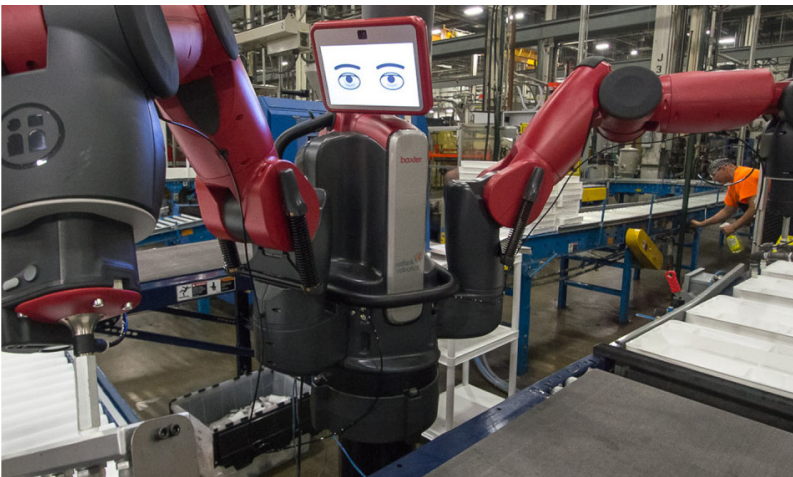


Rethinking Automation

WHITEPAPER

Smart, collaborative robots are the new breed of automation



Rethinking Automation

The automated factory environment was envisioned and built decades ago to meet the needs of manufacturers producing high volumes of mass-produced products. Today, unprecedented change is taking place. Workforce shortages and consumer demands for customized products mean manufacturers need to rethink their processes, their metrics, and even their automation technology strategies.

Take the traditional industrial robot, for example. Fast and efficient, these fixed automation solutions deliver the speed, payloads and mechanical repeatability needed for high-volume, low-mix environments. Although they have obvious advantages, they have very real disadvantages for manufacturers with lower-volume, higher-mix environments. While fast and precise, high speed robots are also fixed, expensive, and inflexible.

To meet these unmet needs, a new breed of automation has emerged that provides an exciting alternative to fixed automation. This new category is called collaborative robotics, and it's changing what's possible for manufacturers of all sizes.

This new class of robot has several distinct advantages over its fixed industrial counterparts, allowing it to:

- Work safely side-by-side with humans
- Perform the simple, repetitive tasks that in the past were difficult and expensive to automate
- Allow anyone on the factory floor to quickly train it without needing any programming knowledge
- Moveable to enable quick deployment and changeover
- Interact with its human co-workers and adapt on the fly to changes in its environment
- Be incredibly affordable

If that sounds too good to be true, then it's time to rethink your idea of production robots.

The Manufacturing Skills Gap in the US

600,000

HIGH-SKILLED
MANUFACTURING JOBS
CURRENTLY UNFILLED

44 years

MEDIUM AGE OF
FACTORY WORKER

78%

WORKERS AGED 45-65

3,000,000

PREDICTED SHORTFALL
OF SKILLED WORKERS
BY 2015

Source:

American Enterprise Institute
<http://bit.ly/1sdrCTW>

Baxter: Collaborative, and more

Within the automation industry, the term “collaborative” is used to define robots that can operate safely outside of a cage. But, to be truly collaborative, a robot must have the ability to work safely side-by-side with humans, adapt to changes in its environment, and interact with the very people it works beside.



Meet Baxter

Built from the ground up to address the challenges of today’s manufacturers, Baxter is a new breed of collaborative robot that integrates safety, flexibility and interactivity. A smart, collaborative robot unlike any other, Baxter is:

Flexible enough to fit into human workspaces. With traditional and other “cage-free” robots, any slight misalignment can wreak havoc on a production line. Baxter is different. With its integrated Robot Positioning System™ and cameras, Baxter responds intelligently to changing workforce conditions, whether that’s stopping when coming into contact with a person or adapting to a table being bumped out of alignment. Traditional robots require building expensive work cells. Baxter works with existing workspaces and fixtures designed for human hands by “feeling” its way into a tight fixture.

