

Credit: KUKA AG

Rise of the Cobots

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RISE OF THE COBOTS

With flexible task options and ability to safely work alongside humans, collaborative robots may just be your next co-worker

By Phil Britt

When Linatex, a Danish supplier of technical plastics and rubber for industrial applications, bought a Universal Robots UR5 robot to automate CNC machine tending in December 2008, they did something unthinkable at the time.

Instead of installing the robot behind safety caging, [they deployed it right alongside their employees](#). Instead of bringing in external programmers to master complex scripting, Linatex could program the robot on their own through a touch-screen.

A decade later, collaborative robots, or cobots, are becoming essential assets for manufacturing and logistics companies as they work alongside humans or perform more difficult, tedious, or dangerous tasks.

Cobots perform several tasks, including high-volume palletizing and de-palletizing of cases, bags and bottles in tight workspaces; delivering several packages, tools and other items from one location to another; and bin picking and other sorting tasks.

Cobot maker Universal Robots said it expects the market for cobots to increase from \$100 million today to more than \$1 billion by 2020. These projects, as well as government and industry interest in cobots, show just how far the technology has advanced in the last 10 years. Another research firm, Markets & Markets, [predicts the market to be worth \\$4.28 billion by 2023](#), growing at a compound annual growth rate of 56.94% between now and 2023.

As the market continues to grow, here's a look at seven of the industry's top cobot suppliers, and their latest offerings.

ABB

ABB recently [unveiled a single-arm collaborative robot](#) to its YuMi family, but with a smaller footprint ([Watch a video here](#)).

Like YuMi, [a small-parts assembly robot introduced in 2015](#), the new robot has a payload of 500 grams and can be integrated into existing assembly lines, ABB said. The new robot also features lead-through programming, eliminating the need for specialized training for operators.

“The success of YuMi has exceeded expectations; it was originally designed for small-parts assembly, but it has turned out to be exceptionally versatile,”



ABB's recently single-arm collaborative robot, part of its YuMi family.

said Sami Atiya, president of ABB's Robotics and Motion division, in a statement at the International Robotics Exhibition 2017 in Tokyo. "It can solve a Rubik's Cube, make sushi, wrap gifts and conduct an orchestra. Based on YuMi's enormous success, we fully expect our new single-arm robot to be equally well-received." The new robot is expected to be available later this year.

In addition, ABB and Kawasaki Heavy Industries [have partnered to share knowledge](#) and promote the benefits of collaborative robots, in particular those with dual-arm designs.

Under the partnership, both robot makers continue to independently manufacture and market their own offerings, while working together on joint technical and awareness opportunities. This includes educating policy makers, non-governmental organizations and the public about the benefits of collaborative automation, and creating common industry approaches to safety, programming and communications.

FANUC ROBOTICS

FANUC's series of collaborative robots include the [CR-4iA](#) and [CR-7iA](#) tabletop-sized models. Both offer the same payload, but a shorter reach than their larger counterparts. The CR-7iA has a 717-mm reach, with a 7-kg payload. The CR-4iA features a 550-mm reach and a 4-kg payload. Both robots are designed for materials handling, particularly small-parts sorting, as well as sorting and



Above: FANUC's smaller collaborative robots are painted green to distinguish them from standard yellow FANUC models.

Left: The FANUC CR-35iA collaborative robot can lift heavy objects, such as tires on an assembly line.

assembly, inspection machine tending and parts delivery.

Fanuc's collaborative robots are painted green to distinguish them from the standard yellow Fanuc robots, while also meeting all industry safety standards. The robots offer versatility with floor, wall and ceiling-mounted options. They all support Fanuc's intelligent functions, such as iRVision and force sensing. They operate with the small Fanuc [R-30iB controller](#) and can run on 120-volt power supplies.

The more established [CR-35iA collaborative robot](#) offers six-axis articulation and is used in heavy lifting applications, such as lifting tires onto vehicles on an assembly line. By taking on this physically demanding work, the CR-35iA helps reduce worker injuries, said Greg Buell, product manager for Fanuc North America.

In addition to these robots, Fanuc built the robot arm for the Miso Robotics' Flippy collaborative robot, which recently started flipping hamburgers at CaliBurger in Pasadena, before being "benched" because [it was too fast for human workers](#). The robot uses Miso Robotics' cloud AI platform to operate the



Miso Robotics' Flippy robot uses a FANUC robotic arm and can quickly cook hamburgers.

robot using a combination of cameras, thermal scanners, and lasers.

