**Robot Revolution**

**The Long-Term Jobs Killer Is Not China. It’s Automation.**

*The New York Times* - [Claire Cain Miller –](http://www.nytimes.com/by/claire-cain-miller)  December 21, 2016

The first job that Sherry Johnson, 56, lost to automation was at the local newspaper in Marietta, Ga., where she fed paper into the printing machines and laid out pages. Later, she watched machines learn to do her jobs on a factory floor making breathing machines, and in inventory and filing.

“It actually kind of ticked me off because it’s like, How are we supposed to make a living?” she said. She took a computer class at Goodwill, but it was too little too late. “The 20- and 30-year-olds are more up to date on that stuff than we are because we didn’t have that when we were growing up,” said Ms. Johnson, who is now on disability and lives in a housing project in Jefferson City, Tenn.

[Donald J. Trump](http://www.nytimes.com/topic/person/donald-trump?inline=nyt-per) told workers like Ms. Johnson that he would bring back their jobs by clamping down on trade, offshoring and immigration. But economists say the bigger threat to their jobs has been something else: automation. “Over the long haul, clearly automation’s been much more important — it’s not even close,” said [Lawrence Katz](http://scholar.harvard.edu/lkatz/biocv), an economics professor at Harvard who studies labor and technological change.

No candidate talked much about automation on the campaign trail. Technology is not as convenient a villain as China or Mexico, there is no clear way to stop it, and many of the technology companies are in the United States and benefit the country in many ways. Mr. Trump [told a group](http://www.nytimes.com/2016/12/14/technology/trump-tech-summit.html) of tech company leaders last Wednesday: “We want you to keep going with the incredible innovation. Anything we can do to help this go along, we’re going to be there for you.”

Andrew F. Puzder, Mr. Trump’s pick for labor secretary and chief executive of CKE Restaurants, extolled the virtues of robot employees over the human kind in an [interview with Business Insider](http://www.businessinsider.com/carls-jr-wants-open-automated-location-2016-3) in March. “They’re always polite, they always upsell, they never take a vacation, they never show up late, there’s never a slip-and-fall, or an age, sex or race discrimination case,” he said.

Globalization is clearly responsible for some of the job losses, particularly trade with China during the 2000s, which led to the rapid loss of 2 million to 2.4 million net jobs, according to [research](http://economics.mit.edu/files/10590) by economists including [Daron Acemoglu](http://economics.mit.edu/faculty/acemoglu) and [David Autor](http://economics.mit.edu/faculty/dautor) of M.I.T.

People who work in parts of the country most affected by imports generally have greater unemployment and reduced income for the rest of their lives, Mr. Autor found in [a paper](http://economics.mit.edu/files/11675) published in January. Still, over time, automation has had a far bigger effect than globalization, and would have eventually eliminated those jobs anyway, he said in an interview. “Some of it is globalization, but a lot of it is we require many fewer workers to do the same amount of work,” he said. “Workers are basically supervisors of machines.”

When Greg Hayes, the chief executive of United Technologies, agreed to invest $16 million in one of its Carrier factories as part of a Trump deal to keep some jobs in Indiana instead of moving them to Mexico, he said the money would go toward automation. “What that ultimately means is there will be fewer jobs,” he [said on CNBC](http://www.cnbc.com/2016/12/05/cnbc-transcript-united-technologies-chairman-ceo-greg-hayes-on-cnbcs-mad-money-w-jim-cramer-today.html).

Take the steel industry. It lost 400,000 people, 75 percent of its work force, between 1962 and 2005. But its shipments did not decline, according to [a study](http://www.princeton.edu/%7Ejdeloeck/CWDL_AER.pdf) published in the American Economic Review last year. The reason was a new technology called the minimill. Its effect remained strong even after controlling for management practices; job losses in the Midwest; international trade; and unionization rates, found the authors of the study, Allan Collard-Wexler of Duke and Jan De Loecker of Princeton.

