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HOW THE WORLD'S BIGGEST COMPANIES ARE FINE-TUNING THE ROBOT REVOLUTION

Automation is leading to job growth in certain industries where machines take on repetitive tasks, freeing humans for more creative duties

By William Wilkes
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ANSBACH, Germany – A few years ago, Roland Rösch's job involved grabbing scalding-hot auto parts from an oven and inspecting them for signs they had failed a safety test.

These days he still inspects, but the grabbing is being done by Fritz, a robot that auto-parts manufacturer Robert Bosch GmbH installed three years ago at this German factory as part of an automation effort.

Fritz is more efficient at handling the dangerous and repetitive task of lifting the 8-inch metal-and-circuitry pieces out of the furnace. This leaves Mr. Rösch less exposed to potential accidents and gives him time to test 20 percent more parts than he did before the robots.

The big question surrounding automation has long been whether robots would compete with workers or help them. Initially, workers feared robots would destroy jobs across the economy. Scholarly research and real-life experience have eased that concern, although some types of workers and industries are ending up on the losing side.

Today, the question is more precise: In which industries does automation help both employer and employee?

The companies that may have cracked the code are those that can assign repetitive, precise tasks to robots, freeing human workers to undertake creative, problem-solving duties that machines aren't very good at. That's particularly relevant for manufacturing, the food sector and service sectors such as billing, where timetable spreadsheets can be automated, freeing up workers to do higher-value tasks.

With demand for Bosch-built steering controls high, the company has used automation to increase its output, leading it to hire more people to perform the type of checks Mr. Rösch conducts.

"We looked for 20,000 new hires last year," a mix of new positions and replacement staff, said Stefan Assmann, one of the company's chief engineers, to join Bosch's total 400,000 employees. Bosch factories world-wide now make use of 140 robotic arms, up from zero in 2011. "We can't see robots having a negative impact on our workforce," Mr. Assmann said.

Computers can zoom through activities humans find difficult, such as playing chess, doing calculus or repeating a set of movements precisely over time. Other, seemingly mundane tasks – brushing your teeth or running through the woods – can overwhelm even complex machines.

Those tasks call on multiple senses, including touch and depth perception, feeding information to a problem-solving brain, which can then finely adjust movements, said Satyandra Gupta, professor of mechanical engineering at the University of Southern California.

For companies, choosing the appropriate tasks to automate is important. Auto maker BMW AG automated some of the physical labor at the Spartanburg plant in South Carolina while retaining tasks involving judgment and quality control for workers.

Robots fit black, soundproofing rubber tubes to the inner rim of car doors, a task once done entirely by hand, on the more than 5,000 or so car doors that pass through the production line each day. Human workers do final checks on the tube's placement. The division of labor speeds up the process.

Since BMW introduced this and other automated processes over the past decade, it has more than doubled its annual car production at Spartanburg to more than 400,000. The workforce has risen from 4,200 workers to 10,000, and they handle vastly more complex autos – cars that once had 3,000 parts now have 15,000.

Being spared strenuous activities gives workers the time and energy to tackle more demanding and creative tasks, BMW said in a statement.

James Bessen, an economist who teaches at Boston University School of Law, said automation like that at the Spartanburg plant has enabled a huge increase in the quality and variety of products, which help spur consumer demand. BMW's share of luxury-car sales in the U.S. has risen sharply, with over 300,000 cars sold last year compared with just over 120,000 in 1997, company figures show.

Tesla Inc., by contrast, has struggled with production of the Model 3 car at its Fremont, Calif., plant after its use of robots got out of balance. Undetected errors in parts built by robots caused bottlenecks in production, meaning it could build only 2,020 cars a week compared with the 5,000 it originally promised, according to the company.

Analysts at investment research firm Bernstein said Tesla automated welding, paint and body work processes, as other manufacturers have done, but also automated final assembly work, in which parts, seats and the engine are installed in the car's painted shell. Errors in this work caused production bottlenecks. "Automation in final assembly doesn't work," said analyst Max Warburton.

"Yes, excessive automation at Tesla was a mistake...Humans are underrated," wrote Tesla CEO Elon Musk in a tweet last month.

Robots have resulted in pay cuts for low-skilled machine operators, such as those who oversee wood- or leather-cutting machines, who play a diminishing role in production due to automation. And they have eliminated entire occupations, especially in simple manufacturing processes where there aren't value-added jobs for displaced workers to move to.

Mining, for example, hinges on raw high-volume production – dig more rock, make more money – which is better done by machines that won't tire or get injured.

Rio Tinto PLC plans to lay off drivers as it introduces self-driving trucks to move iron ore at its mines in Western Australia. The trucks, which follow sensors and maps of the mining site installed in onboard computers, can operate longer than human drivers and are more reliable. Beneath the ground, robotic drilling rigs have taken over the dangerous work of inserting explosives into holes dug in mining shafts.

The automation would improve safety and unlock significant productivity gains, helping generate annual savings of around \$500 million beginning in 2021, said Chris Salisbury, the Rio Tinto board member in charge of the firm's iron-ore mining operations. The company said it would look to retrain or find new roles for the workers affected by the automation.

