

Work in the Digital Age

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The future world of work promises a new age of automation. So where exactly do humans stand in a 21st-century labour market?

Over the course of the 20th century, technological advances translated into unprecedented increases in living standards for the vast majority of workers in each successive generation. Yet today, less than one in five workers in America believe that the generation currently entering the labour market will lead better lives than themselves. As formerly middle-class jobs have been automated away, the US economy has experienced stagnant wages and falling employment. While the digital age may have brought undisputable gains for consumers, there is increasing concern that innovation has taken a turn on labour. This raises questions about the US economy's capacity to create meaningful and self-fulfilling jobs for workers in the future.

In his famous chapter on machinery, published in the third edition of *The Principles of Political Economy and Taxation in 1821*, the British economist David Ricardo argued that the substitution of workers by machines may 'render the population redundant'. Although the idea of technological unemployment did not materialise during the 20th century, there is growing concern that Keynes' prediction of mankind failing to find uses for its labour is now coming true.

This concern reflects the expanding scope of work that computers are able to perform. In the past, they have been phenomenal at performing tasks that can easily be subdivided, routinised and expressed as a set of programmable rules, but less so where work cannot easily be simplified into rule-based activities. Hence, as industrial robots have replaced manufacturing workers many low-skilled workers have been reallocated to jobs consisting of unstructured manual tasks, such as occupations in the services and transportation sectors.

Computers, however, are increasingly making inroads into domains not long ago perceived as inherently human. Rapid advances in machine learning and mobile robotics, associated with the increasing availability of big data, are making an increasing number of complex tasks automatable, by transforming them into well-defined problems.

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Driving a car in rush-hour traffic, for example, was long seen as something a computer would never be capable of – emulating human perception has been a central challenge to programmers for decades. Yet, driverless cars are today roaming the Californian highways. Similarly, computers are increasingly encroaching on the jobs of physicians, most prominently exemplified by Watson – the IBM supercomputer that beat the human champions of *Jeopardy!* – which is now being retrained as a doctor. With the capacity to store all available medical information, digital diagnosticians may fundamentally alter the medical profession.

Even complex scientific processes of hypothesis generation and testing are increasingly within reach for computers. Recently, *KnIT*, a system that mines scientific literature, was demonstrated to be able to generate novel and experimentally testable hypotheses from existing data. Doctors and scientists are unlikely to be out of work soon, but the tasks they carry out may change dramatically in the near future.

Against this background, a 2013 *Oxford Martin School* study by Michael Osborne and one of the authors (Carl Benedikt Frey) shows that 47% of US workers could be replaced by computer-driven technologies over the coming decades. The study



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suggests that a wide range of occupations are susceptible to computerisation, including jobs in administration, transportation, logistics, services and sales. Workers in these jobs are typically less educated and earn lower incomes, suggesting that the next generation of big data-driven computers will mainly affect those in low-skill jobs, exacerbating already growing inequality. By contrast, the manufacturing technologies of the Industrial Revolution largely substituted for skilled labour, as the artisan shop was replaced by the factory system. The computer revolution of the 20th century, on the other hand, caused the hollowing-out of middle-income jobs once created by the Industrial Revolution.

Workers who see themselves replaced by machines will need to shift into jobs that are less susceptible to computerisation. As many of the safe havens for low-skilled workers are now disappearing, this will provide a challenge. Despite recent technological advances, work requiring human creativity and social intelligence – skills where humans will hold a comparative advantage – will be the jobs of the 21st century. For workers to stay competitive in the labour market, they will have to acquire social and creative skills.

New Work In The 21st Century

While technological change destroys old jobs, it also creates employment opportunities in entirely new occupations and industries. Consider the example of the computer itself. With its origins in the 18th century, the term ‘computer’ initially referred to an occupation; literally, one who computes. The coming of the electronic computer meant that the routine activity of carrying out repetitive calculations by human workers gradually was transferred to machines, freeing up human workers to perform less dreary and mind-numbing tasks. Yet at the same time, the computer created many new occupations, such as computer programmers, database administrators and software engineers.

As computers have displaced secretaries, assembly-line workers and cashiers, a central question is to what extent are employment opportunities created by the digital revolution able to replace the jobs made redundant?

