Policy Economy Industrial relations

Up to 500,000 jobs threatened by rise of robots, artificial intelligence: report

As many as half a million accountants, supermarket cashiers, secretaries, typists and bank tellers in what are largely white-collar jobs are threatened by automation, Department of Industry modelling shows.

Jacob Greber | **Economics correspondent** *Senior correspondent*

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As many as half a million accountants, supermarket cashiers, secretaries, typists and bank tellers in what are largely white-collar jobs are threatened by automation, Department of Industry modelling shows.

However, growing fears that robots and artificial intelligence could cast millions from the middle-class into unemployment and poverty are overblown, the department's chief economist, Mark Cully, said.

The fact a large range of relatively high-skilled jobs were likely to be lost only supported the need for Australians and governments to embrace structural change that guarantees economic growth and prosperity, he said.

Many jobs at risk of computerisation are those that involve routine tasks. **Photo: Bloomberg**

One of the greatest benefits of increased automation – even if its temporary impact on jobs is painful – was that it would lead to higher productivity, and eventually cheaper goods and higher disposable incomes.

“Just as it did during the Industrial Revolution, when the invention of the loom led to waves of unemployed weavers but cheaper clothing for the masses," Mr Cully said.

The findings, published on Wednesday in the inaugural Australian Industry Report 2014 brings an Australian perspective to an increasingly intense debate that has raged all year in the US over the question of whether automation and advances in computer software are starting to displace white-collar, middle-class jobs for the first time in accelerating numbers.

The report, which aimed to fill a gap between the “big picture" work of the Reserve Bank and Treasury and the more specific analysis of the Productivity Commission, also looks at the likely contribution of five sectors declared by the government as likely drivers of future economic growth.

In October, in its Industry Innovation and Competitiveness Agenda, the government listed food and agribusiness, mining services, oil, gas and energy resources, advanced manufacturing, and medial technologies and pharmaceuticals as sectors in which Australia has a “comparative advantage".

The latest report calculates that those sectors now account for about 15 per cent of the economy, measured in terms of gross value added, a similar amount of employment and more than 25 per cent of exports.

Jobs under threat

By contrast, the report finds that occupations most at risk of computerisation are those that involve routine tasks, such as bank tellers, clerks, bookkeepers and even highly qualified roles such as pharmacists – 78.6 per cent of whom have at least a bachelor's degree.

"A tertiary education, therefore, does not guarantee a safeguard against automation," Mr Cully said in the report.

A widely-quoted Oxford Martin School study published last year estimated that about 47 per cent of all US jobs are at risk of computerisation, many of them in sectors needing high-level skills, wages and education.

By contrast, Mr Cully said some of the safest jobs were those that did not require advanced education – including truck drivers, electricians and waiters.

Asked what jobs young Australians should train for, Mr Cully said it was more important to get good schooling – whether through an apprenticeship or university – than target any particular sector. "We don't know what the future holds," he said in an interview on Tuesday.

"Nobody would have predicted 25 years ago that we'd have so many people employed doing web design or hiring personal assistants to help with our health."

Most of the jobs growth over the past decade – about 700,000 positions – have been among professionals, with a further 350,000 jobs for managers.

"The story in Australia over the past couple of decades has been around growth in high skills...underpinned by strong growth across the income distribution in earnings and living standards."

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World

The myth of the robot job-ocalypse

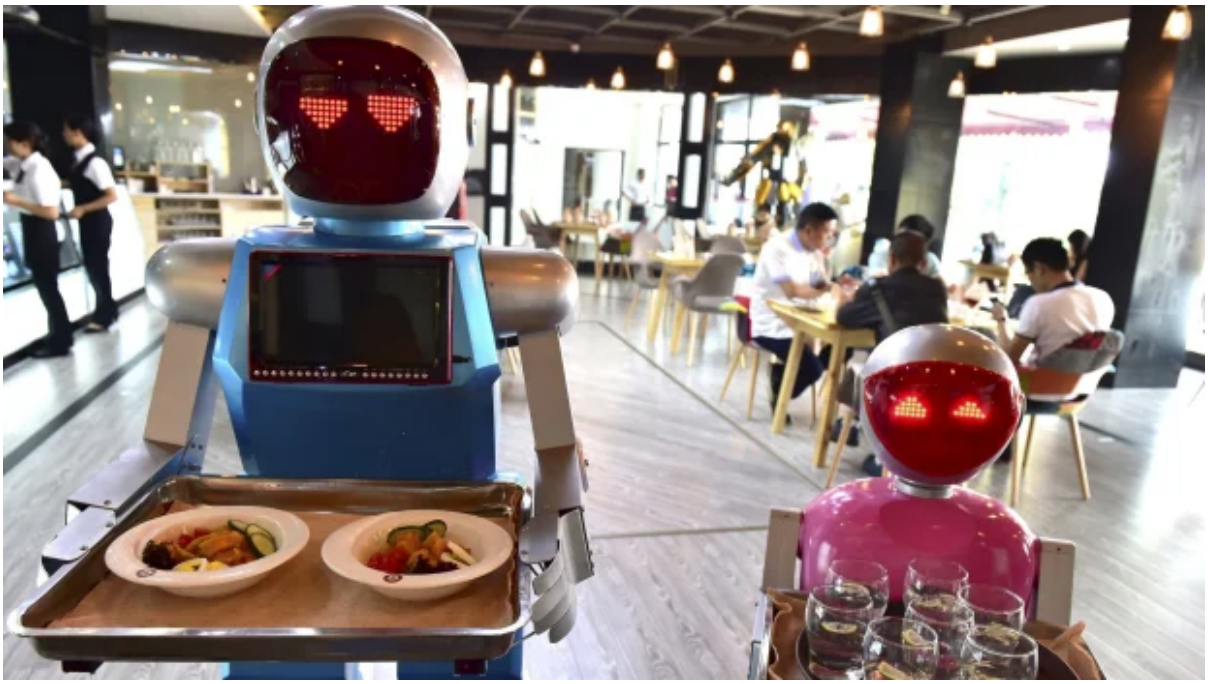
Tim Harford

Aug 20, 2015 – 9.47am

"The number of jobs lost to more efficient machines is only part of the problem . . . In the past, new industries hired far more people than those they put out of business. But this is not true of many of today's new industries."

This sentiment, from *Time* magazine, dates from the early weeks of John Kennedy's presidency. Yet it would slot nicely into many a contemporary political speech. Like any self-respecting remorseless killer robot from the future, our techno-anxiety just keeps coming back.

Arnold Schwarzenegger's *Terminator* was science fiction - but so, too, is the idea that robots and software algorithms are guzzling jobs faster than they can be created. There is an astonishing mismatch between our fear of automation and the reality so far.



There is an astonishing mismatch between our fear of automation and the reality so far. **Reuters**

How can this be? The highways of Silicon Valley are sprinkled with self-driving cars. Visit the cinema, the supermarket or the bank and the most prominent staff you will see are the security guards, who are presumably there to prevent you

stealing valuable machines. Your computer once contented itself with correcting your spelling; now it will translate your prose into Mandarin. Given all this, surely the robots must have stolen a job or two by now?

Of course, the answer is that automation has been destroying particular jobs in particular industries for a long time, which is why most westerners who weave clothes or cultivate and harvest crops by hand do so for fun. In the past that process made us richer.
The worry now is that, with computers making jobs redundant faster than we can generate new ones, the result is widespread unemployment, leaving a privileged class of robot-owning rentiers and highly paid workers with robot-compatible skills.

This idea is superficially plausible: we are surrounded by cheap, powerful computers; many people have lost their jobs in the past decade; and inequality has risen in the past 30 years.

But the theory can be put to a very simple test: how fast is productivity growing? The usual measure of productivity is output per hour worked - by a human. Robots can produce economic output without any hours of human labour at all, so a sudden onslaught of robot workers should cause a sudden acceleration in productivity.

Instead, productivity has been disappointing. In the US, labour productivity growth averaged an impressive 2.8 per cent per year from 1948 to 1973. The result was mass affluence rather than mass joblessness. Productivity then slumped for a generation and perked up in the late 1990s but has now sagged again. The picture is little better in the UK, where labour productivity is notoriously low compared with the other G7 leading economies, and it has been falling further behind since 2007.

Taking a 40-year perspective, the impact of this long productivity malaise on typical workers in rich countries is greater than that of the rise in inequality, or of the financial crisis of 2008. In an age peppered with economic disappointments, the worst has been the stubborn failure of the robots to take our jobs. Then why is so much commentary dedicated to the opposite view? Some of this is a simple error: it has been a tough decade, economically speaking, and it is easy to blame robots for woes that should be laid at the door of others, such as bankers, austerity enthusiasts and eurozone politicians.

It is also true that robotics is making impressive strides. Gill Pratt, a robotics expert, recently described a "Cambrian explosion" for robotics in the *Journal of Economic Perspectives*. While robots have done little to cause mass unemployment in the recent past, that may change in future.

Automation has also undoubtedly changed the shape of the job market - economist David Autor, writing in the same journal, documents a rise in demand for low-skilled jobs and highly skilled jobs, and a hollowing out of jobs in the middle. There are signs that the hollow is moving further and further up the spectrum of skills. The robots may not be taking our jobs, but they are certainly shuffling them around.

Yet Mr Autor also points to striking statistic: private investment in computers and software in the US has been falling almost continuously for 15 years. That is hard to square with the story of a robotic job-ocalypse. Surely we should expect to see a surge in IT investment as all those machines are installed?

Instead, in the wake of the great recession, managers have noted an ample supply of cheap human labour and have done without the machines for now. Perhaps there is some vast underground dormitory somewhere, all steel and sparks and dormant androids. In a corner, a chromium-plated robo-hack is tapping away at a column lamenting the fact that the humans have taken all the robots' jobs.

Financial Times

Policy

Opinion

Don't worry, technology is going to create jobs not kill them

Digital platforms make markets more transparent and efficient, which is exactly the kind of disruption today's labour markets need, writes Michael Spence.

Michael Spence and James Manyika

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This is an age of anxiety about the job-killing effects of automation, with dire headlines warning that the rise of robots will render [https://www.project-syndicate.org/commentary/uber-automation-labor-markets-by-jean-pisani-ferry-2015-07] entire occupational categories obsolete [https://www.project-syndicate.org/commentary/uber-automation-labor-markets-by-jean-pisani-ferry-2015-07]. But this fatalism assumes that we are powerless to harness what we create to improve our lives – and, indeed, our jobs.