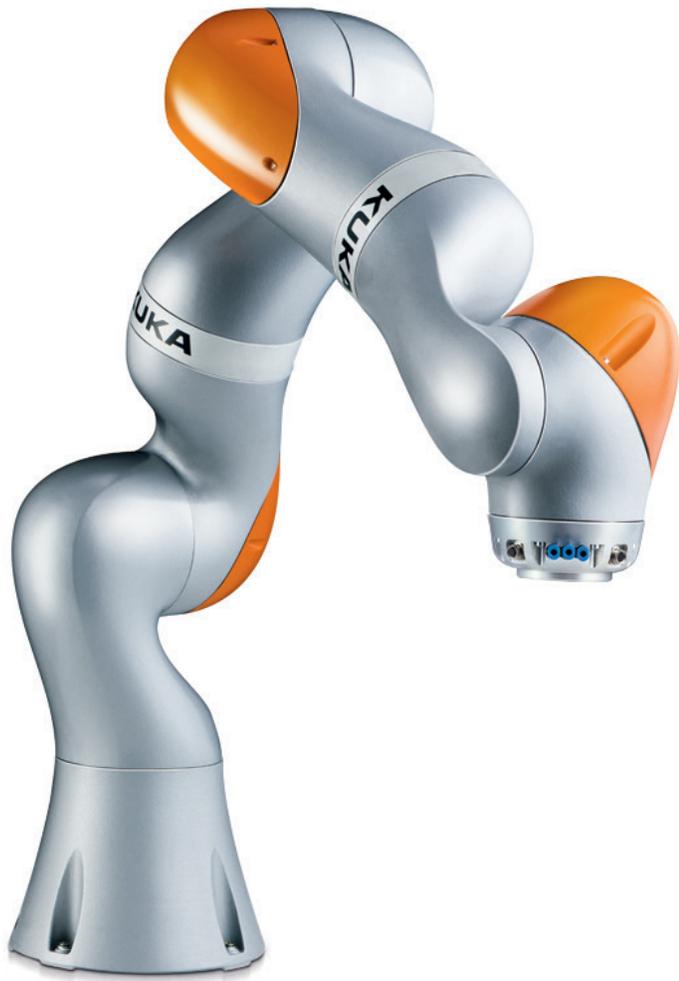
“Much like self-driving vehicles, our system continuously learns from its experiences to improve over time,” said David Zito, CEO of Miso Robotics, [in a statement announcing the robot](#). “Though we are starting with the relatively ‘simple’ task of cooking burgers, our proprietary AI software allows our kitchen assistants to be adaptable and therefore can be trained to help with almost any dull, dirty or dangerous task in a commercial kitchen — whether it’s frying chicken, cutting vegetables or final plating.”

Flippy detects when a burger patty is ready to be turned over and flips it, followed by placing the cooked burger on a bun. The unit features a sensor bar that lets it see in 3D, thermal, and regular vision to instantly detect the exact temperatures of the grill as well as readiness of each burger. Flippy is powered by the company’s proprietary Cooking AI, allowing it to learn new skills over time, including assisting with grilling other foods, frying, chopping and finishing plates.

KUKA AG

KUKA’s [LBR iiwa collaborative robot arm](#) comes in two versions with payload capacities of seven and 14 kilograms. LBR stands for “Leichtbauroboter” (German for lightweight robot), and iiwa is short for “intelligent industrial work assistant.”

KUKA said a Ford automobile plant uses the arm to help install heavy shock absorbers for the Ford Fiesta. The task was difficult for traditional automation robots, and ergonomically challenging for human workers due to the repetitive



KUKA's LBR iiwa collaborative robot can help perform tasks like installing heavy shock absorbers on vehicles.

