

**F**or manufacturers that have yet to bring a robot into their production areas, the prospect of doing so can be daunting. To make it less intimidating, robot manufacturers are taking a step back from their large, industrial robot focus and catering to a need for smaller, self-contained robots that can work side-by-side with people. They're called collaborative robots, or more informally, cobots, and manufacturers are likely to see an influx of them from robot manufacturers in the coming years.

While collaborative robots aren't brand new, they are still considered

forward looking. Various studies show the collaborative market set to grow significantly. For example, a study by BIS Research concludes that from 2015 to 2021, the collaborative robot market is expected to grow to \$2 billion dollars and 150,000 units, approximately.

One industry set to benefit is electronics. At the Beijing World Robot Conference in October 2016, sessions covered how collaborative robots are bringing more flexibility to electronics manufacturing.

Cobots feature integrated sensors, compact design and safety ▶



Yaskawa is currently working with a number of end-of-arm tooling manufacturers to assess which ones they'll recommend to HC10 collaborative robot users.

mechanisms needed when working in close contact with humans. These have helped to change the way manufacturers think about robots in the workplace. Most importantly, collaborative robots are engineered so that the operator least informed about robotics technology can still work with them to improve productivity.

## RISE IN COBOTS

Yaskawa has three years of research and design behind its first collaborative robot, the Motoman HC10. Bernardo Mendez, senior product manager at Yaskawa, says the HC in the HC10 stands for “human collaborative.” The 10 stands for the robot’s payload – 10 kg, which Yaskawa believes is the “sweet spot,” though it is considering developing models with smaller and larger payload capabilities. Mendez isn’t ruling out the development of an HC5 or an HC15 in the coming years.

“There are different ways a robot can interact with a human,” Mendez says. “We’ve opened a myriad of possibilities with the HC10.”

One of the reasons Yaskawa is interested in bringing a collaborative robot to market is a result of what manufacturers are saying to Mendez, who has conducted significant “feet on the ground research.” They are telling him that there is too much cost related to employee training and employee turnaround. Furthermore, repetitive tasks can lead to health issues such as carpal tunnel syndrome, and lifting heavy parts all day can lead to fatigue and production mistakes in humans. Those issues could be resolved with a collaborative robot.

“The idea behind collaborative robots is that all preconceptions will disappear,” Mendez says. “We’ve seen it in the pharmaceutical industry, the electronic component industry, automotive, consumer goods – anywhere there is a high-mix, low-volume type of production task where humans are needed to sort things out – that’s where you’ll see collaborative robots.”

## SAFETY ISSUES

The HC10 is a force limited collaborative robot, it senses disturbances, such as impacts, ▶

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*Bernardo Mendez, senior product manager at Yaskawa*