Evidence of technology's potential to help resolve our job concerns can be found in online talent platforms. Digital platforms already have transformed many parts of the economy. The online marketplaces built by Amazon and Alibaba, for example, have reshaped the retail landscape, partly by changing the local nature of retail markets.

Online talent platforms apply a similar approach to the world of work – with a similar impact. By creating regional, national, and even global job markets, they allow employers to tap into broader talent pools and connect job seekers with a wider universe of opportunities. In this way, they have transformed the typical job search, and are now approaching the critical mass needed to move employment numbers.

New technology will help stem the tide of automation by making labour markets more efficient.

Such platforms take various forms. Websites such as LinkedIn, Monster.com, and Indeed.com – which match individuals with employers seeking to fill traditional jobs – have engaged hundreds of millions of users and many of the world's leading companies, and are generating the bulk of the economic impact. But there are also the digital marketplaces of the "gig economy" (or shared economy), which connect freelancers with work assignments, from web development to chauffeuring passengers, thereby reducing underused labour and capital.

Digital platforms make markets more transparent and efficient, which is exactly the kind of disruption that today's labour markets need. In many countries, 30 to 45 per cent of the working-age population is unemployed, inactive or working only part-time. Companies are complaining that they cannot fill open positions in sectors ranging from technology to healthcare. And those who are employed are often stuck in roles that do not take full advantage of their skills. These issues represent a staggering waste of human and economic potential.

Crude data

The problems stem from the fact that today's labour markets provide crude, incomplete and geographically restricted signals about the skills that are in demand. As a result, mapping out an education, training and career path entails quite a lot of guesswork. That does not only hurt workers; it also means that companies' needs can be left unmet.

Online talent platforms can boost labour-market efficiency by aggregating data on candidates and job openings in a broader geographic area, thereby illuminating for

workers which positions are open today, as well as the actions they can take to gain more fulfilling work. This dynamic could be especially important in Europe, where employment prospects differ radically across countries (and across regions within countries), and many feel trapped in stagnant local economies. It is not likely that someone will move from Spain to Swaziland, even for a dream job, but that person might accept a better position a few hundred miles away.

Moreover, by facilitating faster matches, online talent platforms shorten the duration of unemployment, while the creation of flexible part-time opportunities can draw more inactive workers into the labour force and help part-time workers add hours. At the same time, by connecting the right person with the right role, such platforms can boost productivity.

In short, while online talent platforms cannot boost weak demand in advanced economies, solve complex development issues in the emerging world or create better jobs across the board, they can have a major impact on seemingly intractable issues such as unemployment, underemployment and low job satisfaction. According to a recent McKinsey Global Institute research study [http://www.mckinsey.com/insights/employment_and_growth/connecting_talent_with_opportunity_in_the_ they could increase global gross domestic product by $2.7 trillion annually by 2025. That is equivalent to adding another United Kingdom to the world economy.

Much of the impact of online talent platforms stems from the use of technology to bridge information asymmetries that impair labour-market performance. In the past, these gaps were only partly bridged by signals carrying useful information. But online talent platforms aggregate much larger amounts of information efficiently, increasing the "signal density".

With expanded data, companies can use predictive analytics to identify the best candidate for a given role. Job seekers can augment their educational credentials and employment histories with samples of their work and endorsements from co-workers and customers, thereby conveying their potential value to employers more effectively.

Room for optimism

Furthermore, platforms that aggregate anonymous reviews from current and former employees give individuals a better idea of what it is like to work for a given company, as well as the salary they can and should expect. As employee

satisfaction becomes more widely reported, companies are facing pressure to ensure good working conditions to recruit the talent they need.

So far, the biggest winners from this shift have been educated and skilled professionals in the advanced economies. In fact, the most sought-after engineers and software developers may not need to apply for jobs at all; companies are increasingly recruiting "passive" candidates, sometimes forcing employers to increase the salaries of workers they want to retain.

But it is not all good news. Now that employers have new tools for recruitment and assessment, they may find low-skilled workers easier to replace, potentially worsening income inequality in the short run. In the longer term, however, a better overall system for skills upgrading could be designed – one that could be integral to facilitating upward mobility.

And there is another benefit in this regard. As the career outcomes associated with specific institutions and degree programs become more transparent, education and training providers will become more accountable for preparing their students for prosperous and productive lives.

With global smartphone subscriptions set to reach 8 billion by 2025, online talent platforms have enormous room to expand into new regions and sectors. As these technologies continue to evolve, they may change the world of work in ways we cannot even imagine today. It seems that there is room in the labour market for a little optimism, after all.

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McKinsey Quarterly

Where machines could replace humans—and where they can't (yet)

The technical potential for automation differs dramatically across sectors and activities.

by Michael Chui, James Manyika, and Mehdi Miremadi

As automation technologies such as machine learning and robotics play an increasingly great role in everyday life, their potential effect on the workplace has, unsurprisingly, become a major focus of research and public concern. The discussion tends toward a Manichean guessing game: which jobs will or won't be replaced by machines?

In fact, as our research has begun to show, the story is more nuanced. While automation will eliminate very few occupations entirely in the next decade, it will affect portions of almost all jobs to a greater or lesser degree, depending on the type of work they entail. Automation, now going beyond routine manufacturing activities, has the potential, as least with regard to its technical feasibility, to transform sectors such as healthcare and finance, which involve a substantial share of knowledge work.

These conclusions rest on our detailed analysis of 2,000-plus work activities for more than 800 occupations. Using data from the US Bureau of Labor Statistics and O*Net, we've quantified both the amount of time spent on these activities across the economy of the United States and the technical feasibility of automating each of them. The full results, forthcoming in

early 2017, will include several other countries,[1] but we released some initial findings late last year and are following up now with additional interim results.

Last year, we showed that currently demonstrated technologies could automate 45 percent of the activities people are paid to perform and that about 60 percent of all occupations could see 30 percent or more of their constituent activities automated, again with technologies available today. In this article, we examine the technical feasibility, using currently demonstrated technologies, of automating three groups of occupational activities: those that are highly susceptible, less susceptible, and least susceptible to automation. Within each category, we discuss the sectors and occupations where robots and other machines are most—and least—likely to serve as substitutes in activities humans currently perform. Toward the end of this article, we discuss how evolving technologies, such as natural-language generation, could change the outlook, as well as some implications for senior executives who lead increasingly automated enterprises.

UNDERSTANDING AUTOMATION POTENTIAL

In discussing automation, we refer to the potential that a given activity could be automated by adopting currently demonstrated technologies, that is to say, whether or not the automation of that activity is *technically feasible*.[2] Each whole occupation is made up of multiple types of activities, each with varying degrees of technical feasibility. Exhibit 1 lists seven top-level groupings of activities we have identified. Occupations in retailing, for example, involve activities such as collecting or processing data, interacting with customers, and setting up merchandise displays (which we classify as physical movement in a predictable environment). Since all of these constituent activities have a different automation potential, we arrive at an overall estimate for the sector by examining the time workers spend on each of them during the workweek.

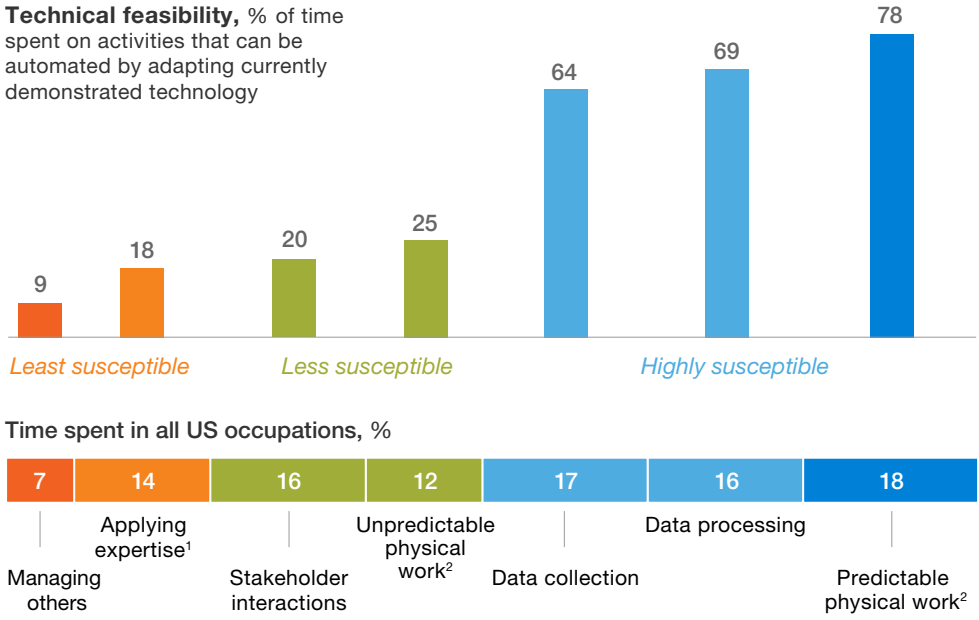
Technical feasibility is a necessary precondition for automation, but not a complete predictor that an activity will be automated. A second factor to consider is the cost of developing and deploying both the hardware and the software for automation. The cost of labor and related supply-and-demand dynamics represent a third factor: if workers are in abundant supply and significantly less expensive than automation, this could be a decisive argument against it. A fourth factor to consider is the benefits beyond labor

[1] For interim insights on our core findings, see Michael Chui, James Manyika, and Mehdi Miremadi, "Four fundamentals of workplace automation," *McKinsey Quarterly*, November 2015, McKinsey.com.

[2] We define "currently demonstrated technologies" as those that have already exhibited the level of performance and reliability needed to automate 1 or more of the 18 capabilities involved in carrying out work activities. In some cases, that level of performance has been demonstrated through commercially available products, in others through research projects.

Exhibit 1

Analyzing work activities rather than occupations is the most accurate way to examine the technical feasibility of automation.



In practice, automation will depend on more than just technical feasibility. Five factors are involved: technical feasibility; costs to automate; the relative scarcity, skills, and cost of workers who might otherwise do the activity; benefits (eg, superior performance) of automation beyond labor-cost substitution; and regulatory and social-acceptance considerations.

[1]Applying expertise to decision making, planning, and creative tasks.
[2]Unpredictable physical work (physical activities and the operation of machinery) is performed in unpredictable environments, while in predictable physical work, the environments are predictable.

substitution, including higher levels of output, better quality, and fewer errors. These are often larger than those of reducing labor costs. Regulatory and social-acceptance issues, such as the degree to which machines are acceptable in any particular setting, must also be weighed. A robot may, in theory, be able to replace some of the functions of a nurse, for example. But for now, the prospect that this might actually happen in a highly visible way could prove unpalatable for many patients, who expect human contact. The potential for automation to take hold in a sector or occupation reflects a subtle interplay between these factors and the trade-offs among them.

