



Automation/Robotics

AUTOMATION AND ROBOTICS REPLACE PEOPLE

Komatsu, the Japanese maker of heavy industrial equipment, includes sensors, GPS technology and Internet connectivity in all the equipment it sells, as mentioned in our preceding three-part *inFocus* series on the Data Arms Race. While Komatsu's original intent was to gain valuable data from its branded equipment worldwide, the company now has a new use for this technology: enabling equipment to operate itself. Ten Komatsu gigantic haul trucks now operate at one of Rio Tinto's Australian mines without a human driver, guided by the Internet equipped sensors and GPS built into the equipment, and Rio Tinto has ordered 150 more. Such tools from the Data Arms Race as well as advances in software and robotics portend a new level of automation capabilities coming to the fore – capabilities that replace human workers in **both** low wage positions and sophisticated high-wage fields. (*Nikkei Weekly*, 8/22/12)



TAKEAWAYS

- The tools of the Data Arms Race allow a variety of processes to be automated, allowing for quicker and more efficient production.
- Advanced robotics are increasingly replacing humans in a variety of fields.
- The combination of data tools and robotics are able to do work in increasingly complex fields such as services, research, medicine, law and the creative arts.
- In any business decision-making, a new question must be considered: How can robots and automation be applied here?

IMPLICATIONS

- Jobs in a wide range of fields are now at risk – not of being outsourced overseas, but of having their line of work performed by a robot or computer.
- Productivity gains in many industries with automation could be substantial.
- Social and political issues are likely to ripple out from this secular change over time and result in a new form of protectionism – not against outsourcing, but rather against automation and robotics.
- More natural resources may be recoverable as extraction begins in areas for which human workers were not suitable.

COMPANIES

Automation and Robotics

Rockwell Automation	(ROK)
Hollysys Automation Tech	(HOLI)
Actuant Corp	(ATU)
Cognex Corp	(CGNX)
ATS Automation	(CN:ATA)
Fanuc Corp	(JP:6954)
Yushin Precision	
Equipment	(JP:6482)
Yaskawa Electric	(JP:6506)
Kuka AG	(GR:KU2)
Elexis AG	(GR:EEEX)
iRobot	(IRBT)

Large-Scale Automation of Low-Wage Work

For as long as the Japanese have been trying to increase the efficiency of their factories, automation and robots have been taking on increasingly complex and challenging tasks and, in many cases, reducing the role of human beings. What has struck us in recent months is the number of new fields where such automation is entering the fray, including fields that had previously used low-skill, low-paid laborers, and thus didn't justify automation. Some businesses have found that automation is now cost effective, can eliminate dangers posed to humans, and can fill in for human workers who are either unavailable in sufficient quantities, or whose variety of needs (*e.g.*, rest, vacation, food, light, warmth, *etc.*) can be eschewed by using robots that can sustain work hours almost indefinitely and work in harsh environments.

Agriculture is one area where such a transformation has begun. As we mentioned in an *eFocus* series last year, one way to reduce waste, limit environmental damage, stretch resources (like water) and boost output is through precision farming, in which every single plant is tended, watered, fed and treated on an individual basis. Such detailed care is only possible in a cost-effective way through mechanization, automated precision equipment and field-tending robotics. John Deere began selling systems this year in which the driver of a combine harvester can summon an automated tractor-trailer on which to offload the grain. Meanwhile, Fendt of Germany makes tractors that can operate in pairs – with one tractor copying the movements of a human-driven tractor a few rows away, effectively cutting the time a farmer spends in the fields and reducing the number of farmhands needed. Meanwhile, robots currently in design are programmed to perform delicate functions such as moving plants in nurseries, picking only the ripest strawberries, planting tulip bulbs, harvesting and packaging mushrooms and packaging potted plants for sale. Some farmers, particularly in the U.S. and Europe, have complained about the unavailability of sufficient low-wage workers and are, therefore, now seeking such robotics, some of which return their investment in 1-2 years (see **eF 604**, 3/3/11; *New Scientist*, 10/27/12; *Wired*, 8/12; *Economist*, 9/12).

The issues raised by automation ripple beyond first-world agricultural markets to the new manufacturing hubs to which jobs have been outsourced. Foxconn's CEO, Terry Guo, last year announced plans to add one million industrial-assembly robots over the next three years.