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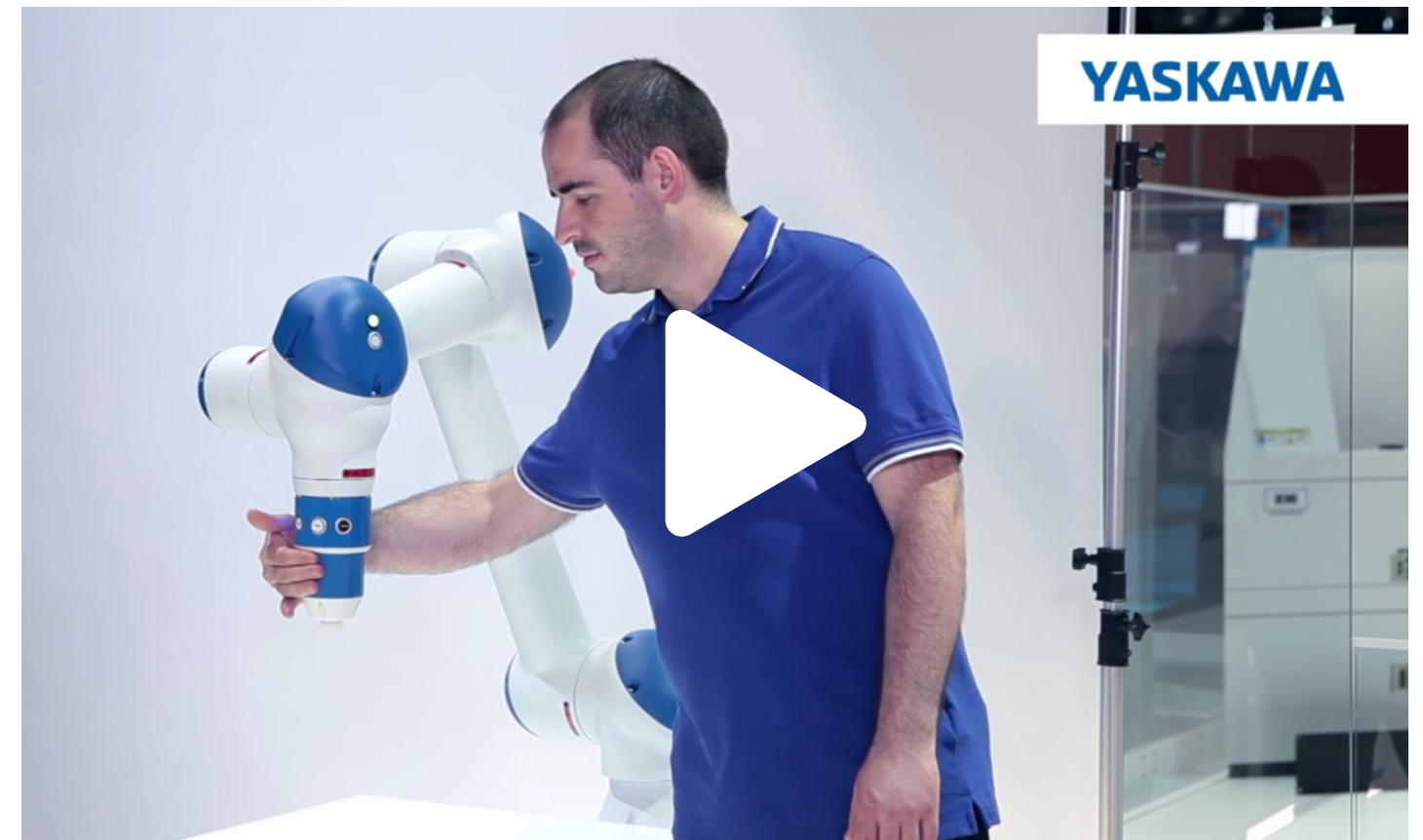
*Bernardo Mendez, senior product manager at Yaskawa*

In this video, an operator demonstrates how safe it is to work in close proximity to the HC10.

pressures and resistance, in its joints and reacts accordingly by limiting the amount of power and force the HC10 can transmit during a disturbance. Should the cobot come into contact with a human, it stops or reverses its course depending on the situation. This concept is known as Power Force Limitation, one of the features required for a robot to be deemed collaborative. The HC10 is the first collaborative robot with Power

Force Limitation, and Mendez says they’re thinking far beyond welding applications for this new unit.

However, as with any artificial device that interacts with a human, a cobot requires a thorough risk analysis to determine the necessary safety measures needed to minimize accidents. This can be achieved by utilizing technologies such as Yaskawa’s Functional Safety Unit, ▶



Watch this video to see how the robotic arm shuts down if the operator comes in contact with the HC10 while it is in motion.

which provides control-reliable zone and tool position monitoring, standstill monitoring and speed limiting.

Part of what makes the HC10 safe is that it is built with dual torque sensors in each of its six axes in the robotic arm. Used in each joint of the robot, these sensors provide the required sensitivity while still retaining the arm stiffness that is needed for smooth and high-speed motion.

Safety barriers are something most manufacturers avoid if at all possible. They take up valuable space and require extra steps to work around, and sometimes require lengthy shutdowns when they need to be moved to accommodate a different job. Collaborative robots, however, reduce the need for safety barriers through their Power Force Limitation functionality.