Even when machines do take over some human activities in an occupation, this does not necessarily spell the end of the jobs in that line of work. On the contrary, their number at times increases in occupations that have been partly automated, because overall demand for their remaining activities has continued to grow. For example, the large-scale deployment of bar-code

scanners and associated point-of-sale systems in the United States in the 1980s reduced labor costs per store by an estimated 4.5 percent and the cost of the groceries consumers bought by 1.4 percent.[3] It also enabled a number of innovations, including increased promotions. But cashiers were still needed; in fact, their employment grew at an average rate of more than 2 percent between 1980 and 2013.

THE MOST AUTOMATABLE ACTIVITIES

Almost one-fifth of the time spent in US workplaces involves performing physical activities or operating machinery in a predictable environment: workers carry out specific actions in well-known settings where changes are relatively easy to anticipate. Through the adaptation and adoption of currently available technologies, we estimate the technical feasibility of automating such activities at 78 percent, the highest of our seven top-level categories (Exhibit 2). Since predictable physical activities figure prominently in sectors such as manufacturing, food service and accommodations, and retailing, these are the most susceptible to automation based on technical considerations alone.

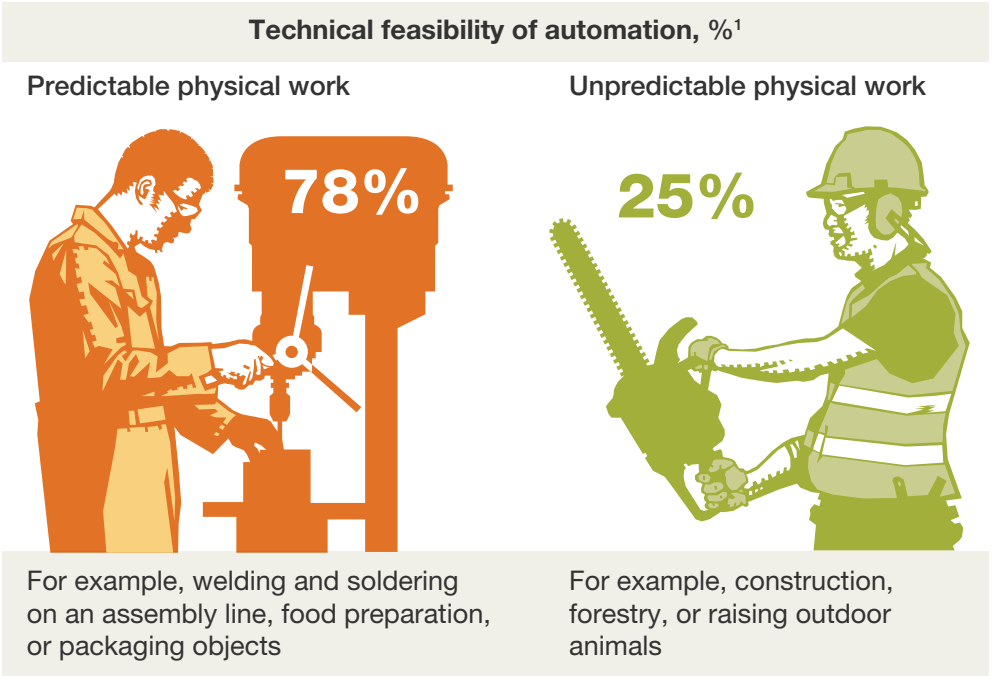
In manufacturing, for example, performing physical activities or operating machinery in a predictable environment represents one-third of the workers' overall time. The activities range from packaging products to loading materials on production equipment to welding to maintaining equipment. Because of the prevalence of such predictable physical work, some 59 percent of all manufacturing activities could be automated, given technical considerations. The overall technical feasibility, however, masks considerable variance. Within manufacturing, 90 percent of what welders, cutters, solderers, and brazers do, for example, has the technical potential for automation, but for customer-service representatives that feasibility is below 30 percent. The potential varies among companies as well. Our work with manufacturers reveals a wide range of adoption levels—from companies with inconsistent or little use of automation all the way to quite sophisticated users.

Manufacturing, for all its technical potential, is only the second most readily automatable sector in the US economy. A service sector occupies the top spot: accommodations and food service, where almost half of all labor time involves predictable physical activities and the operation of machinery—including preparing, cooking, or serving food; cleaning food-preparation

[3] Emek Basker, "Change at the checkout: Tracing the impact of a process innovation," *The Journal of Industrial Economics*, June 2015, Volume 63, Number 2, pp. 339–70.

Exhibit 2

It's more technically feasible to automate predictable physical activities than unpredictable ones.



[1]% of time spent on activities that can be automated by adapting currently demonstrated technology.

areas; preparing hot and cold beverages; and collecting dirty dishes. According to our analysis, 73 percent of the activities workers perform in food service and accommodations have the potential for automation, based on technical considerations.

Some of this potential is familiar. Automats, or automated cafeterias, for example, have long been in use. Now restaurants are testing new, more sophisticated concepts, like self-service ordering or even robotic servers. Solutions such as Momentum Machines' hamburger-cooking robot, which can reportedly assemble and cook 360 burgers an hour, could automate a number of cooking and food-preparation activities. But while the technical potential for automating them might be high, the business case must take into account both the benefits and the costs of automation, as well as the labor-supply dynamics discussed earlier. For some of these activities, current wage rates are among the lowest in the United States, reflecting both the skills required and the size of the available labor supply. Since restaurant

employees who cook earn an average of about $10 an hour, a business case based solely on reducing labor costs may be unconvincing.

Retailing is another sector with a high technical potential for automation. We estimate that 53 percent of its activities are automatable, though, as in manufacturing, much depends on the specific occupation within the sector. Retailers can take advantage of efficient, technology-driven stock management and logistics, for example. Packaging objects for shipping and stocking merchandise are among the most frequent physical activities in retailing, and they have a high technical potential for automation. So do maintaining records of sales, gathering customer or product information, and other data-collection activities. But retailing also requires cognitive and social skills. Advising customers which cuts of meat or what color shoes to buy requires judgment and emotional intelligence. We calculate that 47 percent of a retail salesperson's activities have the technical potential to be automated—far less than the 86 percent possible for the sector's bookkeepers, accountants, and auditing clerks.

As we noted above, however, just because an activity can be automated doesn't mean that it will be—broader economic factors are at play. The jobs of bookkeepers, accountants, and auditing clerks, for example, require skills and training, so they are scarcer than basic cooks. But the activities they perform cost less to automate, requiring mostly software and a basic computer.

Considerations such as these have led to an observed tendency for higher rates of automation for activities common in some middle-skill jobs—for example, in data collection and data processing. As automation advances in capability, jobs involving higher skills will probably be automated at increasingly high rates.

The heat map in Exhibit 3 highlights the wide variation in how automation could play out, both in individual sectors and for different types of activities within them.[4]

ACTIVITIES AND SECTORS IN THE MIDDLE RANGE FOR AUTOMATION

Across all occupations in the US economy, one-third of the time spent in the workplace involves collecting and processing data. Both activities have a technical potential for automation exceeding 60 percent. Long ago, many companies automated activities such as administering procurement, processing payrolls, calculating material-resource needs, generating

[4] For a deeper look across all sectors in the US economy, please see the data representations from McKinsey on automation and US jobs, on public.tableau.com.

invoices, and using bar codes to track flows of materials. But as technology progresses, computers are helping to increase the scale and quality of these activities. For example, a number of companies now offer solutions that automate entering paper and PDF invoices into computer systems or even processing loan applications. And it's not just entry-level workers or low-wage clerks who collect and process data; people whose annual incomes exceed $200,000 spend some 31 percent of their time doing those things, as well.

Financial services and insurance provide one example of this phenomenon. The world of finance relies on professional expertise: stock traders and investment bankers live off their wits. Yet about 50 percent of the overall time of the workforce in finance and insurance is devoted to collecting and processing data, where the technical potential for automation is high. Insurance sales agents gather customer or product information and underwriters verify the accuracy of records. Securities and financial sales agents prepare sales or other contracts. Bank tellers verify the accuracy of financial data.

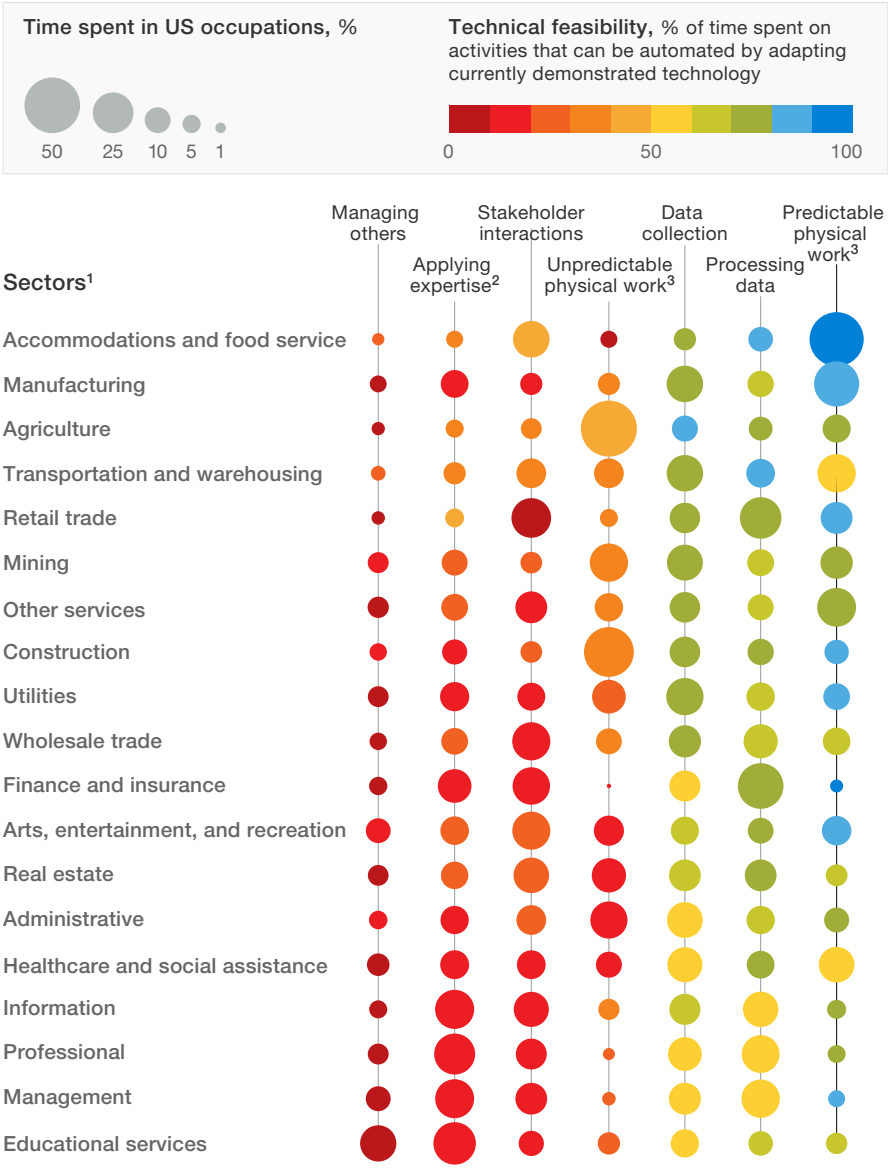
As a result, the financial sector has the technical potential to automate activities taking up 43 percent of its workers' time. Once again, the potential is far higher for some occupations than for others. For example, we estimate that mortgage brokers spend as much as 90 percent of their time processing applications. Putting in place more sophisticated verification processes for documents and credit applications could reduce that proportion to just more than 60 percent. This would free up mortgage advisers to focus more of their time on advising clients rather than routine processing. Both the customer and the mortgage institution get greater value.

