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Race Against the Machine

How the Digital Revolution Is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy

Erik Brynjolfsson and Andrew McAfee • Erik Brynjolfsson and Andrew McAfee © 2011 • 98 pages

Technology

Take-Aways

- Advancing technology streamlines work.
- Human workers are to new machines as workhorses were to tractors.
- With digital technology as a forceful economic driver, more and more workers will become superfluous.
- Yet, thanks to automation, some human work skills are more valuable than ever.
- Advanced technology turbocharges US productivity.
- It helps create a “Great Restructuring” rather than a Great Depression.
- Government must develop effective programs to counter worker displacement.
- These programs should include initiatives to upgrade workers’ skills.
- Organizations must become more innovative in order to deal with the rapidly changing business environment.
- No matter what employment disruptions technology generates, it will improve life for all people worldwide.

Recommendation

The slogan of General Electric's 2012 advertising campaign is "Brilliant machines are changing the way we work." Instead, it could be "In the future, brilliant machines will do all the work." As management professor Erik Brynjolfsson and scientist Andrew McAfee point out, this notion is not far-fetched. They speculate that, given the exponential increases in raw computer power, machines will do many jobs that humans perform today. The authors, who are not technophobes, offer 19 solid, if perhaps unrealistic, suggestions for steps government can take. *getAbstract* recommends this short, fascinating, but scary, treatise to those interested in the influence of advanced technology on the US labor market and to anyone wondering how government can keep people gainfully employed in future.

Summary

Computers Join the Workforce

Computer technology is upending society and causing dramatic changes. Technology and machines have replaced workers and now do their jobs better, faster and cheaper. More workers will suffer the same fate, not just due to machines' effectiveness but also because technology does not ask for vacation pay, benefits or sick leave.

"There is a growing mismatch between rapidly advancing digital technologies and slow-changing humans."

During the summer of 2011, the recession began to ease, and the US economy started to recover. In July, 117,000 new jobs opened up, more than twice the number of new jobs created during the previous two months. But the US was not out of the woods. That same month, unemployment hit 9.1%, not much better than during the worst point of the economic downturn.

"Whatever else computers may be at present, they are not yet convincingly human."

Many observers did not understand what was happening. How could so many workers be unable to find work when economic indicators were relatively positive? GDP growth was not bad. Businesses were ringing up record profits. Economists had declared the recession on the mend. Returns on investment in equipment were sound.

"Of all the grim statistics and stories accompanying the Great Recession and subsequent recovery, those related to employment were the worst."

Normally, when profits are up and companies invest, they open their doors to new workers – but not this time. What happened to all the jobs?

Why the Jobs Vanished

Analysts offer three explanations for extended unemployment: "cyclical, stagnation and the 'end of work'." The cyclical argument is that economic demand remains too sluggish to rehire all those out of work.

Economist Paul Krugman concurred that the evidence indicates that US unemployment “is the result of inadequate demand – full stop.” The stagnation argument posits that the US is in decline due to a failure to innovate and extend productivity. “We have been living off low-hanging fruit for at least 300 years...Yet during the last 40 years, that low-hanging fruit started disappearing,” argues economist Tyler Cowen.

“Some human skills are more valuable than ever, even in an age of incredibly powerful and capable digital technologies.”

Other notable academics theorized about the impact of technology on the economy and the workforce, including famed economist John Maynard Keynes, author and management thinker Peter Drucker, and Nobelist Wassily Leontief. In 1983, Leontief said, “The role of humans as the most important factor of production is bound to diminish in the same way that the role of horses in agricultural production was first diminished and then eliminated by the introduction of tractors.”

“Vending machines now sell iPods, bathing suits, gold coins, sunglasses and razors; some will even dispense prescription drugs and medical marijuana to consumers willing to submit to a fingerprint scan.”

