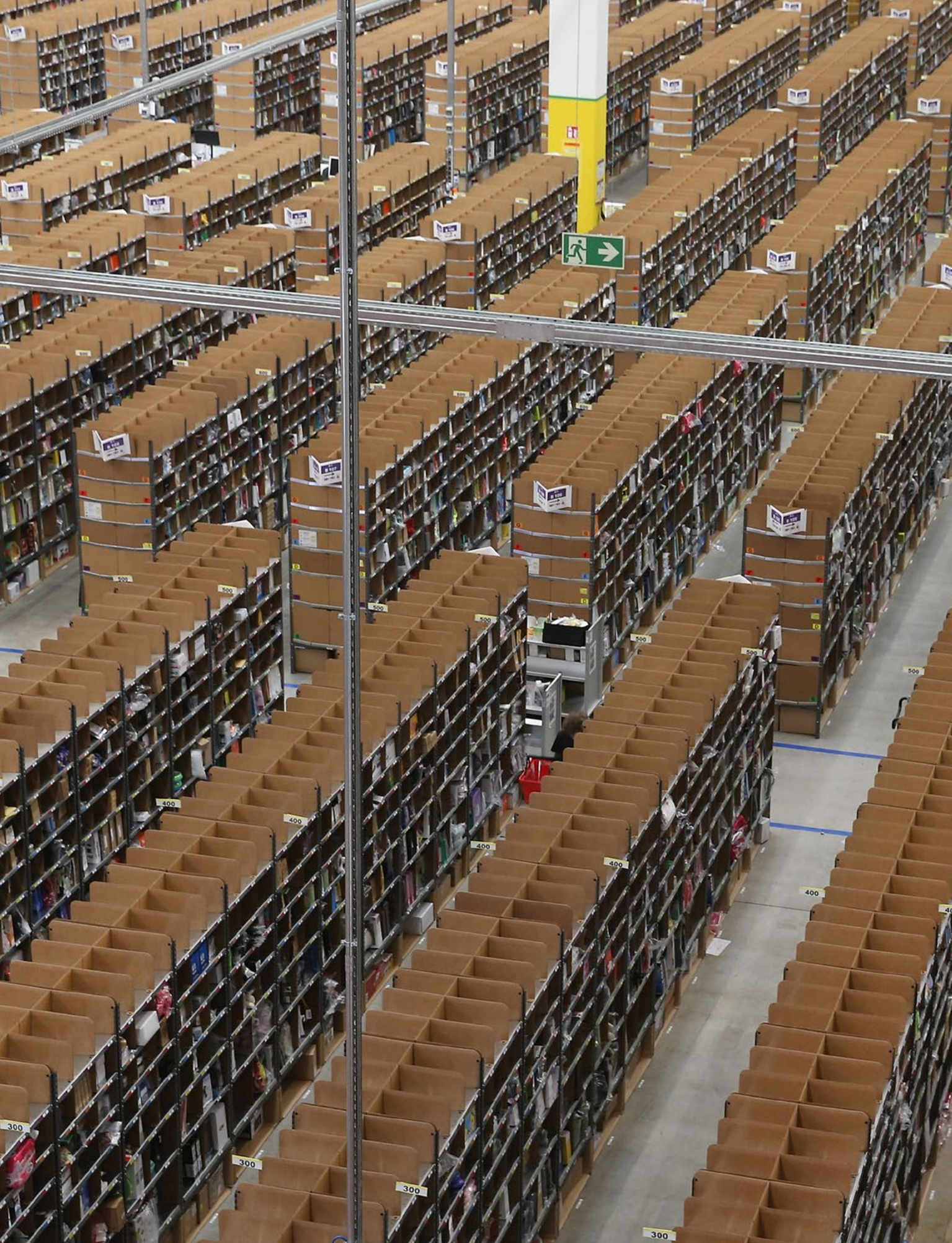


# The Next Step

EXPONENTIAL LIFE

# Technological Progress and Potential Future Risks

DARRELL M. WEST



Opening image:  
Workers walk among shelves lined with goods at an Amazon warehouse, in Brieselang, Germany. Germany is online retailer Amazon's second largest market after the USA.