Other activities in the middle range of the technical potential for automation involve large amounts of physical activity or the operation of machinery in *unpredictable* environments. These types of activities make up a high proportion of the work in sectors such as farming, forestry, and construction and can be found in many other sectors as well.

Examples include operating a crane on a construction site, providing medical care as a first responder, collecting trash in public areas, setting up classroom materials and equipment, and making beds in hotel rooms. The latter two activities are unpredictable largely because the environment keeps changing. Schoolchildren leave bags, books, and coats in a seemingly

Exhibit 3

Automation is technically feasible for many types of activities in industry sectors, but some activities can be more affected than others.



In practice, automation will depend on more than just technical feasibility. Five factors are involved: technical feasibility; costs to automate; the relative scarcity, skills, and cost of workers who might otherwise do the activity; benefits (eg, superior performance) of automation beyond labor-cost substitution; and regulatory and social-acceptance considerations.

[1]**Agriculture** includes forestry, fishing, and hunting; **other services** excludes federal-, state-, and local-government services; **real estate** includes rental and leasing; **administrative** includes administrative support and government administration; **healthcare and social assistance** includes private, state-government, and local-government hospitals; **professional** includes scientific and technical services; **educational services** includes private, state-government, and local-government schools.
[2]Applying expertise to decision making, planning, and creative tasks.
[3]Unpredictable physical work (physical activities and the operation of machinery) is performed in unpredictable environments, while in predictable physical work, the environments are predictable.

random manner. Likewise, in a hotel room, different guests throw pillows in different places, may or may not leave clothing on their beds, and clutter up the floor space in different ways.

These activities, requiring greater flexibility than those in a predictable environment, are for now more difficult to automate with currently demonstrated technologies: their automation potential is 25 percent. Should technology advance to handle unpredictable environments with the same ease as predictable ones, the potential for automation would jump to 67 percent. Already, some activities in less predictable settings in farming and construction (such as evaluating the quality of crops, measuring materials, or translating blueprints into work requirements) are more susceptible to automation.

ACTIVITIES WITH LOW TECHNICAL POTENTIAL FOR AUTOMATION

The hardest activities to automate with currently available technologies are those that involve managing and developing people (9 percent automation potential) or that apply expertise to decision making, planning, or creative work (18 percent). These activities, often characterized as knowledge work, can be as varied as coding software, creating menus, or writing promotional materials. For now, computers do an excellent job with very well-defined activities, such as optimizing trucking routes, but humans still need to determine the proper goals, interpret results, or provide commonsense checks for solutions. The importance of human interaction is evident in two sectors that, so far, have a relatively low technical potential for automation: healthcare and education.

Overall, healthcare has a technical potential for automation of about 36 percent, but the potential is lower for health professionals whose daily activities require expertise and direct contact with patients. For example, we estimate that less than 30 percent of a registered nurse's activities could be automated, based on technical considerations alone. For dental hygienists, that proportion drops to 13 percent.

Nonetheless, some healthcare activities, including preparing food in hospitals and administering non-intravenous medications, could be automated if currently demonstrated technologies were adapted. Data collection, which also accounts for a significant amount of working time in the sector, could become more automated as well. Nursing assistants, for example, spend about two-thirds of their time collecting health information.

Even some of the more complex activities that doctors perform, such as administering anesthesia during simple procedures or reading radiological scans, have the technical potential for automation.

Of all the sectors we have examined, the technical feasibility of automation is lowest in education, at least for now. To be sure, digital technology is transforming the field, as can be seen from the myriad classes and learning vehicles available online. Yet the essence of teaching is deep expertise and complex interactions with other people. Together, those two categories—the least automatable of the seven identified in the first exhibit—account for about one-half of the activities in the education sector.

Even so, 27 percent of the activities in education—primarily those that happen outside the classroom or on the sidelines—have the potential to be automated with demonstrated technologies. Janitors and cleaners, for example, clean and monitor building premises. Cooks prepare and serve school food. Administrative assistants maintain inventory records and personnel information. The automation of these data-collection and processing activities may help to reduce the growth of the administrative expenses of education and to lower its cost without affecting its quality.

LOOKING AHEAD

As technology develops, robotics and machine learning will make greater inroads into activities that today have only a low technical potential for automation. New techniques, for example, are enabling safer and more enhanced physical collaboration between robots and humans in what are now considered unpredictable environments. These developments could enable the automation of more activities in sectors such as construction. Artificial intelligence can be used to design components in engineer-heavy sectors.

One of the biggest technological breakthroughs would come if machines were to develop an understanding of natural language on par with median human performance—that is, if computers gained the ability to recognize the concepts in everyday communication between people. In retailing, such natural-language advances would increase the technical potential for automation from 53 percent of all labor time to 60 percent. In finance and insurance, the leap would be even greater, to 66 percent, from 43 percent. In healthcare, too, while we don't believe currently demonstrated technologies could accomplish all of the activities needed to diagnose and treat patients,

technology will become more capable over time. Robots may not be cleaning your teeth or teaching your children quite yet, but that doesn't mean they won't in the future.

As stated at the outset, though, simply considering the technical potential for automation is not enough to assess how much of it will occur in particular activities. The actual level will reflect the interplay of the technical potential, the benefits and costs (or the business case), the supply-and-demand dynamics of labor, and various regulatory and social factors related to acceptability.

LEADING MORE AUTOMATED ENTERPRISES

Automation could transform the workplace for everyone, including senior management. The rapid evolution of technology can make harnessing its potential and avoiding its pitfalls especially complex. In some industries, such as retailing, automation is already changing the nature of competition. E-commerce players, for example, compete with traditional retailers by using both physical automation (such as robots in warehouses) and the automation of knowledge work (including algorithms that alert shoppers to items they may want to buy). In mining, autonomous haulage systems that transport ore inside mines more safely and efficiently than human operators do could also deliver a step change in productivity.

Top executives will first and foremost need to identify where automation could transform their own organizations and then put a plan in place to migrate to new business processes enabled by automation. A heat map of potential automation activities within companies can help to guide, identify, and prioritize the potential processes and activities that could be transformed. As we have noted, the key question will be where and how to unlock value, given the cost of replacing human labor with machines. The majority of the benefits may come not from reducing labor costs but from raising productivity through fewer errors, higher output, and improved quality, safety, and speed.

It is never too early to prepare for the future. To get ready for automation's advances tomorrow, executives must challenge themselves to understand the data and automation technologies on the horizon today. But more than data and technological savvy are required to capture value from automation. The greater challenges are the workforce and organizational changes that leaders will have to put in place as automation upends entire business

processes, as well as the culture of organizations, which must learn to view automation as a reliable productivity lever. Senior leaders, for their part, will need to "let go" in ways that run counter to a century of organizational development.[5]

Understanding the activities that are most susceptible to automation from a technical perspective could provide a unique opportunity to rethink how workers engage with their jobs and how digital labor platforms can better connect individuals, teams, and projects.[6] It could also inspire top managers to think about how many of their own activities could be better and more efficiently executed by machines, freeing up executive time to focus on the core competencies that no robot or algorithm can replace—as yet.

[5] See Martin Dewhurst and Paul Willmott, "Manager and machine: The new leadership equation," *McKinsey Quarterly*, September 2014, McKinsey.com.

[6] See Aaron De Smet, Susan Lund, and William Schaninger, "Organizing for the future," *McKinsey Quarterly*, January 2016, McKinsey.com.

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KNOWLEDGE AT WHARTON

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The Future of Work: How You Can Ride the Wave of Change

July 29, 2016 • 14 min read

The public discussion over the future of work has followed a storyline that says technology and globalization are coming to whisk your job away. But behind the obvious forces, other perhaps more powerful factors are at play.

HUMAN RESOURCES MANAGEMENT PUBLIC POLICY

Featured Faculty
Matthew Bidwell , Peter Cappelli

Written By
Knowledge at Wharton Staff

For the average job-seeker or any parent wondering what kind of livelihood awaits the next generation, the current headlines are the stuff of anxiety attacks. **Last month**, the Associated Press announced that it would begin using an automated writing service to cover more than 10,000 minor league baseball games each year. Driverless trucks may soon be taking over from humans, elbowing out an entire profession. New technology purports to bring great change to a surprising number of fields, including law,

medicine and financial services. What will be the human toll and net effect on the economy? Has the U.S. reached an epoch of irreversible job loss?

To a large extent, the public discussion over the future of work has followed a storyline that says technology and globalization are coming to whisk your job away. But behind the obvious forces, other perhaps more powerful factors are at play, says Wharton management professor Peter Cappelli, director of the school's **Center for Human Resources**. "If one wanted to look at single changes that matter a lot to work, the biggest in my view has been ideology, the shift from the idea that business had a responsibility to all stakeholders toward the idea that they have responsibility only to one – shareholders." He adds that the second most impactful change has been the rise of China and "the addition of maybe 500 million semi-skilled workers to the world labor force. Neither of those were predictable a decade or more in advance of them happening."