Jobs in the garment industry are also disappearing as firms automate repetitive, high-volume tasks such as sewing and knitting, where machines can work faster and more accurately than humans.

Technological breakthroughs have enabled robots to take on delicate tasks, such as manipulating pliable fabrics, stitching pockets and attaching belt loops to pants. In the early days of automation, it was thought that humans would be needed for such finishing work.

The International Labor Organization has warned that nearly 90 percent of garment and footwear workers in Cambodia and Vietnam are at risk from "sewbots."

At an aggregate level, however, the jobs created by automation outnumber those that are being destroyed, according to analysis by the Massachusetts Institute of Technology's David Autor and Utrecht University's Anna Salomons.

People losing jobs, however, may not be the same ones filling newly created ones, since different skills are often required.

The Asian Development Bank said in April that automation had created an extra 34 million jobs in its region after price falls and quality improvements spurred demand for Asian factory-made goods.

More-developed economies have also seen job growth. Automation in the U.K. over the past 15 years has destroyed 800,000 lower-skilled services jobs – such as call centers – but has created 3.5 million higher-skilled ones in their place, according to a 2017 workforce study by consultancy firm Deloitte. The new jobs paid around \$13,500 more than the jobs they replaced, Deloitte said.

Industrial employment in Germany is expected to rise 1.8 percent by 2021 because robots and automation are making the country's factories more competitive, according to the Germany-based Centre for European Economic Research in April.

Automation can help feed demand for a product – because quality improves or it becomes less expensive or more available – which can create jobs as a result.

Finnish firm Fiskars AB, manufacturer of iconic and once pricey orange-handled scissors, used automation to reach more customers. Workers at its Helsinki plant formerly forged steel blades by hand in 2,700-degree furnaces, repetitive and dangerous work that was slow and costly.

When robots took over the tasks in 2011, technicians moved to quality control, testing the scissors to make sure the blades made the right "snip" sound as they sliced together, and if

they smoothly cut strips of fabric. If necessary, workers could adjust the blades bit by bit, in a process calling on multiple senses that machines couldn't replicate.

Once the process was partly automated, the company was able to increase production and lower prices, stimulating new demand without sacrificing quality, according to Chief Supply Chain Officer Risto Gaggl.

Employment at Fiskars has soared along with higher production, with the company now employing 8,560 people in its factories and offices compared with 4,515 in 2007.

In Europe, "we couldn't find anyone who has been fired because of robots," said Professor Wolfgang Dauth, leader of a yearslong study into the impact on workers of robotization on the continent by the Bonn-based Institute of Labor Economics. Part of the reason is strong labor unions require retraining for workers when robots take over tasks. Another part is that Europe's more-complex industries need human thinkers to work in complement with machines.

Electrolux AB, the world's second-largest appliance maker by units sold after Whirlpool Corp. , has spent millions of euros on automating the production of washing machines and other devices, which are now assembled almost entirely by machine.

The company said robots freed up technicians to spend time on a creative task that is impossible to automate: designing and implementing changes to the factory floor and robot layout to customize procedures and make production more efficient. The constant, incremental improvements make a broader range of production in the same factory space possible, which in turn supports more workers.

The company said it tweaked hiring and training so that its workforce could successfully operate with robots, including a month of robotics training when hired and bimonthly half-day sessions. The company also built robot-testing areas at its factories where technicians can experiment with different robot hardware and software.

Employment at Electrolux has risen to more than 55,000 in 2017 from about 53,000 in 2011, reversing a yearslong trend of shrinking staff numbers after China's December 2001 entry to the World Trade Organization flooded the market with cheaper washing machines.

"We don't see automation going over 50 percent," said Jan Brockmann, chief operations officer at Electrolux. "There's not much point." He said machines would likely take over routine work like assembly, freeing workers to make repairs and improvements to an increasingly efficient production line.

The slow pace of robot rollouts can shield workers, providing time for retraining. Companies rarely automate all of a worker's tasks in one swoop, and it takes time to work out how best to use robots. The high cost of adding new automation also slows the process.

Bosch developed training courses for workers, teaching once single-skilled welders, joiners and mechanics basic software coding skills to enable them to use robots as tools much like hammers or screwdrivers. "We employ designers, engineers and scientists," said Mr. Assmann, one of the firm's chief engineers. "But you still need people who are good with their hands."

U.K.-based food delivery company Ocado Group has progressively automated work processes and has added workers as demand for its once-exclusive internet-grocery

shopping service has surged, in part driven by the efficiency savings that have lowered prices.

The company's chief innovation is a complex web of grocery-transporting conveyor belts that allow it to process consumers' online orders. Another set of robots under development will be assistants for its human maintenance staff, allowing them to be more productive in managing the conveyor belts and other machinery. The company shuts down operations for three hours each day for maintenance, and missing that window could mean being unable to process deliveries.

Instead of walking around the factory to collect whatever tools are needed, the robots will anticipate what tools the workers need, and bring them to hand, acting as automated assistants.

"Our business model would just fail if these machines didn't work," said Graham Deacon, head of automation at Ocado. "We need humans to make sure they don't break down."