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**Emerging technologies, such as industrial robots, artificial intelligence, and machine learning, are advancing at a rapid pace. These developments can improve the speed, quality, and cost of goods and services, but they also displace large numbers of workers. This possibility challenges the traditional benefits model of tying health care and retirement savings to jobs. In an economy that employs dramatically fewer workers, we need to think about how to deliver benefits to displaced workers. If automation makes jobs less secure in the future, there needs to be a way to deliver benefits outside of employment. “Flexicurity,” or flexible security, is one idea for providing health care, education, and housing assistance, whether or not someone is formally employed. In addition, activity accounts can finance lifelong education and worker retraining. No matter how people choose to spend time, there needs to be ways for people to live fulfilling lives even if society needs fewer workers.**

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The list of new technologies grows every day. Robots, Augmented Reality, algorithms, and machine-to-machine communications help people with a range of different tasks.<sup>1</sup> These technologies are broad-based in their scope and significant in their ability to transform existing businesses and personal lives. They have the potential to ease people’s lives and improve their personal and business dealings.<sup>2</sup> Technology is becoming much more sophisticated and this is having a substantial impact on the workforce.<sup>3</sup>

In this paper, I explore the impact of robots, artificial intelligence, and machine learning on the workforce and public policy. If society needs fewer workers due to automation and robotics, and many social benefits are delivered through jobs, how are people outside the workforce for a lengthy period of time going to get health care and pensions? These are profound questions for public policy and we need to figure out how to deliver social benefits in the new digital economy.



## EMERGING TECHNOLOGIES

### Robots

Industrial robots are expanding in magnitude around the developed world. In 2013, for example, there were an estimated 1.2 million robots in use. This total rose to around 1.5 million in 2014 and is projected to increase to about 1.9 million in 2017.<sup>4</sup> Japan has the largest



number with 306,700, followed by North America (237,400), China (182,300), South Korea (175,600), and Germany (175,200). Overall, robotics is expected to rise from a \$15-billion sector now to \$67 billion by 2025.<sup>5</sup>

According to an RBC Global Asset Management study, the costs of robots and automation have fallen substantially. It used to be that the “high costs of industrial robots restricted their use to few high-wage industries like the auto industry. However, in recent years, the average costs of robots have fallen, and in a number of key industries in Asia, the cost of robots and the unit costs of low-wage labor are converging... Robots now represent a viable alternative to labor.”<sup>6</sup>

In the contemporary world, there are many robots that perform complex functions. According to a presentation on robots:

The early 21st century saw the first wave of companionable social robots. They were small cute pets like AIBO, Pleo, and Paro. As robotics become more sophisticated, thanks largely to the smart phone, a new wave of social robots has started, with humanoids Pepper and Jimmy and the mirror-like Jibo, as well as Geppetto Avatars’ software robot, Sophie. A key factor in a robot’s ability to be social is their ability to correctly understand and respond to people’s speech and the underlying context or emotion.<sup>7</sup>

These machines are capable of creative actions. Anthropologist Eitan Wilf of Hebrew University of Jerusalem says that sociable robots represent “a cultural resource for negotiating problems of intentionality.”<sup>8</sup> He describes a “jazz-improvising humanoid robot marimba player” that can interpret music context and respond creatively to improvisations on the part of other performers. Designers can put it with a jazz band, and the robot will ad lib seamlessly with the rest of the group. If someone were listening to the music, that person could not discern the human from the robot performer.

**Amazon has organized a “picking challenge” designed to see if robots can “autonomously grab items from a shelf and place them in a tub.” The firm has around 50,000 people working in its warehouses and it wants to see if robots can perform the tasks of selecting items and moving them around the warehouse. During the competition, a Berlin robot successfully completed ten of the twelve tasks. To move goods around the facility, the company already uses 15,000 robots and it expects to purchase additional ones in the future.<sup>9</sup>**

**In the restaurant industry, firms are using technology to remove humans from parts of food delivery. Some places, for**

**example, are using tablets that allow customers to order directly from the kitchen with no requirement of talking to a waiter or waitress. Others enable people to pay directly, obviating the need for cashiers. Still others tell chefs how much of an ingredient to add to a dish, which cuts down on food expenses.<sup>10</sup>**