The implications are as much political as economic, says Wharton management professor Matthew Bidwell. "Certainly for hundreds of years, people have said in the future nobody is going to work and machines will do it all for us, and that has yet to happen. First of all, up until now technology has created as many jobs as it has destroyed."

Still, he says, the trends, for reasons quite apart from technology, are extremely worrisome. "The working class has not had a good 30 or 40 years in the U.S. and the U.K. The destruction of the minimum wage and destruction of the unions played a role, technology has

played a role, and globalization has played a role," he notes. "Generally, modernization is not working terribly well for a lot of people, and it does result in Brexit, Trump and all that sort of stuff."

The shift is alarming, Bidwell adds, "because one perspective is these technologies are complex enough that you will see a few organizations controlling more and more of them. There is a huge barrier to entry. And I think then the only way to change is major social strife. If jobs really change as much as people say they are going to, for me the scariest piece is the political implications — the massive concentration of power that is likely to result."

> **"If one wanted to look at single changes that matter a lot to work, the biggest in my view has been ideology, the shift from the idea that business had a responsibility to all stakeholders toward the idea that they have responsibility only to one – shareholders."**
>
> –Peter Cappelli

Evaporating Jobs

Nailing down the future of work has long been a line of work in itself. **Author Martin Ford** argues that artificial intelligence threatens to make many professions obsolete, and has advocated for a basic income guarantee. About 47% of the U.S workforce is in jobs at high risk for becoming automated within the next two decades, according to the 2013 Oxford University study "**The Future of Employment: How Susceptible are Jobs to Computerisation?**" by Carl Benedikt Frey and Michael A. Osborne. And not only the jobs you might expect: "Occupations that require subtle judgment are

also increasingly susceptible to computerisation [sic]. To many such tasks, the unbiased decision making of an algorithm represents a comparative advantage over human operators," says the study, which included 702 occupations in its analysis.

What about creative industries, like music and screenwriting, and jobs that require the very human qualities of strategy, wisdom and intuition, like journalism? These jobs are, of course, safe, right? Not so, says Bidwell. "When you look at some of the industries some of the technology has devastated in the last 30 years, journalism and music are very high up the list," he notes. "I think part of the problem is that now you have this infinite distribution capacity, and those markets have been superstar markets, but a smaller number of people are making quite a bit of money. Customers have access into that content, but employees in those industries have not fared terribly well. If all the drudgework gets taken out, are we all going to be doctors or screenwriters? I'm not so sure."

To wit, just because a profession is producing something desirable, or even necessary to the functioning of society, doesn't mean society has figured out a way to pay for the care and feeding of its practitioners.

We have always argued that we are on the precipice of a profound change in the workplace, says Cappelli. "What history tells us is that the big changes move inexorably but reasonably slowly, and there is no single cause," he says. "The current spate of stories about the future of work are driven by stories about technology, but what we know about technology is that it has rarely been the source of

immediate change." The ability to do something with technology is quite different than the notion that it will spread, let alone spread quickly, Cappelli says.

The impact of technology gets mediated by its cost and complexity, he adds. For example, in the 1980s there were reports that VCRs would wipe out traditional television because of the ability to record and then blow through commercials. "Even though it was possible to do, it was difficult to use, so it never happened," Cappelli points out. "The problem basically is that employers are sitting on one side of a supply chain saying, 'We'd like workers with these skills, and by the way, we don't want to train them.' On the other are individuals looking for jobs. Sort of in the middle are community colleges and for-profit schools. The groups trying to help make matches are state and local workforce development agencies."

Change may be slow, but that does not mean it isn't coming. Nearly half of all respondents interviewed **as part of a Pew Research Center study** on the evolution of work 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." The 2014 study was not the typical representative poll of workers and managers, but, rather, a survey of 1,896 internet experts screened by Pew for previously insightful predictions about the internet.

> **"If jobs really change as much as people say they are going to, for me the scariest piece is the political implications — the massive concentration of power that is likely to result."**
>
> –Matthew Bidwell

On the hopeful side, these experts believed that although technology would displace certain kinds of work, it would also free us up from drudgery, leading us to invent new kinds of work. But they also conclude that while some highly skilled workers would triumph in the new work order, others would be forced into lower-paid jobs or suffer permanent unemployment. "Our educational system is not adequately preparing us for work of the future, and our political and economic institutions are poorly equipped to handle these hard choices," the study concludes.

Closing the Skills Gap

A society poorly prepared for the future of work is precisely Art Bilger's concern. The venture capitalist — he is a founding partner of Shelter Capital Partners — has founded an advocacy group called WorkingNation to create public awareness on the issue. With the national non-profit organization, Bilger is sounding the alarm bell on looming "mass structural unemployment" in the U.S. as a result of technology, globalization, longevity and an educational system that has failed to keep pace. The group is producing and distributing content — short videos and documentaries — arguing that society must do more to prepare for change, and spotlighting examples of groups coming up with solutions.

"Never before in history have we had such a steep slope," says Bilger. "This is truly about the heart of American society — the middle class, the very wealthy and those who are impoverished. There is not an aspect of society that won't be impacted by this if we don't deal with it appropriately."

Bilger says that the movements that have sprung up around both Republican Presidential nominee Donald J. Trump and Democratic candidate Bernie Sanders are a reaction to the looming jobs crisis. "I believe at the core of them are exactly these issues. We don't have to look five years down the road, there are millions of people in this country who are in pain, there is absolutely pain out there and it's economic and job-related pain," he notes. "It manifests itself in different ways, but whether you are a Trump fan or a Sanders fan, at the core they are exactly the same issues."

WorkingNation has commissioned well-regarded filmmaker Barbara Kopple to produce a series of pieces on the way work is changing, and how corporations are dealing with the skills gap. One success highlighted is Year Up, a Boston-based non-profit that works in urban areas to provide low-income young adults with skills development, college credits, corporate internships and other forms of support. Additional programs that have caught the eye of WorkingNation are College for Social Innovation, Operation Hope, Americorps, and Service Year Alliance. Bilger's group aims to create a "Future Proof Index" that will guide users to organizations that can assist them.

"What I'd like to see in the near-term," says Bilger, "is a real discussion of these issues so that the average American can understand what's going on — to have mom and pop looking up at

the dinner table with their 12-year-old and understanding where the jobs will be and what the mitigating strategies are. I'd like to see people broadly talking about this."

> **"Corporations have the greatest visibility as to how jobs are changing. If they can't fill jobs, and that is a problem today, they have a real need in terms of day-to-day business."**
>
> **—Art Bilger**

As for where the responsibility lies for preparing the workforce for the future, Bilger says policy at a federal level can help, but the best solutions are to be found on a local level, with organizations like the ones he is highlighting — and with businesses. "I do think corporations can play a very significant role, and I think they have a real responsibility. Corporations have the greatest visibility as to how jobs are changing. If they can't fill jobs, and that is a problem today, they have a real need in terms of day-to-day business. And they've got the greatest resources. When you look at the financial and human resources they could bring to the table, that could be very valuable."

Where Will the New Jobs Come From?

But retraining workers is just one step in restoring real job growth. The other part of the equation is finding ways to actually create jobs, says Colleen LaRose, president and CEO of the North East Regional Employment and Training Association. "The workforce system has historically been divorced from the economic development system. They run on separate tracks, and there is very little collaborative

work that they currently do," she says. "The problem is that they are each going and talking to employers separately, so they are not sharing information."

For instance, LaRose says, if the economic development side learns that a particular company in its area is going to start exporting to China, economic development is not then calling the workforce development side to share the news and suggest that new recruits should speak Chinese. By the same token, she notes, when the workforce system goes out to talk to businesses, they talk with employers about the things they are 'selling' — like tax credits offered to employers for hiring from certain populations with barriers to employment. "But workforce development does not take that valuable time spent with the employer to also speak with them about their plans for expansion, exporting, etc. And if they do happen to learn something that may be of interest to economic development, they seldom if ever share that information with economic development."

Economic development agencies largely use tax incentives to bring in business from other regions. "It's a zero-sum gain in a lot of instances because when you move a company from another area that other area is losing [jobs]. There has to be a way to grow jobs that are honest-to-goodness new jobs, sustainable jobs, in a way that isn't a win-lose," she says.

LaRose sees great promise in the economic gardening movement — a model in which promising second-stage companies are identified (generally having between 10 and 99 employees, with annual revenue between $1 million to $50 million) and given support in a variety of forms that would allow them to grow to the next level. "If a

typical business brings on five or six new employees, that's not as sexy as bringing in 2,000 jobs, but they are new jobs, not relocated jobs, and if you do that over and over, you are really having an impact," LaRose says.

> **"There has to be a way to grow jobs that are honest-to-goodness new jobs, sustainable jobs, in a way that isn't a win-lose."**
>
> —Colleen LaRose

Between 1995 and 2013, although second-stage companies comprised only 13% of U.S. establishments, they generated 35% of all jobs and about 34% of sales, according to the Edward Lowe Foundation, a champion of the idea.

For Bidwell's money, a good investment in being able to ride the ongoing wave of change in the nature of work is not necessarily vocational training, but getting a good, solid education. "The old cliché about college teaching people to think probably has a lot of truth to it," he says. "A lot of reading and writing and a certain amount of math — when you talk about adaptability, it provides you with this ability to take on new kinds of knowledge and rely on those basic skills. When you learn a particular welding technique, that's not necessarily helpful in five years."

The political mood at the moment doesn't point to government taking a strong role in ensuring the future of work, says Bidwell, "because the market has made it very clear that we can pay some people stratospheric amounts of money and other people very little

money, and that does not lend itself to a healthy society. But unless you are going to allow the government to intervene, that's where we're going to end the conversation."

A restoration of balance hinges on redistribution of wealth, spending on education, skills training, higher minimum wages and other interventions to raise the bargaining power of the low-skilled worker. But, Bidwell says, "from my perspective, the political situation in this country is 180 degrees from what would improve their lot."

Says Cappelli: "In short, I don't see any story pointing to fundamental change in the workplace beyond what we are already seeing, which is the continued efforts by employers to get labor cheaper in all kinds of ways without worrying much about the consequences. We've also been seeing the unwinding of the great corporate model that operated from the 1950s to the 1980s. What comes next? No clear pattern."