The end-of-work argument – named after Jeremy Rifkin’s business book, *The End of Work* – concerns the recent staggering increase in technological achievement. Rifkin, an economist and social critic, hypothesizes that a new stage of global history is beginning, an era when “fewer and fewer workers will be needed” to manufacture products and provide services for the world’s population. According to Rifkin, computers will cause this displacement. He predicts, “In the years ahead, more sophisticated software technologies are going to bring civilization ever closer to a near-workerless world.” At present, he explains, every industry is “experiencing technological displacement, forcing millions onto the unemployment rolls.”

“The economics of digital information...are the economics not of scarcity but of abundance.”

The end-of-work theory makes a lot of sense. Computers change everything. But the obsolescence of workers is not inevitable. Thanks to automation, some human work skills are now more valuable than ever, like creative services and personal care. However, technology’s negative effect on employment will accelerate in future years. With digital technology as a forceful economic driver, more workers will become superfluous.

“Real spending on equipment and software has soared by 26%, while payrolls have remained essentially flat.”

Think of this as a “Great Restructuring.” Technological development will continue to advance. Society must examine this phenomenon and develop strategies that enable workers to step out in front of the machines “instead of racing against them.”

“General Purpose Technologies”

Numerous new technologies perform human tasks, and some of them do it brilliantly. For example, the idea of a driverless vehicle was laughable only a few years ago. Now Google has developed “fully autonomous

cars” that can negotiate US roads. One test vehicle traveled more than 1,000 miles without mishap. Lionbridge, a translation services company, has developed GeoFluent, which can accurately translate written words from one language to another. However, completing mechanical human tasks is merely a single facet of the exponential growth of computer power and automated capabilities.

“It doesn’t appear that gardeners and restaurant busboys are in danger of being replaced by machines any time soon.”

Computers are the superstar technologies of a classification known as general-purpose technologies (GPTs), dynamic innovations that can affect a country’s overall economic system or that can have worldwide impact.

Economists Timothy Bresnahan and Manuel Trajtenberg find that GPTs seem to impel “whole eras of technical progress and economic growth.” Computers enable organizations to work smarter. They provide added value with no parallel increase in “labor, capital and other resources.” This means that advanced technology, notably information technology, is fulfilling the classic formula for increasing productivity.

“The message the labor market is clearly sending is that it’s much easier to create value with highly educated workers.”

The growth in US median income – the income point demarking where half the people earn less and half earn more – is tepid, but the super-rich have benefited from the machine-driven increase in productivity. While their wealth is skyrocketing, the average worker is “losing the race against the machine.”

“An Agenda for Action”

Information technology may be responsible for today’s wage stagnation, but that doesn’t have to be true in the future. Society and government can implement solutions to the machine-labor problem. Once these remedies are in place, they will help expand innovation inside organizations and create more human capital nationwide.

“Computers and networks bring in an ever-expanding set of opportunities to companies.”

Policy makers in four areas – including education, entrepreneurship, investment, and “laws, regulations and taxes” – should pursue the following 19 recommendations:

1. **“Invest in education”** – Pay teachers more. US teachers earn only 40% of the earnings of a typical college graduate. Increase teachers’ pay, and more college students will pursue careers in education.
2. **“Hold teachers accountable”** – Abolish tenure.
3. **“Separate student instruction from testing and certification”** – Measure students’ “verifiable outcomes” instead of relying on test scores.
4. **“Make students spend more time in class”** – From kindergarten to high school, US students spend one month per year less in class than students in other countries.
5. **“Increase the ratio of skilled workers in the United States”** – Automatically extend green cards – legal residence status – to foreign students who graduate with advanced degrees from US universities. America should expand its skilled-worker (H-1B) visa program to include more capable individuals.