**Other experimentalists are using a robot known as Nao to help people deal with stress. In a pilot project called “Stress Game,” Thi-Hai-Ha Dang and Adriana Tapus subject people to a board game where they have to collect as many hand objects as they can. During the test, stress is altered through game difficulty and noises when errors are made. The individuals are wired to a heart monitor so that Nao can help people deal with stress. When the robot feels human stress levels increasing, it provides coaching designed to decrease the tension. Depending on the situation, it can respond in empathetic, encouraging, or challenging ways. In this way, the “robot with personality” is able to provide dynamic feedback to the experimental subjects and help them deal with tense activities.<sup>11</sup>**

#### **Computerized Algorithms**

There are computerized algorithms that have taken the place of human transactions. We see this in the stock exchanges, where high-frequency trading by machines has replaced human decision making. People submit buy and sell orders, and computers match them in the blink of an eye without human intervention. Machines can spot trading inefficiencies or market differentials at a very small scale and execute trades that make money for people.<sup>12</sup>

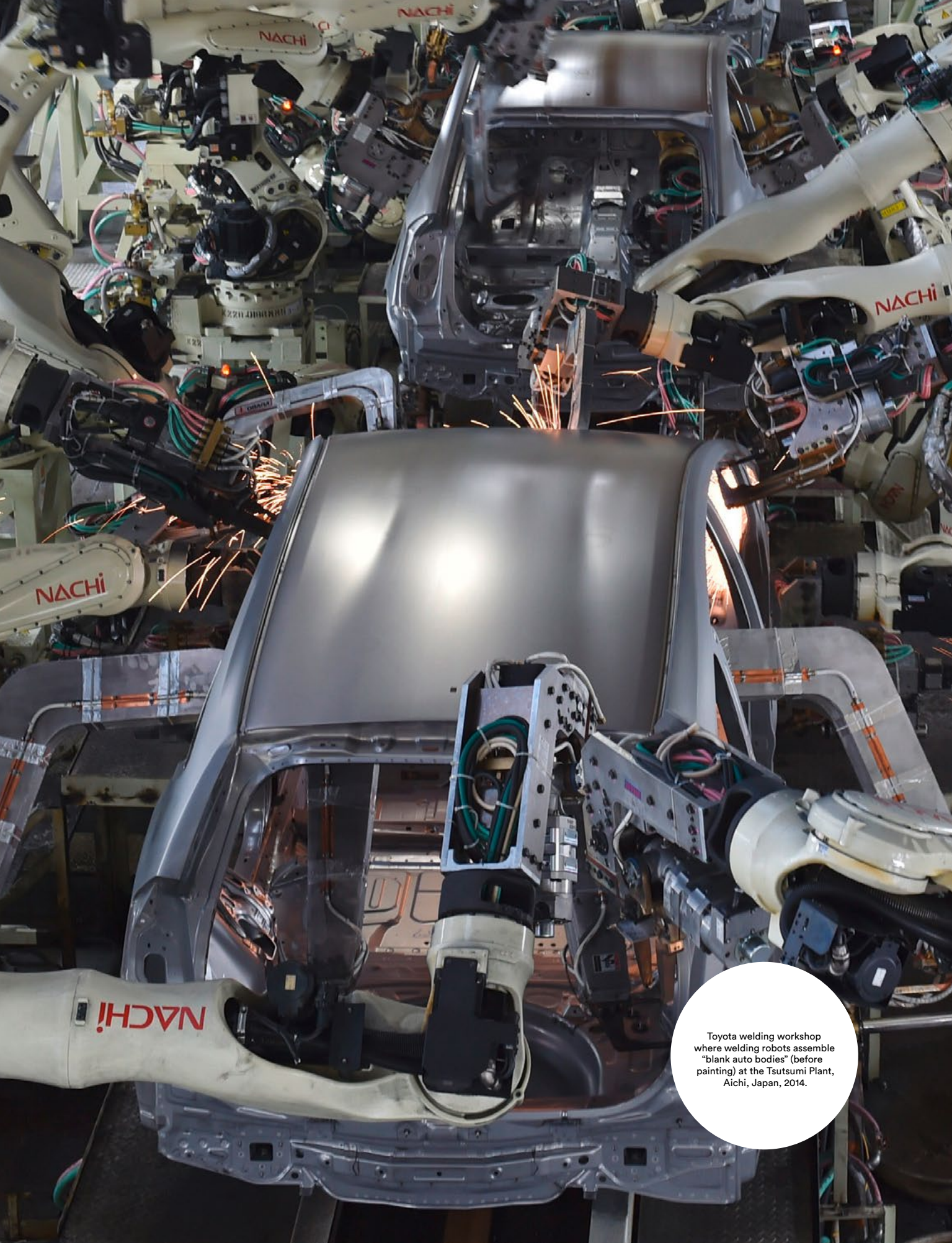
Some individuals specialize in arbitrage trading, whereby the algorithms see the same stocks having different market values. Humans are not very efficient at spotting price differentials but computers can use complex mathematical formulas to determine where there are trading opportunities. Fortunes have been made by mathematicians who excel in this type of analysis.<sup>13</sup>