Technology

Robots and software may not be taking your job after all

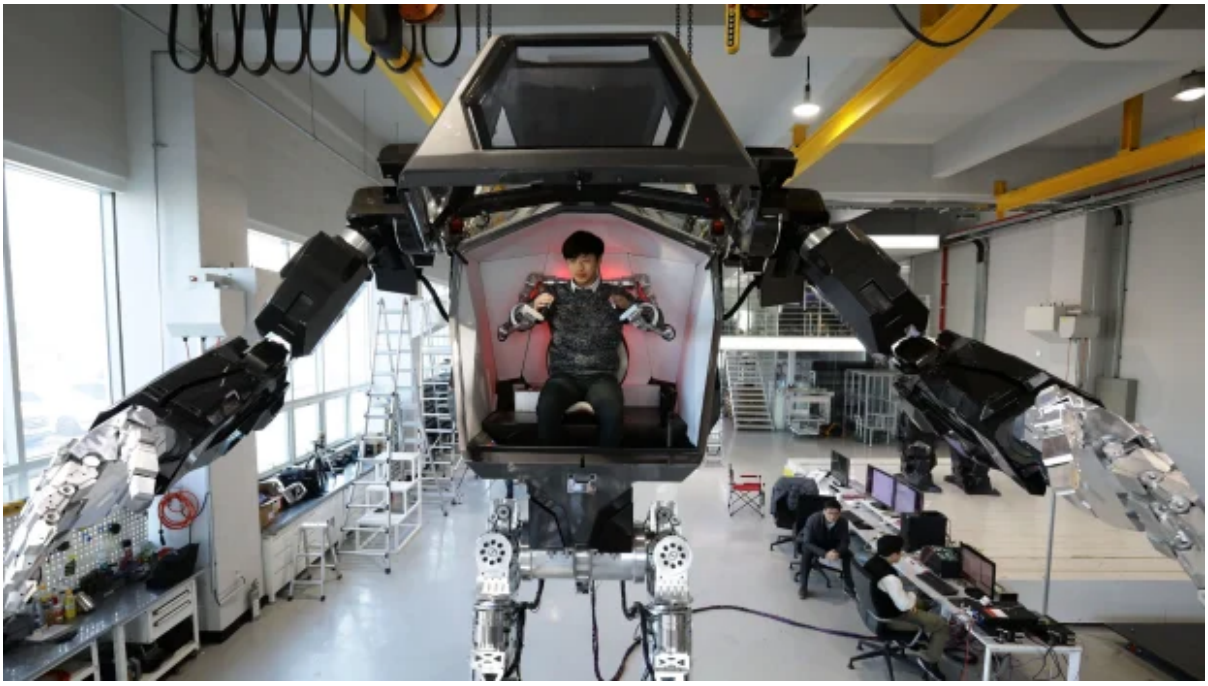
Duncan Weldon

Apr 20, 2017 – 11.00pm

Popular economics moves in cycles, and each cycle gives rise to a new worry about the future. Back in 2008-09 the fashionable concern was about debt, a fear driven partially by Carmen Reinhart and Kenneth Rogoff's "*This Time is Different*." By 2014, cooler kids were clutching copies of Thomas Piketty's "*Capital in the Twenty-First Century*," and fretting about inequality. Nowadays the zeitgeist anxiety is that robots are about to take all of our jobs. Propelled by a never-ending stream of books and op-eds, it is a fear that is surprisingly well-spread, encompassing a spectrum from billionaire technologist Bill Gates to French Socialist presidential contender Benoît Hamon. Thankfully though, while a robot takeover is capturing a lot of column inches, it isn't showing up in the data.

Management consultants at McKinsey & Co. are the latest to, er, drone on about the drones. Their Global Institute has published a report on automation that looks at 46 countries covering around 80% of the worldwide job market. They argue that with a combination of robotics, artificial intelligence and neural networks, almost half the activities that workers are currently paid to do could be automated by 2055. That would have consequences for 1.2 billion workers, who between them earn around $14.5 trillion in wages. These are big and scary numbers, even in global terms.

The report follows in the footsteps of thought-provoking, but under-questioned, work by two Oxford academics, Carl Frey and Michael Osborne [http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf]. In 2013 they claimed that almost half of all US occupations were at a high risk of automation in the next 20 years. They later extended their analysis to the global economy, and found that an outright majority of jobs in advanced economies, more than two-thirds in India and fully three-quarters in China, were susceptible to replacement.



It looks impractical but the technology behind it may have many uses and potentially job-destroying purposes. **Getty Images**

But there has also been one major recent study of technology, automation and the future of work that hasn't grabbed the headlines at all. A 2016 report by the Organisation for Economic Cooperation and Development [http://www.oecd.org/employment/Policy%20brief%20-%20Automation%20and%20Independent%20Work%20in%20a%20Digital%20Economy.pdf] came to a starkly different conclusion: Across the developed economies "only" around 9% of jobs are at a high risk of being replaced by machines in the coming 20 years. That may still sound uncomfortably high, but it is well within the normal range of industrial history. One in 10 jobs disappearing would pose big adjustment difficulties for some, and challenges for government, but it is fundamentally a manageable problem: the kind of thing we've dealt with before.

Crucial difference

The crucial difference comes from a more thorough methodology. Rather than looking at broad occupations and whole classes of activities, the OECD stripped jobs down into individual tasks. Machines are less likely to be able to replicate creativity, social interaction and the need for human-to-human contact anytime soon, and a surprising number of jobs involve these attributes.

Take the US category of "retail salesperson." Frey and Osborne gave that occupation a 92% risk of "computerisation." But the OECD points out that only 4% of such workers perform their jobs without face-to-face interaction or group work. It turns out that three-quarters of bookkeepers, who Frey and Osborne give a 98%

"robotisation risk," could not carry out their role without human contact and collaboration.

The demon robot is starting to look less terrifying. Indeed, he has been maligned before. The BBC archive contains a 1978 episode of the television series "*Horizon*" that explained how a new brain wave called the microchip was "the reason why our children will grow up without jobs to go to." Back in the 1810s, the Luddites destroyed new cotton-producing machinery, which they saw as throwing thousands of workers on to the scrap heap. In reality, the story of human progress since the birth of agriculture around 10000 BC has been the story of humans replacing labour with technology and freeing up time to do new, and different, jobs. That process speeded up after the 1750s, and – even if sometimes falteringly and unevenly – it eventually drove living standards to be transformatively higher.

Two economic effects

Labour-saving technology has two economic effects. The first and more obvious is displacement: New inventions displace workers and throw some people out of employment. But secondly and less obviously, those who keep working are now more productive – churning out as much stuff as many more workers did previously. Those newly productive workers should soon earn more, and so spend more as well. That fuels demand and creates new jobs, compensating for the posts that have gone. Before too long, history suggests that this compensation effect will be the dominant one..

But the debate is still shot through with anxiety – witness the calls from Gates, Hamon and others for a "tax on robots" to slow technological progress and protect jobs. This is certainly a more sophisticated Luddism than the original – "tax the looms" rather than "smash the looms."

There may be more person-to-person skills that will never easily be replaced meaning wild predictions about job losses may be unwarranted.

We are debating a problem we don't have, rather than facing a real crisis that is the polar opposite. Productivity growth has slowed to a crawl over the last 15 or so years, business investment has fallen and wage growth has been weak. If the robot revolution truly was under way, we would see surging capital expenditure and soaring productivity. Right now, that would be a nice "problem" to have. Instead we have the reality of weak growth and stagnant pay. The real and pressing concern when it comes to the job market and automation is that the robots aren't taking our jobs fast enough.

Prospect

Duncan Weldon is chief economist at Resolution Group, a UK financial services business.

Technology

Opinion

Woodside says robots and AI will make, not take, jobs

Shaun Gregory

Aug 14, 2017 – 11.00am

An apocalyptic narrative is grabbing headlines at the moment based on dire warnings of mass unemployment and even warfare as a result of robots replacing humans.

There can be no doubt artificial intelligence will revolutionise the way we work and live, but the prophets of doom are misguided. They will be doing Australia a serious disservice if the dystopian vision they are peddling deters us from embracing innovation and turning it to our advantage.

Woodside has a proud history as a pioneer of the oil and gas industry in Australia. Now we are taking the industry to new frontiers by adopting and developing innovation that builds on our strengths but challenges our thinking.

Woodside Energy is "training" a NASA-developed robonaut at its Perth headquarters. **Woodside**

For an industry that typically works on timeframes spanning decades, we are introducing a new approach built around the emerging field of data science that

can accelerate our way of working and boost returns to shareholders.

It's much broader than robots, but they tend to attract attention. In a lab in our Perth headquarters, we have on loan a NASA robonaut, known as Rick [http://www.afr.com/business/energy/gas/woodsides-nasa-robonaut-touches-down-in-perth-20170616-gwsixg], who has had selfies with various dignitaries.

It's an exciting project, as we use our expertise working in remote locations to support the space agency sending robots to Mars. For our industry, robots that can perform dangerous tasks in remote locations can substantially reduce risks to our people.

But Rick, the robonaut, is just one part of Woodside's expanding data science capability.

Giving access to knowledge

Data analytics and artificial intelligence are about giving our people easy access to the knowledge they need to perform at the highest level.

That's why Woodside has created and trained a cognitive assistant named Willow.

Woodside Energy chief technology officer Shaun Gregory with "Rick" the robonaut at Woodside's Perth office.

Willow is able to search in seconds through millions of files for relevant information that might otherwise take days, weeks or even months to find.

We are training Willow to understand the needs of each individual user, whether an offshore engineer who wants to understand the risk of drilling a particular well or our chief operations officer monitoring production at our facilities.

Each week, Willow learns how to help us better as our people provide feedback. The algorithms behind Willow, built in Perth by Woodside people, are fine-tuned when our staff rate its performance.

To make complex technologies accessible, we sometimes give them human names. But the reality is Rick and Willow are not humans and never will be. They can't train themselves, but rely on inputs from humans. They are there to help us.

I firmly believe these frontier technologies are all about augmenting human intelligence, not taking jobs.

Improving not taking jobs

Technologies that provide quicker access to knowledge can free up people's time, allowing them to think creatively, achieve more and succeed sooner. In our

industry, that can help us make better decisions faster and potentially accelerate the commercialisation of a resource.

With every generation, the types of jobs that are needed change, and we are currently undergoing another generational change. As a society, we need to ensure our future workforce develop the skills that will be needed.

At Woodside we hire 100 graduates each year, most of whom have science, technology, engineering or maths qualifications. The STEM skills will become increasingly important as technologies continue to evolve.

It's vital that visionary employers work with schools, universities and colleges to ensure they deliver the relevant skills.

Australian companies, from oil and gas to telecommunications, are already pushing the boundaries and testing new technology-driven solutions to business problems.