Historically, revolutionary technologies such as the automobile and the railroad have created vast employment opportunities. Relatively speaking, however, the technologies of the digital revolution have created little new work. A recent study found that less than 0.5% of the US labour force is employed in technology-driven industries created since the turn of the century, such as internet auctions, web designing and video and audio streaming. These industries have not created many jobs for ordinary workers: people working in digital industries are much better educated

than the average population and earn more than twice the US median wage. Such high-skill demands make it unlikely that these jobs will provide the opportunities that the 20th-century factory floors did for the many.

Risks And Opportunities

While the digitalisation of the economy poses a number of challenges, it also presents a wide range of opportunities. The concentration of entrepreneurial talent has been the engine of progress over recent decades, with *Google*, *Facebook*, *Bloom Energy* and *Tesla Motors* all based in Silicon Valley. Nevertheless, the digital revolution has reduced the cost of distance, easing interactions across locations. As a result, those in geographically distant places have unprecedented access to global markets and information.

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Most digital products can in principle be produced anywhere for a global market. Even more traditional goods have become increasingly mobile. Online marketplace *Etsy*, for example, allows small-scale artisans to reach customers all over the world through its online marketplace. For the geographically isolated, the internet provides unparalleled possibilities for self-realisation and to apply their ingenuity to solving problems. Thus, while location is still important, geography is no longer the limiting factor it used to be.

Digital technologies offer the possibility of making education and training available more cheaply. Online training has grown exponentially, with the proliferation of Massive Open Online Courses (MOOCs), and many Ivy League universities provide free online lectures by the world’s leading instructors. In this digital age, a high-quality education is available to anyone with a computer and internet access. Though it remains to be seen how these training programs can be made more effective, policymakers would do well to support the development of alternative ways of retraining and educating workers.

Similar advances in finance, such as peer-to-peer lending and crowdfunding, mean seed funding has become more available to entrepreneurs. *Crowdcube*, for example, provides an alternative to banks, business angels and venture capitalists, by allowing start-ups to access seed funding from ‘the crowd’. Additionally, digital innovation requires less capital; according to a recent survey of mobile app developers, the average cost of developing an app was \$6,453. This makes becoming an entrepreneur open to more ordinary people.

Although these developments offer a wide range of opportunities, a number of challenges lie ahead. As

the pace of technological progress becomes ever faster, lifelong careers are likely a thing of the past. Since the early 1970s, the average tenure of male workers has declined by 25%, suggesting that while our parents had careers, in the future we'll have gigs. Moreover, within five years, Millennials – the generation in their late teens to early 30s – will constitute half of the workforce; a generation steeped in digital technology, with demands for more flexible jobs. To accommodate a more flexible labour market, welfare systems must be redesigned to accommodate the changing norm away from full-time, lifelong employment. Social safety nets should encourage entrepreneurial risk-taking and ease shorter stints in the labour market, with more frequent shorter spells of unemployment.

A more fundamental concern is the existing political, economic and social interests invested in maintaining the technological status quo. While legal and regulatory barriers to new technologies may protect jobs in the short term, these will reduce the long-term prospects for growth if they stifle innovation and arrest technological progress. It is time for a grand bargain that supports progress, while also addressing the related challenges through policy actions that build a more inclusive society.

Some 150 years ago, western societies began their economic transformation as millions left agriculture for a life in the bustling industrial centres. In the 19th century, 80% of US workers were employed in agriculture. Today, that number is less than 2%. Anyone predicting how the labour market would change over these 100 years would be hard pressed to envision the new work created. That droves of new jobs would be created in the industrial cities to soak up the millions who left the countryside would be nearly unthinkable.

Today, we stand at the brink of a similar technological revolution. The future of work will look very different to the factory floors of the 20th century.

How we manage this transition boils down to how well we adapt and while the challenges today are no less daunting, history shows that where creativity and human ingenuity meet them, economic growth and wellbeing improve at an unceasing pace.

Fellowship in Action. Filling the Gaps

Black Country Atelier (BCA) is a team of designers, engineers and scientists who visit schools and colleges to share their passion for smart technology with students. Designer and founder Jing Lu started *BCA* after realising there was a gap between industry practice and what pupils were learning. “The students were really hungry for modern design tools like computer aided design and manufacture,” explained Jing.

Taught by industry specialists, students learn the practical application of modern design tools. “We want to develop these projects and lead interested students into work placements and real practice to stretch them,” said Jing.

A generous grant from the *Comino Foundation* is supporting *BCA*'s three-year ‘*Manual of Modern Making*’ project. Dedicated to working with four RSA Academies, it aims to transform students’ learning of design and technology using the latest techniques in digital fabrication technologies.

Find out more at www.blackcountryatelier.com

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