Education Institutions," https://www.ed.gov/accreditation

[67] European Commission, "Europass Digital Credentials Infrastructure," https://ec.europa.eu/futurium/en/europass/europass-digital-credentials-infrastructure

[68] Employment and Training Administration, U.S. Department of Labor, https://www.dol.gov/agencies/eta

a national strategy to ensure students and workers have the education and training needed to compete in today's economy.[69] Moving forward, governments should continue to identify and incentivize training programs oriented toward developing skills that will be marketable in the future. If efforts to collect and coordinate workforce development data are successful, then governments will be in a strong position to identify effective training programs. While there are well-established federal approaches to workforce training and reskilling (for example, programs authorized under the Workforce Innovation and Opportunity Act), as congress seeks to provide COVID-19 assistance to workers it should consider an incremental or iterative method for implementing a skills-based approach for federal workforce programs.

In addition, governments should provide tax incentives for private employers to develop and open training programs and support workforce reskilling. Workday supports the passage of Sen. Warner's (D-VA) and Rep. Krishnamoorthi's (D-IL) Investing in American Workers Act (S.538, H.R. 5102), which would provide a worker retraining tax credit modeled on the R&D tax credit.[70] Specifically, it would give businesses a tax credit of 20 percent of what they spend above a baseline for worker training (limited to training for those earning $85,000 or less). Similarly, Sens. Klobuchar (D-MN), Sasse (R-NE), Booker (D-NJ), and Scott (R-SC) introduced The Skills Renewal Act, which would provide a $4,000 refundable tax credit to cover the costs of needed training for those impacted by the COVID-19 response. Proposals should also be considered that would provide employers greater flexibility in providing workers educational assistance under Section 127 of the Internal Revenue Code (for example, S. 2007, The Upward Mobility Act, introduced in the 115th Congress by Sens. Flake, R-AZ, and Cortez Masto, D-NV). Governments can further promote partnerships between businesses and community colleges to support training for post-high-school graduates or dual-degree students through funding or tax credits. On the individual level, the government could allow Coverdell accounts and Pell grants to be used to gain non-degree, accredited credentials.

The government can also be a leader in the training space, exploring options for implementing its own low-cost or free training programs, including experiential learning programs that either complement a worker's current employment or provide transition support after employment. If workers are encouraged to pursue ongoing training and that training is accessible and tied to realistic employment outcomes, the workforce will be better prepared to react to a changing market. In fact, government advocacy for lifelong learning can be effective. For example, in Denmark, the government has allocated funding specifically so that adults can undergo two weeks of certified skills training each year, along with generally emphasizing the importance of training programs

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[69] The White House, "Executive Order Establishing the President's National Council for the American Worker," (July 19, 2018) https://www.whitehouse.gov/presidential-actions/executive-order-establishing-presidents-national-council-american-worker/

[70] U.S. Congress, Senate, Investing in American Workers Act, S.538, 116the Cong., firstt sess., introduced in Senate Feb. 25, 2019, https://www.congress.gov/bill/116th-congress/senate-bill/538/text, and U.S. Congress, House, Investing in American Workers Act, H.R. 5012, 116the Cong., first sess., introduced in House Nov.8, 2019, https://www.congress.gov/bill/116th-congress/house-bill/5012/text

in the workplace.[71] This emphasis on training has given the country superior employee mobility; 70 percent of workers perceive mid-career transitions positively, versus 30 percent or less in most other European countries.[72] Another variation on this would be for governments to create grant-matching programs with municipalities to experiment with training programs in various regions.

The government should also implement policies that provide more accessible online training and education, either incentivizing private entities to provide training, partnering with private entities or educational institutions to provide training, or providing public training programs online. Research suggests that online training programs will only increase in popularity due to their accessibility, and that they can be extremely effective.[73]

V. Social Considerations

It is critical for public and private entities to keep in mind the social implications of these changes, ensuring that the most vulnerable communities are not left behind. The COVID-19 crisis has further underlined the inequalities that persist in the workforce, and the commensurate importance of ensuring that economic recovery is inclusive and fairly distributed. To that end, Workday has identified three key considerations that should guide any workforce development conversation.

Assisting disadvantaged communities. Individuals from disadvantaged communities unsurprisingly face the most rigid barriers to employment. When embracing emerging technology in the context of workforce development, it is critical that such technology be used to assist disadvantaged individuals. A European Commission study found that only 4.4 percent of 66 million adults with at-best lower secondary education background participated in adult learning and job training in 2015.[74] A similar study in the U.S. also found that 57 percent of adults with secondary schooling or lower identified themselves as lifelong learners, as compared with 81 percent who had completed tertiary education.[75] Furthermore, the automation of jobs currently held by humans poses an outsized risk to minority populations. A 2017 report found that in 30 occupations with a high risk of disruptive automation, 31 percent of those workers are Latino, and 27 percent are African American, as compared to 24 percent who are white and 20 percent Asian American.[76]

Fortunately, technology can be a driver of equity and ultimately improve workforce participation. For example, with more data, training programs can be oriented to meet the specific needs of certain communities and the job markets

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[71] World Economic Forum, "The Future of Jobs."

[72] *Id.*

[73] Pew Research Center, "The Future of Jobs."

[74] Accenture, "It's learning."

