

18 November 2013

Technology Trends and The Future of Labor

Robert Manning has no doubts that a convergence of technologies — including robotics, 3D printing, synthetic biology and Big Data — are bringing about a new economic revolution. By severing the link between productivity and employment, however, they will also introduce dramatic social, political and strategic changes.

By Robert A Manning for ISN

Over the coming generation to 2030, the world is likely to undergo a technological transformation with profound social and economic consequences. These changes are likely to be far more significant than those of the past two decades, during which the explosion of Information and Communications Technology (ICT) revolutionized the global economy and empowered individuals in unprecedented ways. A synergistic convergence of ICT, robotics, artificial intelligence, new materials, 3D printing, robotics, nanotech, synthetic biology and big data promise a new industrial revolution and an exponentially expanding networked, knowledge economy.

In particular, 3D printing and robotics are at an inflection point, with capabilities for each increasing substantially as prices are plummeting. 3D printing (or additive manufacturing) is both localizing and customizing production. Based on computer-aided design, 3D printers can assemble with precision items from caps for teeth to auto and airplane parts. 3D printing is beginning to expand from a niche technology to more widespread use, with potential implications for global supply chains.

Robotics is an extension of what has been called a second “digital economy,” as in swiping credit cards or downloading an airplane boarding pass: performing services independent of human activity. Until very recently, industrial robots were used primarily for redundant activities such as auto assembly, and tended to be expensive, in the range of \$300,000. But developments in software, (e.g. robot operating systems), sensing (e.g. Xbox Kinect) and artificial intelligence have enabled the deployment of human-like robots that can be easily programmed and work alongside people at a cost down to \$22,000 (as in the case of [Baxter](#), produced by Rethink Robotics). Similarly, telepresence robots – now in the range of \$12,000 – which allow doctors to monitor and communicate with hospital patients from anywhere via video are changing healthcare.

In a dramatic example of how robotics is transforming the workplace, FOXCONN, which employs 1.2 million Chinese and assembles some 40% of the world’s consumer electronics has announced it will purchase one million robots over the next three years. [\[1\]](#) Increasingly, jobs that require low-skilled, repetitive physical labor will be done by robots, a shift that some have compared to the shift in the workforce from agriculture to industry as urbanization took off at the turn of the 20th century. [\[2\]](#)

Over the coming decade, robots will be replacing a wider array of jobs currently performed by largely by humans. Warehousing, distribution, picking and packing agriculture, light manufacturing, surveillance and security (envision drone/robot teams), data-entry and analysis jobs will all be done largely by robots. “E-discovery”, using Big Data to process legal documents is replacing legions of legal researchers. Airplane pilots and truck drivers may also be replaced by robots by 2030-2040.

In the service industry, healthcare will be populated by robots making diagnoses, performing surgery, delivering medication to patients, and helping take care of the elderly. Japan’s robotics industry is heavily motivated by the need for robots to help in caring for its aging population. Given the graying demographics in Japan and other OECD nations, robots are likely to play a rapidly growing role in regard to care for the elderly. Robots may also replace many in the military with robot soldiers – something not far removed from the movie “I, Robot.”

Policy implications: Alternative futures

These transformational technologies, particularly robotics, pose both risks and opportunities to policy-makers and to society writ large. In the past, transformational technologies tended to be part of the economic process of “creative destruction,” with old jobs replaced by whole new industries. But the breadth and scope of robotics and the digital economy displacing human-performed jobs is without precedent. Technology is now severing the link between productivity and employment that has marked the industrial era.

Where there is a need for human judgment and human interaction – policemen, teachers, coaches, counselors, doctors – and those needed to oversee, repair, and create technologies, these would appear to be the obvious areas of enduring jobs – at least for the time being. But that still leaves a large realm of uncertainty. It is an open question whether Western universities and technical training programs will re-orient themselves toward approaches that prepare the workforce for the technical skills that will be needed for employment in this emerging economy.

There is a raging debate among economists and social analysts, and between “techno-optimists” and “techno-pessimists” about whether the technology transformation underway will free humanity to reach new creative heights, or lead to a dystopia characterized by an elite of knowledge-workers alongside increased poverty, and income inequality. The pessimists also focus on ethical, legal and moral issues raised by the deployment of robots. While the debate is complicated by the reality of a global slowdown and recession in much of Europe, there are compelling arguments in both directions.