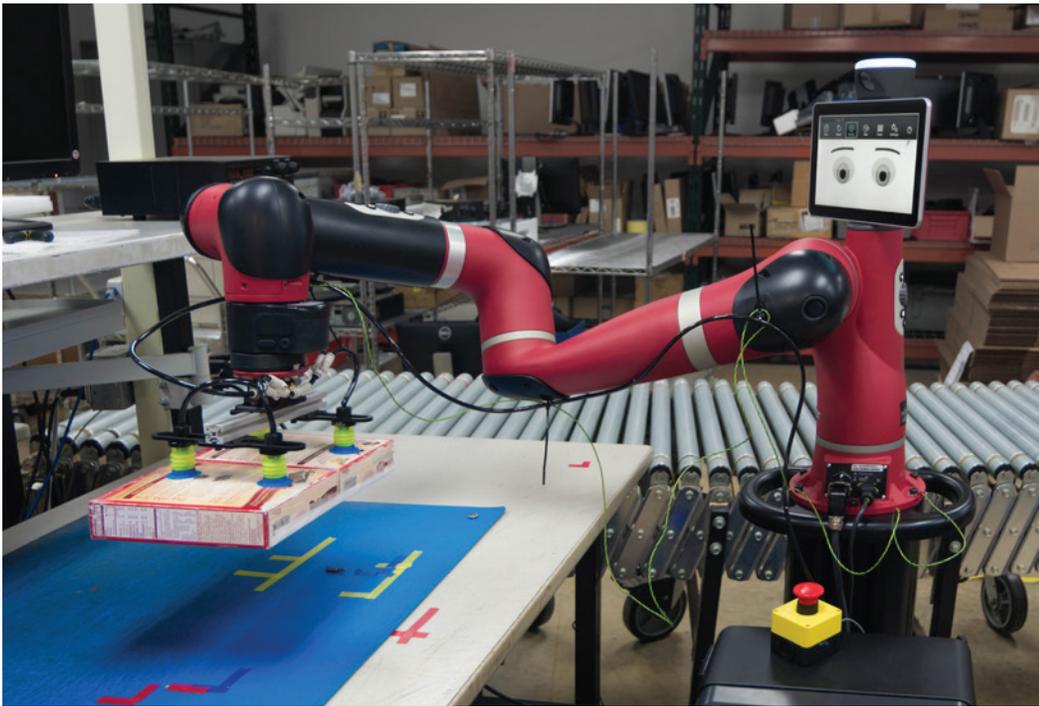
nature and heavy lifting involved, KUKA said.

The LBR iiwa offers a high-performance servo control that can detect contours rapidly under force control; enabling the collaborative robot to select the correct installation position; and mount components within a 2% accuracy of the maximum torque.

KUKA also offers a mobile platform for the collaborative robot, featuring Mecanum wheels (wheels that can move in any direction) with nearly infinite degrees of two-dimensional freedom. The mobile version of the cobot gives companies the ability to cut throughput times and reduce idle times in the manufacturing process, KUKA said. Live mapping and laser scanning provide immediate reaction if a person or object moves into the cobot's path, providing safe navigation in a collaborative environment.

RETHINK ROBOTICS

[Rethink's Sawyer cobot](#) features a 7-degree of freedom robotic arm with a 1260-mm reach and the ability to maneuver in tight spaces. Sawyer includes



The Sawyer collaborative robot from Rethink Robotics includes built-in force sensing and can maneuver in tight spaces.

built-in force sensing capabilities that let it make adaptive decisions as tasks run. This lets the robot work within one millimeter of optimal positioning while operating next to humans, Rethink said.

Sawyer is being used in several applications, from CNC machining (computer numerical control) to loading and unloading at several manufacturing facilities, the company said.

[Moduform](#), a furniture manufacturer, is using Sawyer to address a worker shortage at the company's Fitchburg, Mass., plant. The robot helps workers assemble drawers, performing tasks like picking up parts from a pallet, pushing them into place, sliding into a dovetail machine, turning on the machine, retracting the piece and repeating the process until the drawer is complete.

Another company, Tennplasco, uses Sawyer at its Lafayette, Tenn., injection molding facility to supply labor – particularly for the second and third shifts – that can't be met through available human labor supply, the company said.

[Tennplasco uses the cobot to help assemble and inspect automotive parts.](#)

Rethink Robotics recently launched a software development kit (SDK), which lets researchers and students build and test programs for the Sawyer robot. The SDK integrates with the Gazebo Simulator, an open-source simulated world that visualizes the robot and its contact with the environment. This lets researchers run and test code in the simulation before running it on the robot.

The SDK also includes a new motion interface that lets researchers program the robot in Cartesian space, lowering the barriers for motion planning for



Stäubli's TX-2 offers several configuration to meet customers' differing safety requirements.