[75] *Id.*

[76] Joint Center for Political and Economic Studies, "Race & Jobs at High Risk to Automation," (Dec. 15, 2017) https://jointcenter.org/race-jobs-at-high-risk-to-automation/

in their region.[77] Not only can training programs be tailored to the specific jobs that may be available to individuals from such communities, but the training programs themselves can incorporate considerations related to educational background, family life, and other metrics that will improve accessibility and participation. In fact, data can even be used to proactively identify vulnerable workers and pair them with lifelong learning opportunities and ultimately employment, even before their current employment is disrupted.[78] Similarly, open credentialing should catalog the job skills of all workers and students, meaning that even individuals in disadvantaged areas could have access to valuable information about what jobs they may be qualified to fill. At Workday, we offer our customers Workday Learning, a learning management system that offers personalized experiences that can be used from anywhere and helps our customers build strong cultures of engagement and opportunity.[79]

Increasing diversity makes the workforce more effective. Extensive research demonstrates that organizations with greater diversity perform better. Companies in the top quartile for racial and ethnic diversity are 35 percent more likely to have financial returns above their respective national industry medians, and companies in the top quartile for gender diversity are 15 percent more likely to have financial returns above their respective national industry medians. By contrast, companies in the bottom quartile for both gender and ethnicity and race are statistically less likely to achieve above-average financial returns than the average companies in the dataset (that is, bottom-quartile companies are lagging rather than merely not leading).[80] Diversity dashboards are an integral part of our Workday Human Capital Management product , enabling companies to monitor criteria such as pay equity, time-to-promotion, turnover, and more. Looking ahead, we plan to add diversity scorecards, enabling managers to execute against real-time diversity goals.[81]

Safety nets for those left behind. Embracing and implementing emerging technologies in the labor market will provide a strong opportunity for increasing employment worldwide. However, it is inevitable that with any disruption to the nature of work, some workers will fall through the cracks. This reality has become increasingly clear in light of the widespread job displacement caused by the COVID-19 outbreak. Any discussion about the future of work must acknowledge this reality and contemplate solutions that will seek to address not only immediate impacts but also measures that can promote opportunities for all and seek to address long-standing racial and social justice issues. For those who are permanently pushed out of the workforce, governments should

[77] OECD, "The Future of Work: OECD Employment Outlook 2019," (2019) https://www.oecd.org/employment/Employment-Outlook-2019-Highlight-EN.pdf

[78] Accenture, "It's learning."

[79] Workday Blog, An Inside Look at Workday Learning: Reinventing How Employees Learn (Sept. 29, 2015) https://blog.workday.com/en-us/2015/an-inside-look-at-workday-learning-reinventing-how-employees-learn.html

[80] Vivian Hunt, Dennis Layton, and Sara Prince, "Why Diversity Matters," McKinsey (Jan. 2015) https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters.

[81] Carin Taylor, Workday Blog, Taking Action to Build Belonging, Diversity, and Inclusion (Oct. 8, 2019) https://blog.workday.com/en-us/2019/taking-action-to-build-belonging-diversity-and-inclusion.html

consider whether safety nets currently in place are sufficient to sustain them. In a 2016 report, the Obama Administration explicitly addressed this issue, urging the modernization and strengthening of federal social safety nets, including public healthcare, unemployment insurance, welfare, and food stamps, to support those pushed out of the labor market by emerging technology.[82] Other experts have highlighted this issue as well, suggesting that existing social safety net systems may not be sufficient to absorb workers who lose their jobs due to technology-related disruption, as opposed to normal business cycle fluctuations.[83] Whether existing safety nets are sufficient for this scenario depends on the structures in place within each individual country. However, governments would benefit from considering whether a program developed specifically for workers displaced by technology would be a beneficial addition to the social programs currently in place.

Data is no substitute for worker mobility. With all the benefits that emerging technology will bring to the abilities of employers and workers to identify suitable job opportunities, we should be cautious to prevent data from disrupting workers' freedoms to pursue the careers they want. Just because a worker has a certain skill set does not mean that they should be precluded from pursuing new opportunities. The goal of embracing technology in workforce development should be a job market that is mobile, agile, and adaptable, both from the employer and worker perspective. To that end, both employers and workers should evaluate the data they have, be creative in interpreting that information, and be open to new ideas and new opportunities. That flexibility and entrepreneurialism are pillars of the modern labor market, and technology should be used to support those characteristics.

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[82] The White House, "Artificial Intelligence, Automation, and the Economy," (Dec. 20, 2016) https://obamawhitehouse.archives.gov/blog/2016/12/20/artificial-intelligence-automation-and-economy

[83] Pamela Loprest and Demetra Nightingale, "The Nature of Work and the Social Safety Net," The Urban Institute (July 2018) https://www.urban.org/sites/default/files/publication/98812/the_nature_of_work_adn_the_social_safety_net.pdf ..In particular, the authors highlight the need to adapt employer benefits to the changing nature of work, such as strengthening access to benefits for non-full-time workers.

VI. Conclusion

The next technological revolution driven by AI and ML is at our doorstep. Although this revolution will power innumerable benefits that cut across all sectors of society, it is already making an impact on the workforce. Addressing the potential challenges that may arise in the wake of these changes requires thoughtful and deliberate investments, policymaking, and other efforts by both the private sector and government. To anticipate and effectively adjust for future shifts in the workforce, we must be vigilant in our efforts to advance skills acquisition and training and to think creatively about how to make credentialing systems support both employers and employees. The urgent need to address these issues is even more apparent as COVID-19 roils the global economy, with the potential to change the face of employment for decades to come. And where technological innovations such as ML have driven much of this change in the long-term, they will also be at the forefront of our response.

We have started to see some promising new solutions that can continue to inspire thinking in this space. But our work is not yet done. As a community of employers and workers, technology consumers and producers, and private organizations and policymakers, we all have the responsibility to ensure that we shape emerging technologies in accordance with our principles and values. It is incumbent on us to continue promoting thoughtful, effective solutions to the policy issues highlighted above to recover and sustain an equitable and thriving workforce and better match talent to opportunity.