Techno-optimism

The knowledge-based economy, in general, is not labor-intensive. For example, Apple, Amazon, Facebook, Google and Twitter have roughly \$1 trillion in market capitalization. But together, they employ fewer than 150,000 people—less than the number of new entrants into the American workforce every month.

On the positive side, robotics combined with emerging technologies such as 3D printing, nanomanufacturing, nanobiotechnology and more capable artificial intelligence may reinforce a trend toward more local, customized production, marketing and distribution, and spawn some entirely new industries, such as lab-manufactured food, vertical farming in cities and other fields we cannot yet fathom.

The commercialization of robots will almost certainly benefit – and probably facilitate the proliferation of – small and medium industries (there are some 300,000 in the US, for example), and democratize

the economy. Imagine a small business with a cadre of 3D printers for manufacturing a range of products and a couple of Baxter-like robots to lift, pack, and help distribute them.

"It is a safe bet," writes *Wired* magazine's Kevin Kelly, "that the highest-earning professions in the year 2050 will depend on automations and machines that have not been invented yet....Robots create jobs that we did not even know we wanted done." [3] This is illustrative of what may be called the techno-optimism argument.

Techno-pessimism

In their highly influential book, *Race Against the Machine*, Erik Brynjolfsson and Andrew McAfee lean toward the pessimistic, outlining a future where technology destroys an array of jobs, particularly low-skill service and manual labor jobs. They do point out that technology will upgrade some jobs, but their assessment concludes by anticipating growing income inequality and suggestions of a need to devise new income redistribution, as wealth concentrates among technology owners. However fair it may appear, redistributing wealth tends to be an explosive political issue.

There is a third school of thought between the techno-optimism and techno-pessimism arguments. In a thoughtful analysis of both schools, social scientist Richard Florida suggests a third possibility. He argues that human beings are not passive objects, and economic transformations are what societies make of them. "Our key tasks during economic and social transformations," Florida says, "are to build new institutions and new social structures and to create and put into effect public policies that leverage technology to improve our jobs, strengthen our economy and society and generate broad shared prosperity." [4] Florida argues that rather than factories or large corporations, cities are "the key organizing unit of the postindustrial economy." Florida argues that cities are the organizing or pivot point for creativity, the great containers and connectors."

The dark side of robotics

There are a host of questions regarding efficacy and liability. However smart a machine may be, machines malfunction. Dependency on automated systems independent of human judgment and real-time monitoring, whether electrical grids or robot cars could pose risks and dangers. Given that AI is about software, what is the risk of hackers? Could cyber thieves hack Google-type driverless cars and steal them or wreak havoc on traffic? If a robot surgeon errs, who will be liable? Even if robots are programmed to obey laws and norms, what about cultural differences: whose laws and whose norms?

In addition, there may be unanticipated social consequences from the use of robots. In the area of healthcare, for example, would dependency on robots mean a decline in surgeon's or other medical skills? Similarly, will increased use of robots and a decline in human inter-action in education alter the learning process in negative ways? There are also psychological/emotional issues arising from robot caregivers for the handicapped and elderly. Will the ill and elderly who tend to be socially marginalized suffer from a lack of human interaction, or will they develop affinities for robot or cyborg caregivers?

Conclusion

One certainty in regard to the question of how the transformational technologies now emerging will shape the world of 2030 is that robotics will be an important part of the social and economic landscape of the future. The pace and scope of deployment of robotics and the other components of the Third Industrial Revolution will largely be driven by the private sector. But the economic, social, political and strategic consequences of the transformation that will take place will ripple through governments at every level, from local and community to national.

[1] See Xinhua News Service, July 30, 2011:

http://news.xinhuanet.com/english2010/china/2011-07/30/c_131018764.htm

[2] See Erik Brynjolfsson and Andrew McAfee, *Race Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy* [Kindle Edition] Amazon ebook, for a compelling argument on Robotics and the future of work.

[3] See Kevin Kelly "Better Than Human: Why Robots Will—and Must—Take Our Jobs, *Wired*, December 2012.

[4] See Richard Florida, "Robots Aren't the Problem: It's Us," *The Chronicle of Higher Education*, March 25, 2013.

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Publisher

[International Relations and Security Network \(ISN\)](#)

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