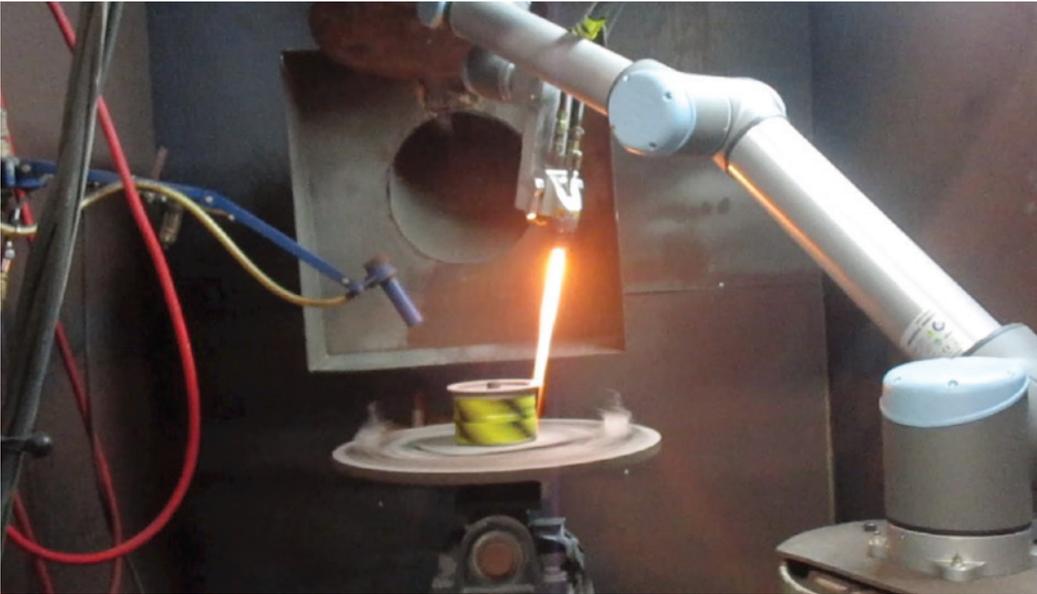
programmers who don't have a full robotics background. The new release also lets researchers leverage new impedance and force control, and includes support for ClickSmart, the family of gripper kits that Rethink announced last year.

STÄUBLI

Stäubli's newest collaborative robot, [the TX-2](#), offers several configurations to meet the needs and safety requirements of customers. The TX-2 comes with a new CS9 safety control and has a "separate safe digital encoder" for each axis and an "integrated safety board." The series has six models that handle loads from 2 to 15 kilograms, with a reach ranging from 515 up to 1,450 millimeters. Sensors monitor every motion and all position coordinates of the robot arm, its speed and acceleration, in real time, Stäubli said.

The MRC-1 configuration of the TX-2 is standard, with the unit inside a cage so it can operate at high speed, with no human interaction. The MRC-2 (human contact not desired, but possible) and MRC-3 (human contact expected) configurations are the most popular, said Sebastien Schmitt, robotics division manager for Stäubli North America.

MRC-2 and MRC-3 don't have guarding, but instead use electronic sensors such as laser scanners to sense when a human approaches. If a human enters the first safety zone, the robot slows down so the human can approach with relative safety. If a human enters the second, closer, safety zone, the robot comes to a complete stop. As the human leaves the respective zones, the



Universal Robots collaborative robots can be used in welding applications.

robot automatically returns to its previous speed, Schmitt said.

The MRC-4 configuration is a force-limited operation of the robot. It can run fast but stop immediately if it contacts itself or another hard object, like another robot, machine or support post. Users can further enhance safety by covering the robot with a touch-sensitive skin to help it stop on contact.

In the MRC-5 setup, a human guides the robot arm for precise positioning, enabling the robot to act as an extension of the human operator. The MR-4 and MR-5 configurations are now in pilots at various plants, Schmitt said.