#### **Artificial Intelligence**

Artificial intelligence refers to “machines that respond to stimulation consistent with traditional responses from humans, given the human capacity for contemplation, judgment and intention.”<sup>14</sup> It incorporates critical reasoning and judgment into response decisions.

Long considered a visionary advance, AI is now here and being incorporated in a variety of different areas. It is being used in finance, transportation, aviation, and telecommunications. Expert systems “make decisions which normally require a human level of expertise.”<sup>15</sup> These systems help humans anticipate problems or deal with difficulties as they come up.





Toyota welding workshop where welding robots assemble "blank auto bodies" (before painting) at the Tsutsumi Plant, Aichi, Japan, 2014.



There is growing applicability of artificial intelligence in many industries.<sup>16</sup> It is being used to take the place of humans in a variety of areas. For example, it is being used in space exploration, advanced manufacturing, transportation, energy development, and health care. By tapping into the extraordinary processing power of computers, humans can supplement their own skills and improve productivity through artificial intelligence.

## IMPACT ON THE WORKFORCE

The rapid increase in emerging technologies suggests that they are having a substantial impact on the workforce. Many of the large tech firms have achieved broad economic scale without a large number of employees. For example, Derek Thompson writes: “Google is worth \$370 billion but has only about 55,000 employees—less than a tenth the size of AT&T’s workforce in its heyday [in the 1960s].”<sup>17</sup> According to economist Andrew McAfee: “We are facing a time when machines will replace people for most of the jobs in the current economy, and I believe it will come not in the crazy distant future.”<sup>18</sup>

In a number of fields, technology is substituting for labor, and this has dramatic consequences for middle-class jobs and incomes. Cornell University engineer Hod Lipson argues that “for a long time the common understanding was that technology was destroying jobs but also creating new and better ones. Now the evidence is that technology is destroying jobs and indeed creating new and better ones but also fewer ones.”<sup>19</sup>

Martin Ford issues an equally strong warning. In his book, *The Lights in the Tunnel*, he argues that “as technology accelerates, machine automation may ultimately penetrate the economy to the extent that wages no longer provide the bulk of consumers with adequate discretionary income and confidence in the future. If this issue is not addressed, the result will be a downward economic spiral.”<sup>20</sup> Continuing, he warns that “at some point in the future—it might be many years or decades from now—machines will be able to do the jobs of a large percentage of the ‘average’ people in our population, and these people will not be able to find new jobs.”

Firms have discovered that robotics, machine learning, and artificial intelligence can replace humans and improve accuracy, productivity, and efficiency of operations. During the Great Recession of 2008–09, many businesses were forced to downsize their workforce for budgetary reasons. They had to find ways to maintain operations through leaner workforces. One business leader I know had five hundred workers for his \$100 million business and now has the same size workforce even though the company has grown to \$250 million in revenues. He did this by automating certain functions and using robots and advanced manufacturing techniques to operate the firm.

