Cage free robot collaborators coming to a factory near you
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Robots cage-free - and able to work in cooperation with all employees (instead of being designed by engineers for engineers), and affordable for small businesses - have captured the imaginations of many.

“Demand is pretty strong and we see that in Australia and we see that more or less all over the world,” Dr Esben Østergaard, co-founder and CTO of Universal Robots, told Manufacturers’ Monthly.

“And it’s a little bit about giving more responsibility to the people working near the robots instead of these robots only being able to be touched by the experts.”

In the increasingly frequent stories about the category, the two companies often mentioned in the same breath are Dr Østergaard’s Universal Robots and Boston-based Rethink, both of which have some claim to being pioneers.

However, both companies will tell you their products are very different.

Humanoid or tool
Collaborative robots are usually pitched in terms of their ease of use. A line worker can manipulate UR’s and Baxter’s robot arms, with this movement repeated by the robot (with a few simple interface inputs along the way).
The category and UR’s products have caught on, “Because of the flexibility and ease of use of the robot,” offered Dr Østergaard

“That’s a big selling argument.”

Similarly, Rethink’s products are designed to be easy to set up and to reprogram.

“Our goal is - maybe this is the best thing to say: our goal is to make it frictionless to put the robot into a new task in the factory,” Dr Brooks told Manufacturers’ Monthly.

The word “training” is often used in the company’s literature in place of “programming”, which is in keeping with the robots positioning as a friendly, human-like presence. Other marketing exercises - such as having it (the robot is not referred to as having a gender) serve beer in Budweiser ads - also lend to this.

“I think the Universal Robot is a great robot, but to me it’s more of a conventional industrial robot,” offered Dr Brooks of the difference between the companies’ approaches.

Before Baxter’s release in 2012, there were several different concepts for its design explored by Brooks, who founded Rethink (as Heartland) in 2008.

Baxter’s humanoid appearance was not the starting point, coming after other versions were tried out. The display/face provides its human co-workers with feedback on the robot’s progress in tasks (for examples, it will look confused if it is interrupted during a job, look at where it is about to move to, and its screen will turn red to let a human know Baxter is aware a person is nearby.)

The design also has to do with the ability to switch a person and a robot between certain jobs. Baxter has a reach similar to a human’s for this reason, though with slightly longer arms (to compensate for a lack of hips to bend from).

Both companies have seen some degree of their products being viewed as team members within factories.

For example, UR’s machines are sometimes referred to by human names by floor workers at a BMW assembly in the US.

This does not indicate that they are viewed as being human-like, said Østergaard.

“There is a tendency that companies name the robots, I think a little bit, yes, but the robot as I see it is more like a tool,” he said.

“Do you name your electric screwdriver? Probably not. But at some point, when the tool becomes sophisticated enough, you feel it should have a personality, and that’s why you invent a name for it.”

Both companies are also quick to volunteer that their robots are there to aid human workers rather than replace them - understandable given the fairly regular “automation versus jobs” stories nowadays.
For Dr Østergaard, the robot-as-a-tool-for-workers approach helps counter a "machines vs. jobs" argument, and takes away the discussion.

“Nobody says that an electric screwdriver steals jobs,” he pointed out.

“So if we can get the same kind of view of robotics then at least...by making them accessible to people, they are less feared.”

As well as flexibility - suitable for low-volume, high-mix output - a large part of the appeal of collaborative robots is the ability to take away repetitive jobs such as machine tending or picking/placing small loads. Neither was practical with heavy industrial robots of the kind seen in automotive factories.

“Baxter and Sawyer, they’re not dexterous, they’re not able to do cognitively demanding things; they do really boring tasks,” said Dr Brooks.

“And the workers are often the ones that come up with them. And certainly in the US and China, by the way, it’s not like people are lining up to get factory jobs. So the popular press says ‘robots are going to take away all the jobs’ - that is just not the case*.”

Another worker-friendly aspect of both companies’ robots is their level of safety.

Again, there are big differences in how each company approaches this. Both stop when met by a certain level of force, though Rethink has embedded force sensors in its robots’ joints, while Universal ascertains a certain level of force by measuring disturbances in current.

“I’d gladly put my head in front of Baxter when it’s running at full speed and I’m still okay,” offered Dr Brooks. “I would not put my head near a Universal Robot.”

Other differences include repeatability levels (more an emphasis for Universal, which has a higher level of precision, with Rethink concentrating on the ability to work in semi-structured environments); the American company’s machines come with built-in vision systems (these are integrated later if needed with UR); and degrees of freedom in robot arms.