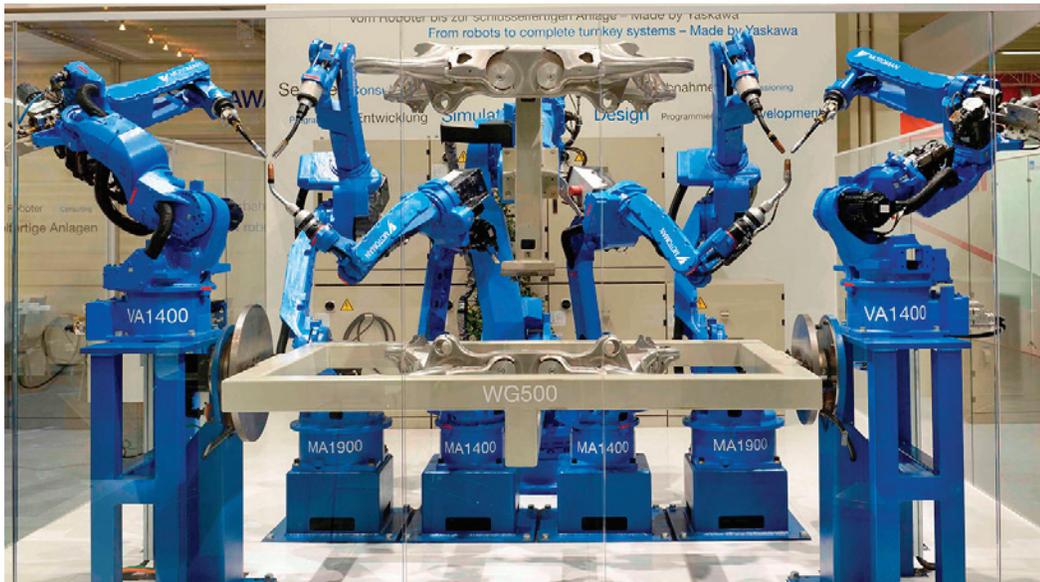
UNIVERSAL ROBOTS

Universal Robots' cobots are deployed in various plants for picking and placing, polishing, welding, machine tending, packaging and palletizing and related uses.

In January 2018, [Universal's UR10 cobot](#) was integrated with its Zero Footprint Palletizer (ZFP), which offers a maximum load of 18 pounds, as well as quick deployment with a facility's existing packing lines, the company said. The unit also offers a vertical 7-axis swing system with the ability to stack on each side.

"The UR10 arm was chosen for this solution due to its ease-of-use and safety features," said Rob Antonides, president of Apex Motion Control, Universal's North American integrator, in a prepared statement.

"We deliver automation solutions for the food industry and saw a clear market need for a flexible automation solution that addresses high mix/low volume runs in space restrained spaces." The ZFP can operate with no guarding. If an operator is detected in the carton pickup area, the UR10 reduces the robot's speed until the area is cleared.



Robots from Yaskawa Motoman can work in collaborative or non-collaborative environments, since they are built on the same platform.

Other Universal cobots are used in welding, through a collaborative welding package developed by ARC Specialties Inc. Universal said its new [SnapWeld Collaborative Robot Welding package](#) is the first integrated metal inert gas welding system for cobots.

“We saw this as a unique opportunity to develop an integrated low-cost system for gas metal arc welding applications that no one else in the market is currently offering,” said John Martin, vice president of ARC Specialties, in a prepared statement. The welding system includes a Profax wire feeder and water-cooled torch, enabling welds up to 600 amps, the company said.

YASKAWA MOTOMAN

By building its collaborative and non-collaborative robots on the same platform, the company offers units that can be programmed to work in both environments, said Bernardo Mendez, senior product manager.

“This makes our industrial robots very useful; customers can take advantage of the commonalities in the platform,” Mendez said.

The company’s [HC10 collaborative robot](#), introduced in April 2017, is used in materials handling applications, palletizing and assembly inspection. The robot can handle weights up to 10 kg, which is heavy enough to cause injuries to human workers performing the same repetitive task, Mendez said.

The HC 10 features dual torque sensors in all joints that constantly monitor force to quickly react to any contact. It is designed to eliminate operator pinch points while through-arm utilities hide cabling. This increases safety by reducing the risks of snagging or interference with other equipment, the

company said.

The company's Easy Teach software lets an operator hand-guide the HC10 when teaching it new program paths, to enable quick deployment or redeployment.

THE COBOT IS HERE TO STAY

Whether from a major robotics maker or smaller startup, it's clear that the cobot can help companies to meet their needs, whether in a warehouse, factory floor or other location to help humans work in a safer environment. Whether creating new efficiencies or cost savings, the cobot has gone from an interesting oddity to a major asset at many modern companies.

As the market continues to expand and cobots learn new tasks, it should be interesting to see where they end up next.