As we celebrate National Science Week, let's get a real conversation going between our educators and employers to ensure Australia is positioning itself today to make the most of tomorrow.

Shaun Gregory is senior vice-president and chief technology officer at Woodside Energy

Opinion

Technology is not about to destroy your job. That's a myth.

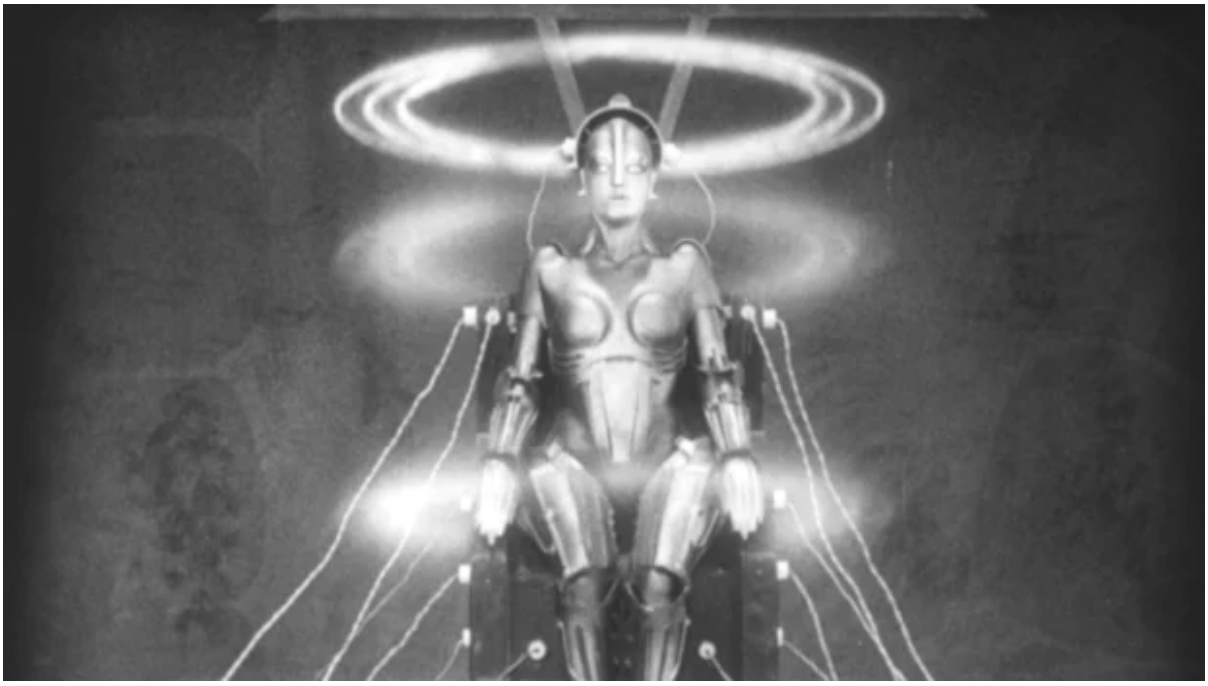
Barry Eichengreen

Dec 13, 2017 – 11.45pm

Robots, machine learning, and artificial intelligence promise to change fundamentally the nature of work. Everyone knows this. Or at least they think they do.

Specifically, they think they know two things. First, more jobs than ever are threatened. "Forrester predicts that AI-enabled automation will eliminate 9pc of US Jobs in 2018 [https://urldefense.proofpoint.com/v2/url?u=https-3A__www.forbes.com_sites_gilpress_2017_11_12_forrester-2Dpredicts-2Dthat-2Dai-2Denabled-2Dautomation-2Dwill-2Deliminate-2D9-2Dof-2Dus-2Djobs-2Din-2D2018_-232831d8d412b0&d=DwMFaQ&c=N9aEhCy8U0rJkO1xCZf7rgM9fohfR5qe_N93viZd7O8&r=oudc&e=]," declares one headline. "McKinsey: One-third of US workers could be jobless by 2030 due to automation [https://urldefense.proofpoint.com/v2/url?u=https-3A__www.cnbc.com_2017_11_29_one-2Dthird-2Dof-2Dus-2Dworkers-2Dcould-2Dbe-2Djobless-2Dby-2D2030-2Ddue-2Dto-2Dautomation.html&d=DwMFaQ&c=N9aEhCy8U0rJkO1xCZf7rgM9fohfR5qe_N93viZd7O8&" seconds another.

Reports like these leave the impression that technological progress and job destruction are accelerating dramatically. But there is no evidence of either trend. In reality, total factor productivity, the best summary measure of the pace of technical change, has been stagnating since 2005 in the United States and across the advanced-country world.



The numbers do not back up digital dismissal.

Moreover, as the economist Timothy Taylor recently pointed out [https://urldefense.proofpoint.com/v2/url?u=http-3A__conversableeconomist.blogspot.com_2017_12_is-2Djob-2Ddisruption-2Dhistorically-2Dlow-2Din.html&d=DwMFaQ&c=N9aEhCy8U0rJkO1xCZf7rgM9fohfR5qe_N93viZd7O8&r=dNTmvxy_nwlNOXiKT5dGlUBQeZ5FYaT3I&e=], the rate of change of the occupational structure, defined as the absolute value of jobs added in growing occupations and jobs lost in declining occupations, has been slowing, not accelerating, since the 1980s. This is not to deny that the occupational structure is changing [https://urldefense.proofpoint.com/v2/url?u=http-3A__equitablegrowth.org_working-2Dpapers_evolving-2Doccupational-2Dstructure_&d=DwMFaQ&c=N9aEhCy8U0rJkO1xCZf7rgM9fohfR5qe_N93viZd7O8&r=dNT But it calls into question the widely held view that the pace of change is quickening.

The second thing everyone thinks they know is that previously safe jobs are now at risk. Once upon a time, it was possible to argue that robots would displace workers engaged in routine tasks, but not the highly skilled and educated – not the doctors, lawyers and, dare one say, professors. In particular, machines, it was said, are not capable of tasks in which empathy, compassion, intuition, interpersonal interaction, and communication are central.

Now, however, these distinctions are breaking down. Amazon's Alexa can communicate. Crowd-sourcing, together with one's digital history, can intuit buying habits. Artificial intelligence can be used to read X-rays and diagnose medical conditions [https://urldefense.proofpoint.com/v2/url?u=https-3A__www.newyorker.com_magazine_2017_04_03_ai-2Dversus-2Dmd&d=DwMFaQ&c=N9aEhCy8U0rJkO1xCZf7rgM9fohfR5qe_N93viZd7O8&r=dNTmwTW

QabhyTDqJQ4Sxr1BdvjXMJLDocHvwqvc&e=]. As a result, all jobs, even those of doctors, lawyers, and professors, are being transformed.

Roles changing, not disappearing

But transformed is not the same as threatened. Machines, it is true, are already more efficient than legal associates at searching for precedents. But an attorney attuned to the personality of her client still plays an indispensable role in advising someone contemplating a messy divorce whether to negotiate, mediate, or go to court. Likewise, an attorney's knowledge of the personalities of the principals in a civil suit or a criminal case can be combined with big data and analytics when the time comes for jury selection. The job is changing, not disappearing.

These observations point to what is really happening in the labor market. It's not that nurses' aides are being replaced by health-care robots; rather, what nurses' aides do is being redefined. And what they do will continue to be redefined as those robots' capabilities evolve [https://urldefense.proofpoint.com/v2/url?u=http-3A__www.businessinsider.com_japan-2Ddeveloping-2Dcarebots-2Dfor-2Delderly-2Dcare-2D2015-2D11&d=DwMFaQ&c=N9aEhCy8U0rJkO1xCZf7rgM9fohfR5qe_N93viZd7O8&r=dNTmwTWXpBT6JlQVR7FqvByaIjGxs&e=] from getting patients out of bed to giving physical therapy sessions and providing emotional succor to the depressed and disabled.

At one level, this is good news for those concerned about the prospects of incumbent workers: there will continue to be demand for workers in existing occupations. Not all nurses' aides will have to become software engineers. The knowledge they acquire on the job – of how one interacts with patients, how one recognises their moods, and how one acknowledges their needs – will remain pertinent and valued. They will use that knowledge to guide and co-operate with their robotic colleagues.

Thus, the coming technological transformation won't entail occupational shifts on the scale of the Industrial Revolution, with its wholesale redistribution of labor between the agricultural and industrial sectors. After all, the vast majority of Americans already work in the service sector. But it will be more important than ever for people of all ages to update their skills and renew their training continuously, given how their occupations will continue to be reshaped by technology.

In countries like Germany, workers in a variety of sectors receive training as apprentices and then over the course of their working lives. Companies invest and

reinvest in their workers, because the latter can insist on it, possessing as they do a seat in the boardroom [https://urldefense.proofpoint.com/v2/url?u=http-3A__www.tandfonline.com_doi_abs_10.1080_01402388608424561&d=DwMFaQ&c=N9aEhCy8U0r BZbGlcikVSP48x4WyBrauI4yv5Mjqywmt4TvrSQ&e=] as a result of the 1951 Codetermination Law. Employers' associations join with strong trade unions to organise and run training schemes at the sectoral level. The schemes are effective, in part, because the federal government sets standards for training programs and issues uniform curricula for trainees.

In the US, board membership for workers' representatives, strong unions, and government regulation of private-sector training are not part of the prevailing institutional formula. As a result firms treat their workers as disposable parts, rather than investing in them. And government does nothing about it.

So here's an idea. Instead of a "tax reform" that allows firms to expense their capital outlays immediately, why not give companies tax credits for the cost of providing lifelong learning to their employees?

PROJECT SYNDICATE

Barry Eichengreen is a professor at the University of California, Berkeley.

Project Syndicate

Technology AI

Opinion

Is anyone's job really safe once AI learns to fake sincerity?

Algorithms cannot share your feelings or feel your pain like a human care professional can. But don't bank on them not learning how to try.

Barry Eichengreen
Economics professor

Jan 17, 2023 – 12.28pm

With hindsight, 2022 will be seen as the year when artificial intelligence gained street credibility. The release of ChatGPT [https://www.afr.com/link/follow-20180101-p5cbll] by the San Francisco-based research laboratory OpenAI garnered great attention and raised even greater questions.

In just its first week, ChatGPT attracted more than a million users and was used to write computer programs, compose music, play games, and take the bar exam. Students discovered that it could write serviceable essays worthy of a B grade – as did teachers, albeit more slowly and to their considerable dismay.