Another [analysis](http://projects.cberdata.org/reports/MfgReality.pdf), from Ball State University, attributed roughly 13 percent of manufacturing job losses to trade and the rest to enhanced productivity because of automation. Apparel making was hit hardest by trade, it said, and computer and electronics manufacturing was hit hardest by technological advances.

Over time, automation has generally had a happy ending: As it has displaced jobs, it has [created new ones](http://economics.mit.edu/files/11512). But some experts are beginning to worry that this time [could be different](http://www.nytimes.com/2014/12/16/upshot/as-robots-grow-smarter-american-workers-struggle-to-keep-up.html). Even as the economy has improved, jobs and wages for a large segment of workers — particularly men without college degrees doing manual labor — have not recovered.

Even in the best case, automation leaves the first generation of workers it displaces in a lurch because they usually don’t have the skills to do new and more complex tasks, Mr. Acemoglu found in [a paper](http://economics.mit.edu/files/11512) published in May.

Robert Stilwell, 35, of Evansville, Ind., is one of them. He did not graduate from high school and worked in factories building parts for tools and cars, wrapping them up and loading them onto trucks. After he was laid off, he got a job as a convenience store cashier, which pays a lot less.

“I used to have a really good job, and I liked the people I worked with — until it got overtaken by a machine, and then I was let go,” he said.

Dennis Kriebel’s last job was as a supervisor at an aluminum extrusion factory, where he had spent a decade punching out parts for cars and tractors. Then, about five years ago, he lost it to a robot.

“Everything we did, you could program a robot to do it,” said Mr. Kriebel, who is 55 and lives in Youngstown, Ohio, the town about which Bruce Springsteen sang, “Seven hundred tons of metal a day/Now sir you tell me the world’s changed.”

Since then, Mr. Kriebel has barely been scraping by doing odd jobs. Many of the new jobs at factories require technical skills, but he doesn’t own a computer and doesn’t want to.

Labor economists say there are ways to ease the transition for workers whose jobs have been displaced by robots. They include retraining programs, stronger unions, more public-sector jobs, a higher minimum wage, a bigger earned-income tax credit and, for the next generation of workers, more college degrees. The White House on Tuesday released a report on automation and the economy that called for better education from early childhood through adult job transitions and for updating the social safety net with tools like wage insurance. Few are policies that Mr. Trump has said he will pursue.

“Just allowing the private market to automate without any support is a recipe for blaming immigrants and trade and other things, even when it’s the long impact of technology,” said Mr. Katz, who was the Labor Department’s chief economist under President Clinton.

The changes are not just affecting manual labor: Computers are rapidly learning to do some white-collar and service-sector work, too. Existing technology could automate 45 percent of activities people are paid to do, according to a July [report by McKinsey](http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet). Work that requires creativity, management of people or caregiving is least at risk.

Ms. Johnson in Tennessee said both her favorite and highest-paying job, at $8.65 an hour, was at an animal shelter, caring for puppies.

It was also the least likely to be done by a machine, she said: “I would hope a computer couldn’t do that, unless they like changing dirty papers and giving them love and attention.”

**Automation Is Killing, Creating and Transforming Jobs**

**As demands for certain skills rise, employees will work side by side with robots, experts predict**

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| Society For Human Resource Management – [www.shrm.org](http://www.shrm.org) - By Steve Bates - Aug 24, 2016 |

An unstoppable wave of automation is transforming the workplace. While many low-skill jobs are being eliminated, positions demanding higher skills are being created. Most jobs in existence today will add and lose specific functions in the future as robots and other forms of technology take on routine tasks and free humans to focus more on creative and analytic efforts, according to experts.

It will be a messy transition. It will be particularly painful for workers who lose their jobs and for employers that fail to recognize where automation fits into their operations.

Labor market experts disagree about how many American jobs will be lost to automation. A 2013 report by Oxford University researchers concluded that about 47 percent of total U.S. employment is at risk because of automation. A 2015 report by McKinsey & Co. forecast that automation could eliminate as much as 45 percent of work activities currently performed in the U.S.

Forrester Research predicts that robots—all forms of automation, machine learning and intelligent machines—will replace 16 percent of American jobs but will create the equivalent of 9 percent of those jobs by 2025. That would represent a net loss of 7 percent of jobs.