Despite creating very different robots for very different tasks, both companies have a legitimate claim on inventing “collaborative robots” as a category or piece of nomenclature.

What led to co-bots?
Dr Østergaard made his first robot at age four. This was made out of Lego - possibly the most archetypically Danish way to get started - and used in his father’s civil engineering work on the water supply of Cebu in the Philippines. (The story is worth looking up in the excellent Pransky Interview in Industrial Robot: An International Journal, published earlier this year.)

A robotics prodigy and a holder of more than 30 patents, Østergaard completed research positions in the United States and Japan, before returning to Denmark.

As a PhD student at the University of Southern Denmark (Odense), Østergaard teamed up with two other students on a problem thrown to them by the government.
The trio (including Kristian Kassow and Kasper Støy) was tasked with finding a way of bringing more automation into the Danish food and beverage industry.

Initial research was carried out in 2003, an idea for a company formed in 2004, and UR launched in 2005.

Their first non-prototype robot - arguably the first “co-bot” sold - was sold in 2009, and they will have sold over 5,000 units of their UR10, UR5 and UR3 machines since then. According to their CTO, they are now heading up to 300 units a month sold.

The company was acquired in May by Teradyne for $US285 million (plus performance incentives)

Dr Brooks was born in Adelaide, completed a masters at Flinders University (in pure mathematics) and a Doctorate at Stanford University. His interest in robotics was piqued at around eight by the How and Why Wonder Books on the topics of electricity and robots.

He has achieved considerable successes in academia, spending a quarter of a century on the faculty at MIT, and as an entrepreneur, co-founding iRobot (see Manufacturers’ Monthly’s May edition.) Among his many achievements is an Advance Global Australian Award for Advanced Manufacturing, announced in July.

His entry into industrial robotics was influenced by what he picked as a looming shortage of labour in China (where iRobot outsourced production of its hugely popular Roomba machines) and a desire to bring manufacturing back to the United States.

Since launching, there have been over 1,000 Baxters sold.

Whatever the co-bot term - which is now used by several companies to describe their robots - means, who popularised it?

“It’s my view - you might ask the other companies, they may tell you something different, but I think we sort of introduced the category and people are seeing that technology makes it plausible today and it’s actually worthwhile doing,” claimed Dr Brooks.

“So from that point of view, it’s a great artistic success.”

Robot rivals?
Both companies were founded by gentlemen successfully able to bring innovations out of academia and into the commercial world. And both have strong links to local, world-class clusters of robotics expertise.

Rethink’s home is in the robotics hotspot of Boston, in the city’s Innovation District. Dr Brooks is not the only MIT alum on the board, and much IP generated at the university - such as their robots’ series elastic actuators, which add to its safety while operating alongside humans - can be found in Baxter.
Assembled if Teradyne’s HQ location near Boston’s technology ecosystem - and strength in robotics startups - had any influence in selling, Østergaard said the location was handy, but not decisive. UR will be keeping its R&D in Odense.

“'It’s not a bad thing to have a strong connection to the Boston area, for sure, but it was not part of the decision,” he answered.

Odense boasts an impressive technology ecosystem of its own. According to Innorobo, there are over 70 firms specialising in robotics in the southern Denmark city, and over 1,800 employees in the industry. There are also more than 10 relevant research institutions, and four high-tech incubators.

Neither company identified any sort of rivalry when asked and suggested that they both sold very different offerings suitable different tasks.

“Theirs is a fairly conventional sort of programming system with a graphics layer on top, ours is a task-based run, coordinate-based system; and we’ve got built-in cameras and things,” said Dr Brooks.

“So in my view, it’s different.”

The term under which both businesses marketed their products was a broad one. Both companies addressed different problems, said Dr Østergaard.

“I don’t think there will be a lot of applications where there will be competition between our products,” he added.

“Anyway, the market is big, so we just welcome more players.”

According to UR’s CEO, Enrico Krog Iversen, the addressable market might be worth as many as 1 million units a year, and too big for one company to try and tackle on its own.

“There is a lot of room for innovation,” said Dr Østergaard.

“So there’s a lot of room for new start-ups. I don’t know how many arms we will need.”

In the world of co-bots, there’s a definite excitement.

And as with industrial robots in general, demand will only go up in a labour-constrained and increasingly tech-heavy manufacturing world. So will competition in the collaborative robot market.

“When we started talking about it, no one else was, and the major companies are all saying ‘we’re doing that too,” said Dr Brooks.

“So we’ve got to run really fast! Because [now] they all know this is a good idea.”

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