Can AI get in touch with your feelings? **Getty**

ChatGPT is far from perfect, much as B-quality student essays are far from perfect. The information it provides is only as reliable as the information available to it, which comes from the internet. How it uses that information depends on its training, which involves supervised learning, or, put another way, questions asked and answered by humans.

The weights that ChatGPT attaches to its possible answers are derived from reinforcement learning, where humans rate the response. ChatGPT's millions of users are asked to upvote or downvote the bot's responses each time they ask a question. In the same way that useful feedback from an instructor can sometimes teach a B-quality student to write an A-quality essay, it's not impossible that ChatGPT will eventually get better grades.

This rudimentary artificial intelligence forces us to rethink what tasks can be carried out with minimal human intervention. If an AI is capable of passing the bar exam, is there any reason it can't write a legal brief or give sound legal advice? If an AI can pass my wife's medical-licensing exam, is there any reason it can't provide a diagnosis or offer sound medical advice?
An obvious implication is more rapid displacement from jobs, compared to past waves of automation, and more rapid restructuring of surviving jobs. And the jobs that will be automated out of existence will not be limited to the low-skilled and low-paid.

Less obvious is who is safe from technological unemployment. What human traits, if any, will an AI be unable to simulate? Are those traits innate, or can they be taught?

How worried should we be? Type 'Write an 800-word commentary on AI' into ChatGPT and judge for yourself.

The safest jobs will be those requiring empathy and originality. Empathy is the ability to understand and share the feelings and emotions of others. It creates the interpersonal compassion and understanding that are fundamental to social interactions and emotional well-being. It is especially valuable in circumstances and periods of difficulty. That's why empathy is valued in religious leaders, caregivers, and grief counsellors.

It is possible to imagine that, with the help of facial-recognition software, an AI can learn to *recognise* the feelings of its interlocutors (that it can learn what is known as "cognitive empathy"). But it can't obviously *share* their feelings (it can't learn

"affective empathy") in the same way that my wife, in her empathic moments, shares my feelings. Add that to the list of reasons why an AI can't replace my wife, my doctor, or my rabbi.

There is no consensus about whether affective empathy can be cultivated and taught. Some argue that affective empathy is triggered by mirror neurons in the brain that can't be artificially stimulated or controlled. Empathy is just something we experience, not something we can learn. It follows that some of us are better wired than others to be caregivers and grief counsellors. [https://www.afr.com/link/follow-20180101-jcsuy]

Other researchers suggest that this emotional response can indeed be taught. There is even a training company for medical clinicians called Empathetics, Inc. If true, it may be possible that more people can be prepared for automation-safe jobs where affective empathy is required.

But if humans can learn affective empathy, then why can't algorithms? The idea that jobs requiring affective empathy will remain safe from automation assumes that people can distinguish true empathy from the simulation.

Originality is distinct from creativity

Originality means doing something that hasn't been done previously, for example, creating a painting, composition, or newspaper commentary wholly unlike what has come before. Originality is distinct from creativity, which involves combining pre-existing elements in novel ways.

Another OpenAI [https://www.afr.com/link/follow-20180101-p5c6qw] product, DALL•E, is able to generate sophisticated images from text descriptions ("a painting of an apple" or "the 'Mona Lisa' with a moustache"). This has created some consternation among artists. But are its responses, derived using a large dataset of text-and-image pairs, original artwork?

It is questionable whether they are original in the sense of portraying an aesthetically pleasing image unlike any seen before, as opposed to combining existing visual elements associated with existing text. Artists who trade on originality may have nothing to fear, assuming of course that viewers can distinguish original artwork from the rest.

Again, there is no consensus on whether originality is inborn or can be taught. The answer, most likely, is: a bit of both.

How worried should we be? Type “Write an 800-word commentary on AI for Project Syndicate” into ChatGPT and judge for yourself.

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Barry Eichengreen is Professor of Economics at the University of California, Berkeley.

Technology AI

Exclusive

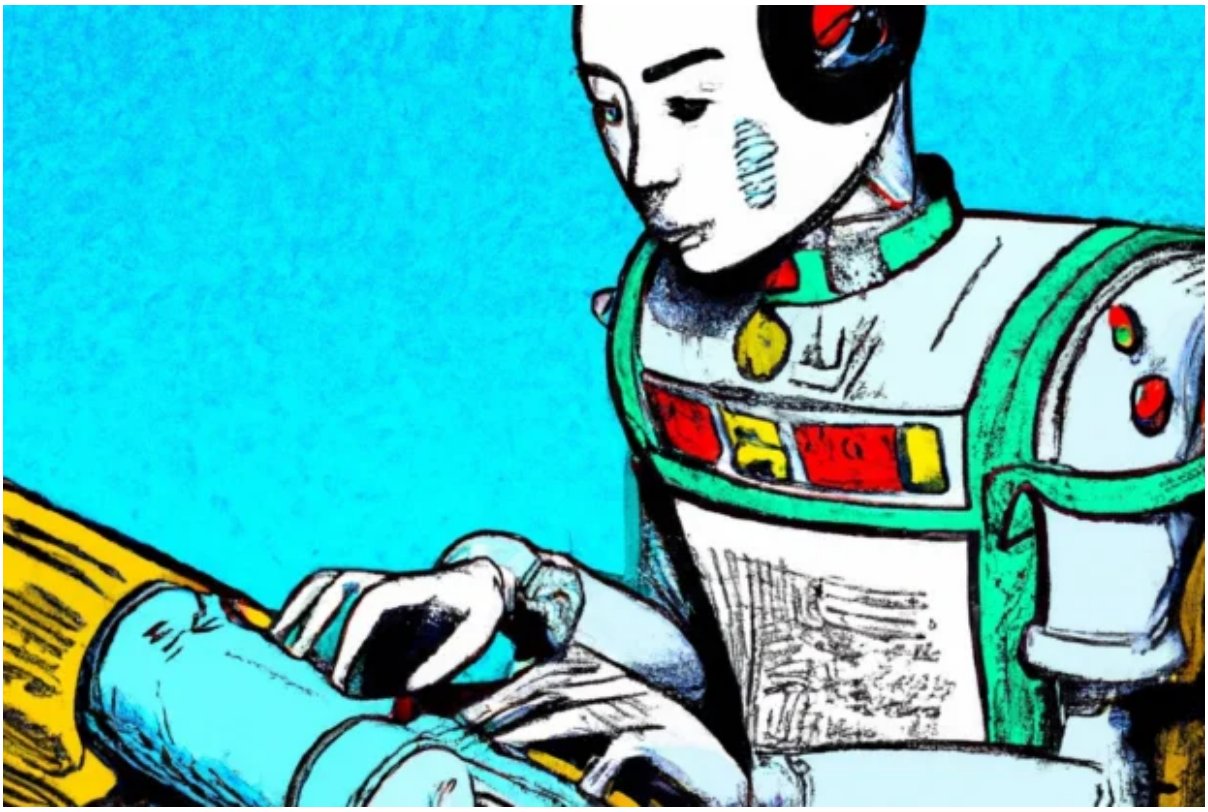
AI is meant to improve your job. These Aussies don't buy it

Tess Bennett *Technology reporter*

Mar 28, 2023 – 5.00am

Australian workers are not buying tech industry assurances that increasingly smart artificial intelligence will make their jobs better and not replace them, with almost half telling researchers they are bracing for significant changes to the workforce.

Telsyte's Australian Digital Consumer Study 2023 found 35 per cent of workers anticipate their roles could be performed fully by machines, AI, or robots in the future.



Consumers think graphic designers, accountants and customer service professionals are most at risk of being replaced by machines. **DALL-E**

Almost a third of workers said their roles could be completely taken over by machines or AI in 10 years' time. That figure rose to 57 per cent when the timeframe was extended to 20 years.

Of those who agree that their roles could be performed by machines, 42 per cent believe that part of their roles will be replaced within five years, while 71 per cent believe this will happen within 10 years.

The survey of more than 1000 consumers conducted in mid-January, found that 20 per cent of Australians aged 16 and over were already aware of ChatGPT, and 1 million Australians were already using it, just six weeks after OpenAI's chatbot launched. [https://www.afr.com/technology/chatgpt-takes-the-internet-by-storm-bad-poetry-and-all-20221207-p5c4hv]
A third of Australians are already interested in using intelligent AI-based chatbots such as ChatGPT for various tasks and, of those interested, 33 per cent of workers want to use intelligent AI-based chatbots to help them do their jobs.

"The Australian workforce is trying to reduce the workload, happy to hand off parts of their workload to AI, but are wary of being replaced at the same time," said Foad Fadaghi, Principal Analyst and Managing Director at Telsyte.

"It's an unusual circumstance where consumers feel they cannot stand in the way of the fast progress in artificial intelligence."

The roles that consumers think are most likely to be eliminated are customer services, IT services, accountants, tourism and graphic designers.

The federal government has tapped a handful of experts in robotics [https://www.afr.com/technology/the-plan-to-create-higher-paid-jobs-after-the-robots-take-over-20221212-p5c5p4], automation and manufacturing to develop a national robotics strategy to make sure the obsolete roles are replaced by higher-paying gigs.

Software makers are working quickly to embed large language models into workplace technology, giving white-collar workers the power to summarise documents, make presentations and charts and analyse spreadsheets.

Microsoft is trialling [https://www.afr.com/technology/microsoft-trial-to-put-ai-bots-in-your-meetings-20230316-p5cstm] a new AI feature called Copilot, a chatbot that can take directions and complete tasks in Word, Excel, PowerPoint, Outlook emails and Teams, with 20 organisations and is planning a wider roll-out in the coming months.

Google is also racing to integrate generative AI features into its Workspace apps such as Gmail, Google Docs and Slides.

For its part, Microsoft executives stressed the tools are designed to save workers' time by creating a first draft, not to replace humans entirely.

Despite an eagerness to use AI for tasks such as language translation, research, brainstorming ideas and summarising long documents, few are willing to pay for the service, Telsyte's research found.

Less than 10 per cent of the Australians surveyed said they are willing to pay for AI subscription services such as GPT-4, which charges $22 per month, to help them with their day-to-day tasks and queries.

Sixteen per cent of those working in the professional, scientific and technical services and education and training would pay for the service.

On average, those willing to pay for AI subscription services said they would spend just under $10 per month. However, 37 per cent of respondents are willing to pay more than $10 per month, indicating a potential demand for prosumer applications.

"AI subscription services whether paid directly or through an equivalent suite of products present a seismic shift in the IT Industry," Mr Fadaghi said.

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