"This transition has, in fact, been going on for decades," said a 2016 Forrester report, *The Future Of White-Collar Work: Sharing Your Cubicle With Robots*. For example, software "bots" are already scheduling humans' meetings online, handling travel request forms and processing employment contracts. Intelligent devices are helping manage warehouses and parking garages to boost efficiency. IBM's supercomputer Watson, which defeated humans on the quiz show "Jeopardy," is working with doctors to improve diagnoses of patients' diseases.

Among the traditional jobs most endangered by automation are travel agent, meter reader, flight attendant, lumberjack, librarian and newspaper reporter.

The loss of jobs is a particularly hot issue in the 2016 elections. Labor market experts point to automation and globalization as the primary reasons for jobs being eliminated or shifted overseas. They note that transformations such as these have happened frequently during history.

"For centuries, humans have feared machines," said Harry J. Holzer, a professor of public policy at Georgetown University in Washington, D.C. "Their worst fears have never turned out to be true." Experts say that while there are always winners and losers in these transitions, the big-picture view is that technology will boost productivity and fuel the economy.

**Shifting Roles**

Occupations focusing on human interaction, such as doctor, nurse and massage therapist, will be among those most immune to being replaced by robots. Flesh-and-blood artists, designers, athletes and entertainers also will retain a place in society. New jobs attributable to the rise of automation will include software developers and managers who can integrate automation technology into existing business models. People will work directly with robots to help them learn new functions or handle their tasks better, though the robots might not look like humans and the human-robot communication will occur mostly via keyboard.

The shifting of job tasks from humans to robots will require a massive change in job descriptions, not to mention in talent acquisition strategies. According to Forrester, automation will change every job category by at least 25 percent as soon as 2019. "Few firms are prepared for their [cognitive tipping points], which will lead to a restructuring of work nearly as profound as the transition from the agricultural age to the industrial age," said its 2016 report.

**The Training Challenge**

Training future employees—and retraining current ones—will be an immense challenge in the face of the transformation. Experts say that workers will need skills related to a specific job function as well as broader competencies.

"Thriving in today's fast-changing world requires breadth of skills rooted in academic competencies such as literacy, numeracy and science but also including things such as teamwork, critical thinking, communication, persistence and creativity," according to the 2016 report *Skills for a Changing World* from the Brookings Institution, a Washington, D.C., think tank.

"Back in the 1970s, you took part of yourself to work. Now you take the whole person to work," said Anthony P. Carnevale, Ph.D., director of the Georgetown University Center on Education and the Workforce. "There's a much broader range of human competencies necessary."

For decades, employers have hired young people and trained them to do a particular job. Today, however, employers are expecting job applicants to be better prepared for jobs with highly technical requirements.

"Students can't learn everything once they get to the job," said Mary V.L. Wright, senior director of national career education advocacy group Jobs for the Future.

Educational systems can't turn on a dime, but "employers can help colleges figure out 'What are the competencies we require for this position' and 'Here's how we want you to teach them,' " said Angela Hanks, associate director of workforce development policy at the Center for American Progress, a progressive public-policy advocacy organization.

"We need to contextualize skills to the needs of today's economy," said Maria Flynn, senior vice president of Jobs for the Future. She said that, to minimize disruption, employers "can embed learning in an individual's job to prepare them for the next job."

Retraining displaced workers is particularly difficult. Some of them lack the fundamental skills that are prerequisites to learning today's sophisticated job functions. Training programs are fragmented, and many are not matched closely to the emerging needs of employers.

"How do you prepare people for jobs that are not really there yet?" Hanks asked.

While some local and regional job training partnerships involving employers have shown great promise—and apprenticeships are drawing increasing interest from employers—the best programs are not large and widespread enough to make a big dent in the ranks of the unemployed.

Experts say it's difficult to predict exactly how the technology revolution will play out. But they offer some solace to employers: Don't expect to see robots asking for raises or organizing their own labor unions anytime soon.

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