Whether those plans come to fruition may depend on cues from Beijing, which would no doubt be displeased to watch wage-paying jobs displaced by robots. Still, Frankfurt's International Federation of Robotics tracked a 50 percent jump in purchases of advanced industrial robots by China in 2011, a place one would not expect robots to be embraced. (*New Scientist*, 7/28/12; *Technology Review*, 10/12)

Robots can also perform jobs where the use of human labor is difficult or challenged for various reasons. Scientists in South Africa, have designed a robot that can go into gold and platinum mines after a new section is blasted and scan for rock face weaknesses before human workers enter; it can also operate in shafts too narrow for humans. Right now, that job is done by hand by a mining foreman using a hammer, at a great deal of risk. Scientists at DARPA noted that the Fukushima Daiichi nuclear crisis in Japan last year was a wake-up call for the need for robots that can maneuver in landscapes and environments that are extremely hazardous to human health. Aquatic robots are currently swimming through Brooklyn's hyper-toxic Gowanus Canal, where human divers cannot safely traverse, helping researchers plan the multibillion dollar clean-up effort required there. (*New York Times*, 10/15/12)

Sometimes humans themselves create the threat that can be avoided through automation. Campden BRI, a food research firm in the U.K., is working on ways to automate food-processing facilities so that humans need not enter the production space. As their lead scientist noted, people act as carriers to various pathogens that can end up in food; remove the humans and you can even manufacture in facilities filled with an inert gas or with UV lighting that would inhibit bacterial growth. Those claims reminded us of those made by management at Amazon when they purchased Kiva Systems, the robot manufacturer, back in March: Kiva's robots operate in a warehouse 24 hours a day, and Amazon can turn-off the lights and the heat in the facility. Humans, on the other hand, can't perform well in such conditions. (*Food Manufacture* [UK], 11/1/12; *Technology Review*, 10/12)

Moving into High Skilled Fields

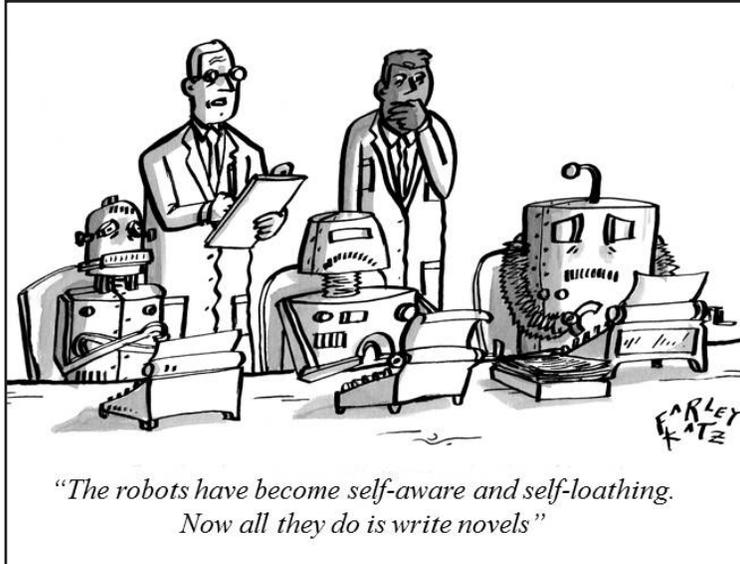
Automated capabilities are entering a domain that was once thought to be solely the preserve of humans, including a variety of intellectual, creative, and service capabilities that are considered "high-skilled".

For instance, in the previous *inFocus*, we noted that Narrative Science produces software that can take the data from sporting events or financial reports and write a news story about those activities that appears to be written by a human reporter (see **inF** 717, 12/13/12; *Investor's Business Daily*, 8/22/12).

Consider the following new capabilities for automation:

News/Media: Scores is a software product that matches the current features of a live sporting event – such as teams, key players, score, and field position – against a database of related stories, providing a sportscaster with commentary to accompany the game – a job typically handled by a producer. One can imagine such technology being paired with that of Narrative Science to write interesting sports stories using analogies and quirky historical references. (*New Scientist*, 10/6/12)

Law: Automation still can't replace some tasks, but it can certainly reduce time spent on such work and thus the number of professionals needed. Co3 Systems has developed software that automates the process of filing legal paperwork with government agencies.