“The first thing we hear from potential cobot users is the expectation of removing the physical fence,” Mendez explains. “We do not propose a fenceless coexistence. We want to substitute physical fences for

electromechanical ones, which will allow for closer human interaction with a robot. The safety requirements remain the same as before – it is the approach to minimize risk that is changing. This is a category of automation that people want to see working side by side with a robot without material cages or a high level of complex programming.”

### **EASY TO OPERATE**

One of the objectives of bringing a collaborative robot into the workspace is offering an ease of use not associated with industrial robots. With very little training, a worker should be able to “instruct” the robot what to do, and it should respond with precision. Utilizing Easy Teach technology designed by Yaskawa, operators can skip the lengthy programming normally associated with robots and guide the arm and tooling on a work trajectory appropriate for each individual job.

Hand guiding is also a big factor in the simplification of cobot programming; moreover, hand guiding presents a significant benefit when the cobot ▶

There is no need for complex programming with the HC10. Operators can use the hand guiding technology instead.

Ease of use is what manufacturers require today. The HC10’s ergonomic design includes no pinch points, making it safe to move.



Utilizing Yaskawa's Functional Safety Unit, operators can safely work side by side with the HC10 and not risk injury due to collision.



is interrupted and there is need for a recovery operation.

There is also a hardware representation of Easy Teach called SmartHub. This feature of the HC10 represents another option for the operator to reduce the complexity of programming a cobot, as well as making the recovery operation easier.

The HC10 is designed with a geometry that includes no pinch points, which makes it safe for the operator to handle and move all six axes. The operator can also use a pendant attached to the robot to fine tune positioning or for access to more complex programming tools.

Mendez says they are looking into developing an interface that is more in line with what is available with an iPad or other tablet computers.

### **ARM THE TOOL**

Mendez admits that there are a lot of cobots on the market today, but what sets the HC10 apart is that all the tubing and wiring is contained within the robotic arm, making it much safer

to work around – there is nothing attached to the arm that will snag on nearby objects.

“A lot of robots,” Mendez begins, “support their end-of-arm tooling with hoses and cables that run outside the cobot’s arm. We went the opposite direction – everything is inside the arm with the HC10.”

Yaskawa is only making the robotic arm, relying on third parties to develop the tooling that will fit the needs of HC10 users. Mendez and the Yaskawa team are currently working with end-of-arm tooling manufacturers and assessing which vendors they’ll recommend to buyers.

The key to expansion into non-traditional industries is in the development of end-of-arm tooling mechanisms that will cater to specific applications.

“I don’t think there will be a limit,” Mendez responds when asked about types of end-of-arm tooling that the HC10 will use. “It could work with thumbtacks – it depends on the ▶



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programming, tooling design and ancillary technologies, such as vision, I/Os and sensors, integrated into the system."

As far as welding operations are concerned – beyond the actual welding – the HC10 could serve fabricators well for finishing and prep work, such as deburring and surface finishing. It can also work downstream, sorting parts after they've been welded.

Yaskawa is currently working to offer software that will detect what type of tooling has been placed on the arm, which will offer a plug-and-play option for operators, Mendez says.

### LAUNCH DATE

Mendez says the HC10 received plenty of praise during the Automatica conference in June and IMTS in September. In fact, the interaction he has with people at trade shows has confirmed his belief that the machine will be of great use in many industries.

"Anyone from the big guys in automotive to the small and medium

enterprises are showing interest," Mendez says. "People who own a bakery have even approached us, saying, 'I bake bread and I never dreamed I would use a robot to package the bread or palletize it into boxes.' They are finding these robots not as intimidating and also not as space grabbing."

Yaskawa plans to conduct a beta testing program and then proceed to launch the HC10 cobot in 2017.

"All those rules of engagement are being defined right now, and that's the other exciting part," Mendez says of the development of the HC10 as a collaborative solution, "because robot manufacturers like Yaskawa are going to have to come out with their own version of how to solve not only the safety situation, but also the needs of the customers." ■

YASKAWA MOTOMAN