The US Bureau of Labor Statistics (BLS) compiles future employment projections. In its most recent analysis, the agency predicts that 15.6 million new positions will be created between 2012 and 2022. This amounts to growth of about 0.5 percent per year in the labor force.

The health-care and social assistance sector is expected to grow the most with an annual rate of 2.6 percent. This will add around five million new jobs over that decade. That is about one-third of all the new jobs expected to be created.<sup>21</sup> Other areas that are likely to





experience growth include professional services (3.5 million), construction (1.6 million), leisure and hospitality (1.3 million), state and local government (929,000), finance (751,000), and education (675,000).

Interestingly, in light of technology advances, the information sector is one of the areas expected to shrink in jobs. BLS projections anticipate that about 65,000 jobs will be lost there over the coming decade. Even though technology is revolutionizing many businesses, it is doing this by transforming operations, not increasing the number of jobs. Technology can boost productivity and improve efficiency, but does so by reducing the number of employees needed to generate the same or even higher levels of production.

Manufacturing is another area thought to lose jobs. The BLS expects the United States to lose 550,000 jobs, while the federal government will shed 407,000 positions, and agriculture, forestry, fishing, and hunting will drop 223,000 jobs.<sup>22</sup> These sectors are the ones thought to be least likely to generate new positions in the coming decade.

**Since BLS projections make few assumptions about emerging technologies, it is likely that their numbers underestimate the disruptive impact of these developments. It is hard to quantify the way that robots, artificial intelligence, and sensors will affect the workforce because we are in the early stages of the technology revolution. It is hard to be definitive about emerging trends because it is not clear how new technologies will affect various jobs.**

**But there are estimates of the likely impact of computerization on many occupations. Oxford University researchers Carl Frey and Michael Osborn claim that technology will transform many sectors of life. They studied 702 occupational groupings and found that “forty-seven percent of US workers have a high probability of seeing their jobs automated over the next twenty years.”<sup>23</sup>**

**According to their analysis, telemarketers, title examiners, hand sewers, mathematical technicians, insurance underwriters, watch repairers, cargo agents, tax preparers, photographic process workers, new accounts clerks, library technicians, and data entry keyers have a ninety-nine percent of having their jobs computerized. At the other end of the spectrum, recreational therapists, mechanic supervisors,**

**emergency management directors, mental health social workers, audiologists, occupational therapists, health-care social workers, oral surgeons, supervisors of fire fighters, and dieticians have less than a one percent chance of having their tasks computerized. They base their analysis of improving levels of computerization, wage levels, and education required in different fields.<sup>24</sup>**

**In addition, we know that fields such as health care and education have been slow to embrace the technology revolution, but are starting to embrace new models. Innovations in personalized learning and mobile health mean that many schools and hospitals are shifting from traditional to computerized service delivery. Educators are using massive, open, online courses (MOOCs) and tablet-based instruction, while health-care providers are relying on medical sensors, electronic medical records, and machine learning to diagnose and evaluate health treatments.**

Hospitals used to be staffed with people who personally delivered the bulk of medical treatment. But health providers now are storing information in electronic medical records and data-sharing networks are connecting lab tests, clinical data, and administration information in order to promote greater efficiency. Patients surf the web for medical information and supplement professional advice with online resources. Both education and health-care sectors are seeing the disruption that previously has transformed other fields.

Given the uncertainties surrounding job projections, it is not surprising that experts disagree over the impact of emerging technologies. For example, in their highly acclaimed book, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, economists Erik Brynjolfsson and Andrew McAfee argue that technology is producing major changes in the workforce. According to them:



Technological progress is going to leave behind some people, perhaps even a lot of people, as it races ahead. As we will demonstrate, there has never been a better time to be a worker with special skills or the right education because these people can use technology to create and capture value. However, there has never been a worse time to be a worker with only “ordinary” skills and abilities to offer, because computers, robots, and other digital technologies are acquiring these skills and abilities at an extraordinary rate.<sup>25</sup>

Former US Treasury Secretary Lawrence Summers is equally pessimistic about the employment impact. He argues that “if current trends continue, it could well be that a generation from now a quarter of middle-aged men will be out of work at any given moment.” From his standpoint, “providing enough work” will be the major economic challenge facing the world.<sup>26</sup>

However, some economists dispute these claims. They recognize that many jobs will be lost through technology improvements, but say that new ones will be created. There may be fewer people sorting items in a warehouse because machines can do that better than humans. But jobs analyzing big data, mining information, and managing data-sharing networks will be created. According to those individuals, the job gains and losses will even out over the long run. In future decades, work will be transformed but humans will still be needed to manage the digital world.