It walks attorneys through what they need to do and prints out the appropriate forms for each state, potentially cutting the time it takes to handle a case by 10 to 20 percent. Law is sophisticated knowledge work, but complex software is making the job easier, if not outright "killing" all the lawyers as Shakespeare recommended. (*Technology Review*, 10/12)

Driving: CarSpeak, a new tool under development at MIT allows cars to "see" the area around them by

accessing sensors and cameras actually in other cars on the road. The software creates a continuous 3D view of the car's environment assembled from information captured by all the nearby cars. Letting the car "see" from every angle allows the car to respond to sudden obstacles that the human driver may not have seen, such as children running onto the road. (*New Scientist*, 9/15/12)

Jet Maintenance: British jet-engine maker Rolls Royce is developing a snake-like robot that can slither into a jet engine, without requiring disassembly of the engine, and scan for internal damage and weakness like a medical endoscope. A UV laser in the upcoming model would allow the tool to repair cracks in the engine. Rolls Royce noted its desire to automate these tasks because there aren't currently enough boroscope experts in the world to maintain all the jet engines by hand. Automated surgery on a jet engine – what's next, automated surgery on humans? Yes... (*New Scientist*, 9/29/12)

Medical Surgery: The Insertable Robotic Effector Platform, entering animal testing this fall, is a Columbia and Vanderbilt Universities project to develop a snake-like robot that can enter a tiny incision, or be inserted through the mouth, and work its way to an organ to perform appendectomies, hysterectomies, some types of kidney surgery and possibly ear and throat surgery. So, yes, automated surgery is possible, too. (*Scientific American*, 11/12)

Clearly, automation and robotics are working their way into several "high-skill" fields, but surely tasks involving social interaction like customer service or care, is still solely the domain of humans, right? No. Over 100 models of so-called "social robots" exist capable of performing such tasks as comforting the lonely, assisting patients suffering from dementia and helping autistic kids learn. Paro is a Japanese-made robot that looks like a plush baby seal – it coos, moves around and bats its eyelashes. A 2009 review of 43 studies in *Gerontology* found robots like Paro increased positive mood and eased stress in the elderly. In one study, some people in two nursing homes thought Paro was a real animal, and many spoke to it. We also noted in our Data Arms Race series that patients in one study preferred talking with a virtual avatar discharge nurse rather than a real person in that role (see **inF** 715, 12/10/12; *Pacific Standard*, 12/12; *New Scientist*, 8/11/12).

What's Next? People More Like Robots

Will humans be offered capabilities to become more robot-like? If so, what are the implications of such an “augmented reality”. So-called “wearable computing,” exemplified by Google’s Project Glass, are wearable computerized devices that give their users specific information pertinent to their circumstances – for instance, someone wearing glasses featuring Google Glass could walk through a museum or city with information superimposed in their field of vision about what route to traverse, and the significance of specific works of art or landmarks. The need for city tour guides and museum docents would be greatly diminished. Similarly, The Move Project seeks to design workout clothing with built in sensors that transmit body position data to the users’ smartphones with an app that lets them analyze, for example, how well they performed Pilates exercises. The software creates an animation of the entire workout that can be replayed to show users where they go astray. Who needs a Pilates instructor now? These are just the kinds of

service-industry jobs that could never be outsourced overseas, but, with new technology that performs such service tasks, can now be rendered less necessary. (*New Scientist*, 8/11/12; *Guardian Weekly*, 8/10/12)

Automation’s Big Deal

Society’s aggressive push toward automation brings with it a host of implications. For one, automation in some fields has brought in new forms of systemic risk that did not exist when human beings were at the controls. Automated trading algorithms on Wall Street operate faster than humans can monitor, creating stressful volatility in the market. But the broader societal implication is that fewer and fewer occupations will be immune to automation and robotic replacement in the coming years – moving well beyond manufacturing into a variety of high-skilled fields, dangerous occupations and fields where low-wage laborers have historically provided the manpower needed. This secular change is set to continue and have a large impact for many years. (*Wired*, 9/12)