6. **“Teach entrepreneurship as a skill”** – Only the most prestigious business schools teach entrepreneurship. More colleges and universities should join them.
7. **“Boost entrepreneurship”** – Develop a new category of “founders’ visas for entrepreneurs.” Canada and some other nations offer such visas.
8. **“Create clearinghouses and databases...for new businesses”** – Make new business templates available to would-be entrepreneurs. Provide “digital ‘cookbooks’” to help entrepreneurs set up their new companies.
9. **“Lower the governmental barriers to business creation”** – US regulations hinder entrepreneurs seeking approval to start new businesses, which limits growth. The government should make it easier for people to start companies.
10. **“Upgrade the country’s communications and transportation infrastructure”** – The American Society of Civil Engineers gives the US’s infrastructure a *D* grade. Make America more productive by improving its infrastructure.
11. **“Increase funding for basic research”** – Congress should budget additional monies for the National Science Foundation, the National Institutes of Health and the Defense Advanced Research Projects Agency.
12. **“Preserve the relative flexibility of American labor markets”** – Institute no new laws governing employee retention or dismissal. These rules lead firms, especially those introducing new products or employing novel business models, to regard hiring as a risk.
13. **“Make it...more attractive to hire a person than to buy more technology”** – To decrease payroll taxes on employers, authorize tax breaks and special subsidies for companies that hire people who have been long out of work.
14. **“Decouple benefits from jobs”** – When jobs come with lucrative benefits, employees are more reluctant to give them up, so they stay in their positions longer. As a result, workers are less likely to become entrepreneurs, which can be a big loss for the economy.
15. **“Don’t rush to regulate new network businesses”** – Critics say that Amazon’s Mechanical Turk – a new crowdsourcing tool that allows users to bid for temporary positions – favors the lowest bidder and thus exploits its participants. However, the government should give novel businesses maximum leeway to try new approaches.
16. **“Eliminate or reduce the massive home-mortgage subsidy”** – Mortgage tax breaks cost America \$130 billion annually. Home ownership limits the mobility of labor, which makes the economy less flexible, just when it needs to become more so.
17. **“Reduce the large...subsidies to financial services”** – Today, more top college graduates take jobs in the financial sector because the government’s too-big-to-fail policy eliminates all risks.
18. **“Reform the patent system”** – A shortage of qualified patent examiners creates a systemic backlog in issuing patents. Numerous, easily issued “low-quality patents” clog the court system. This inefficiency inhibits innovation.
19. **“Shorten...copyright periods”** – Liberalize the fair-use standard, i.e., the regulations governing how much of a written copyrighted work can be featured in another work. Copyrights apply to almost any digital content, which limits creativity.

“Digital technologies change rapidly, but organizations and skills aren’t keeping pace.”

These recommendations will expand innovation. They are only the beginning of a necessary conversation about the effort required to reduce the unemployment created by technology and to promote income equality. As computers take over many areas of business, commerce and manufacturing, members of the workforce perceive them as dangerous and destructive. However, technology creates opportunities for workers and expands the economy. To properly harness this new technology, organizations must be willing to innovate and to train workers in new skills.

“The Digital Frontier”

Rapid online developments create a digital frontier that is already generating new employment possibilities. Digitization creates abundance, not scarcity.

“Computers are machines that help with ideas, and economies run on ideas.”

Consider the Internet, now the biggest, most accessible information repository in history. The digital frontier, a well of creativity and new ideas, improves the lives of millions of people across the planet. With a computer and an Internet connection, anyone can immediately launch a business or access a data set. Digital technologies benefit consumers and introduce new efficiencies to businesses and their markets. They open up government and make it more accountable to citizens everywhere.

“The Third Industrial Revolution”

The world has experienced three industrial revolutions. Steam powered the first revolution, which dramatically changed the world. Historian Ian Morris explains that these changes were so monumental that they “made mockery of all that had gone before.” Electricity powered the second industrial revolution and vastly increased productivity. Computers and networks power the third industrial revolution, which is underway now.

“Many workers...are losing the race against the machine.”

Like the first and the second industrial revolution, the third industrial revolution will play out for decades to come. Similar to the two that preceded it, the third industrial revolution will improve peoples’ lives worldwide, even as some of its changes bring difficult periods of transition.

About the Authors

Erik Brynjolfsson, a professor at the MIT Sloan School of Management and director of the MIT Center for Digital Business, is chairman of the *Sloan Management Review*. **Andrew McAfee** is a principal research scientist and associate director at the MIT Center for Digital Business.



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