For example, MIT economist David Autor has analyzed data on jobs and technology but “doubts that technology could account for such an abrupt change in total employment [...] The sudden slowdown in job creation is a big puzzle, but there is not a lot of evidence it is linked to computers.”<sup>27</sup> In the same vein, Harvard economist Richard Freeman is “skeptical that technology would change a wide range of business sectors fast enough to explain recent job numbers.”<sup>28</sup>

Northwestern economist Robert Gordon takes an even stronger stance. He argues that:

Recent progress in computing and automation is less transformative than electrification, cars, and wireless communication, and perhaps even indoor plumbing. Previous advances that enabled people to communicate and travel rapidly over long distances may end up being more significant to society’s advancement than anything to come in the twenty-first century.<sup>29</sup>

Based on this reasoning, he does not anticipate dramatic workforce effects from emerging technologies, even though many other experts already see the substitution of technology for labor.

A Pew Research Center study asked 1,896 experts about the impact of emerging technologies. Its researchers found that:

Half of these experts (48%) envision a future in which robots and digital agents have displaced significant numbers of both blue- and white-collar workers—with many expressing concern that this will lead to vast increases in income inequality, masses of people who are effectively unemployable, and breakdowns in the social order.<sup>30</sup>



## IMPLICATIONS FOR PUBLIC POLICY

In the classic Edward Bellamy book, *Looking Backwards*, protagonist Julian West wakes up from a 113-year slumber and finds that the United States in 2000 is completely different from 1887. People stop working at age forty-five and devote their lives to mentoring other people and contributing to the overall sense of community.<sup>31</sup> There are shorter work weeks for ordinary people and everyone receives full benefits, food, and housing.

“Utopia is on the horizon. When I walk two steps, it takes two steps back. I walk ten steps, and it is ten steps further away. What is Utopia for? It is for this, for walking.”

**EDUARDO GALEANO (1940–2015)**  
Uruguayan writer.

**Christo**

*The Floating Piers (2014–16)*

Lake Iseo, Italy. With this project, inaugurated in June 2016, Bulgarian artist Christo realized his dream of being able to walk on water. It consisted of a three-kilometer-long platform linking two villages on the banks of Lake Iseo—Sulzano and Monte Isola—with the small island of San Paolo.





Similar to our time period, new technologies at that time enabled people to be very productive in a short period of time. Society did not need a large number of workers so people could devote much of their lives to education, volunteerism, and community development. In conjunction with these employment trends, public policy shifted to encourage new lifestyles and ways of living.

In flash-forwarding to the current era, we may be on the verge of a similar technology transition. Robotics and machine learning have improved productivity and enhanced the overall economy of developed nations. Countries that have invested in innovation have seen tremendous growth in overall economic performance. In the future, it may be possible that society will not need as many workers as seen today.

Yet unlike Bellamy's utopia, there has been little public discussion regarding the economic or policy impact of emerging technologies. Observers worry that knowledge societies are destroying industrial and manufacturing jobs, and exacerbating social and economic divisions. In its most pointed form, skeptics fear that technology will eliminate jobs, reduce incomes, and create a permanent underclass of unemployable people. As argued by Nicolas Colin and Bruno Palier: "Employment is becoming less routine, less steady, and generally less well remunerated. Social policy will therefore have to cover the needs of not just outside the labor market but even many inside it."<sup>32</sup>

**If technology innovation allows businesses to provide goods and services with far fewer employees, what will that mean for workers? A significant increase in the number of people without full-time jobs would exacerbate divisions within society and complicate the distribution of benefits such as pensions, health care, and insurance. Most benefits are tied to employment so if the economy requires fewer workers due to technological advancement, we need to consider how this will affect social benefit delivery.**

**In this section, I review short- and long-term steps we should consider to deal with emerging technologies. This includes thinking about how to deliver benefits outside of jobs, considering a basic income guarantee, revamping the earned income tax credit, providing activity accounts for lifetime learning and job retraining, encouraging corporate profit-sharing, providing benefit credits for volunteerism, making curricular reforms to assure that students have the skills they need for a twenty-first-century economy,**

## **encouraging adult education and continuing learning, expanding arts and culture for leisure time, and avoiding a permanent underclass suffering the ill effects of income inequality.**

### **Benefits Outside of Jobs**

If we end up in a situation with many people unemployed or underemployed for significant periods of time, we need a way to provide health care, disability, and pension benefits outside of employment. Called “flexicurity” or flexible security, this idea “separate(s) the provision of benefits from jobs.”<sup>33</sup> It offers health care, education, and housing assistance on a universal basis.

Currently, people must work sixty percent of the time (around twenty-four hours a week) in order to qualify for full-time benefits. When they are fully employed, they are eligible for company-sponsored health-care plans and pensions. During the period since World War II, jobs have been a primary distribution system for social benefits. Except for the poor and elderly, this keeps benefits outside of the public sector and places the onus on private companies.

That approach worked well in an era when most of the people who wanted jobs were able to get them. People with limited skills were able to get well-paying jobs with benefits in factories, warehouses, and production facilities. They could educate their children, achieve a reasonable standard of living, and guard against disabling illnesses.

The complication came when the economy shifted, wages stagnated, and technology made it possible for companies to get by with fewer workers. The advent of robotics, machine learning, artificial intelligence, and machine-to-machine communications eliminated a number of jobs and put a number of people outside the typical workforce.

For health care, people need access to quality care through plans outside of employment. It is possible through commercial insurers to purchase catastrophic insurance for extraordinary health claims. Or if people are poor or elderly, there are government programs that guarantee access to medical care. The recent expansion of health insurance through the Affordable Care Act has extended insurance to millions of people who previously lacked coverage.

In regard to retirement planning, many employers have moved to 401-style pension plans. Employees contribute to their own funds and sometimes get a match from the employer. But this does not help those outside the workforce who need retirement assistance. Even Social Security is tied to employment. People who have not worked are not eligible for retirement benefits so we need to figure out ways to take care of those people in the newly emerging economy.

### **Provide Activity Accounts for Lifetime Learning and Job Retraining**

We should consider the establishment of activity accounts for lifetime learning and job retraining. In an era of fast technology innovation and job displacement, there needs to







be a means for people to gain new skills throughout their adulthood. When people are employed, their companies could contribute a set amount to an individual's fund. This account could be augmented by contributions from the person him or herself as well as the government. Similar to a retirement account, money in the fund could be invested tax-free in investment options including cash reserves, stocks, and bonds. The owner of the account could draw on it to finance lifetime learning and job retraining expenses. It would be portable, meaning that if the person moved or switched jobs, the account would migrate with that individual.

The goal of this account is to provide incentives for continuing education. Under virtually any scenario, people are going to have to continue their education beyond the first twenty years of their lives. Emerging jobs are going to require different skills than what people gain in school. There will be new jobs created that may not exist today. As pointed out by Brookings Institution scholar Kemal Dervis, it will be crucial as technology innovation continues in the future to provide people with a means to upgrade their skills and knowledge levels.<sup>34</sup> He notes that France has established "individual activity accounts" that provide social benefits.

With the expected increase in leisure time, adults need time and financial support for continued learning. We should not envision education merely as a time for young people to learn new skills or pursue areas of interest. Instead, we need to think about education as a continuing activity that broadens people's horizons over the course of their entire lives. Education is an enrichment activity and we need to view it as a general benefit for the individual as well as the society as a whole.

#### **Incentives for Volunteerism**

The trends cited in this analysis suggest that we need to consider income supplements or benefit eligibility through vehicles other than full-time jobs. The workforce ramifications of emerging technologies mean that many people in the future may not be able to provide for their families through regular employment.

One possibility comes through volunteer activities. Even if people have limited employment options, many participate in a wide range of public-minded organizations. They help other people, train the next generation, or provide assistance for the less fortunate in society.

A variety of survey evidence demonstrates that young people are particularly interested in volunteerism. In general, they have different attitudes toward work and leisure time, and many say they want time to pursue outside activities. For example, a survey of American students found that they want "a job that focuses on helping others and improving society." In addition, they value quality of life considerations, not just financial well-being.<sup>35</sup>

A number of them value volunteer activities outside of their work experience. They have varied interests and want extra-curricular activities that fulfill them. This may involve tutoring in after-school programs, helping English as a Second Language pupils, stopping domestic violence, protecting the environment, or encouraging entrepreneurship. According to a Deloitte study, "63 percent of Millennials donate to charities and 43 percent actively volunteer or are a member of a community organization."<sup>36</sup>

**In a digital world where there may be less work and more leisure time, it makes sense to think about incentives and work credits for volunteerism. This could include credits toward social benefits or public rewards that acknowledge community contributions. In the United Kingdom, for example, volunteers get reimbursed for expenses or earn credits for job training programs through participation in worthy causes. In addition, volunteering counts as “looking for work” so people can use those activities to qualify for national insurance credits.<sup>37</sup>**

**Going forward, the United States should consider those types of incentives. In the future, people are likely to have more time outside of employment so it makes sense to encourage them toward community engagement and give them incentives to volunteer for nonprofit organizations or charitable causes. This will benefit the overall community and give people purposeful activities in which to engage.**

#### **Expanding Arts and Culture for Leisure Time**

The so-called “end of work” may create a new kind of economy. According to Harvard economist Lawrence Katz: “It is possible that information technology and robots [will] eliminate traditional jobs and make possible a new artisanal economy [...] an economy geared around self-expression, where people would do artistic things with their time.”<sup>38</sup> From his standpoint, this transition would move the world from one of consumption to creativity.

People will use their leisure time to pursue interests in arts and culture, or special areas that they follow. This could include reading, poetry, music, or woodworking. Depending on their background, they could have more time for family and friends. A study of family time found that macroeconomic conditions affect how much time people spend together. When employment problems rise, “fathers spend more time engaging in enriching childcare activities” and “mothers are less likely to work standard hours.”<sup>39</sup> As long as there are opportunities for people to pursue broader interests, reduction in work does not have to eliminate chances for cultural pursuits.

#### **CONCLUSION**

To summarize, advanced societies are at a major turning point in terms of how we think about work, leisure, and social benefit delivery. If these economies need fewer workers to complete needed tasks and benefits are delivered mainly through full-time jobs, there is a danger that





many people will have difficulties getting health care, pensions, and the income maintenance they need to sustain their lives. This is of particular concern at a time of large income inequality and highly skewed economic distributions.<sup>40</sup>

The contrast between the age of scarcity in which we have lived and the upcoming age of abundance through new technologies means that we need to pay attention to the social contract. We need to rewrite it in keeping with the dramatic shifts in employment and leisure time that are taking place. People have to understand we are witnessing a fundamental interruption of the current cycle where people are paid for their work and spend their money on goods and services. When a considerable portion of human labor is no longer necessary to run the economy, we have to rethink income generation, employment, and public policy. Our emerging economic system means we will not need all the workers that we have. New technologies will make these individuals obsolete and unemployable.

In this situation, it is important to address the policy and leisure time issues raised by persistent unemployment or underemployment. There is a danger of disruptions and unrest from large groups of people who are not working. That creates poverty and social dissatisfaction and runs the risk of instability for the society as a whole. Stability cannot be enforced through a police presence or having wealthy individuals live in gated communities.

There needs to be ways for people to live fulfilling lives even if society needs relatively few workers. We need to think about ways to address these issues before we have a permanent underclass of unemployed individuals. This includes a series of next steps for society. There needs to be continuous learning avenues, opportunities for arts and culture, and mechanisms to supplement incomes and benefits other than through full-time jobs. Policies that encourage volunteerism and reward those who contribute to worthy causes make sense from the standpoint of society as a whole. Adoption of these steps will help people adapt to the new economic realities.

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