Programmable on the fly. Traditional robots require weeks of programming by highly skilled engineers. With Baxter, factory employees “train” the robot by moving its arms and pressing a few buttons. Baxter performs the set task and then can be redeployed for another task.

Continuously innovative. Traditional robots are dumb and inflexible. They perform the same task repeatedly until they’re reprogrammed to perform a new one. With Baxter, the hardware is the platform and the software provides the value. With regular software upgrades based on customer testing and feedback, Baxter grows more valuable the longer you own it.

Rethink those simple, repetitive tasks



Baxter's key differentiator, however, is that it cost-effectively performs the repetitive tasks that in the past only humans could do, either because they were small batches or required humans in or near the workspace. These tasks include:

Material handling. Moving parts to and from tables, cases and conveyors while maintaining counts and/or re-orienting parts

Loading and unloading. Setting delicate circuit boards into testing fixtures, visual inspections and barcode scans, and placing them into position for the next stage in the production process

Kitting and packaging. Packing multiple components into specific configurations, packaging parts and materials for many different types of products and containers

Baxter redefines automation because it performs these simple, repeatable tasks either working side-by-side with people or alone at a workstation. The result is improved efficiencies and an opportunity for people to be better used in higher-skill tasks.

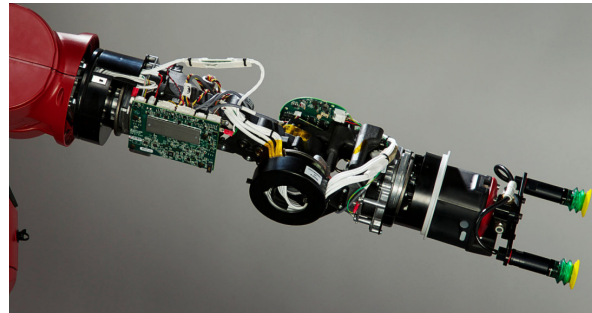
Baxter is a complete hardware and software automation platform integrating several systems that help manufacturers achieve real benefits. These systems include the patented Series Elastic Actuators, the ground-breaking Robot Positioning System, and the highly intuitive User Interface (UI).

Series Elastic Actuators

Invented by Matt Williamson, Technology Director for Rethink Robotics, and Gill Pratt, while both were at MIT, the Series Elastic Actuator (SEA) is a patented technology embedded in each joint of Baxter's two arms.

The SEA consists of a spring in series with the output of an electric motor and gearbox. A sensor is used to measure the twist of the spring, and a control system is used to control the output torque at the joint.

The result is a robot incorporating force control rather than rigid positioning, and force sensing at each of the 7 joints in the arm. To position Baxter's arms, simply touch a cuff; the



47-pound arm goes into zero gravity mode – making it virtually weightless. The SEA is what gives Baxter its unique smoothness of handling and ensures it won't damage parts, fixtures, materials or people.

Hands-On User Interface

Due to a growing near-shoring emphasis, a much publicized labor shortage, and an aging workforce of post World War II baby boomers, manufacturers are scrambling to find and train skilled workers. Rather than replace people, however, Baxter was designed to integrate into existing workforces – to be trained and used by the people with whom it works.

Unique to the robotic industry is Baxter's upgradable software, Intera™. By moving Baxter's arms and joints as needed, and following the software's intuitive icons on the face screen, anyone from production floor employees to engineers can train Baxter to perform tasks using context versus coordinates. The software allows people to train the robot on tasks as they arise, with no loss of productivity.



The upgradable software is what enables Baxter to become smarter, faster, and more adept at handling an increasingly complex array of tasks. This approach means Baxter evolves and adapts over time without manufacturers having to increase capital investment.

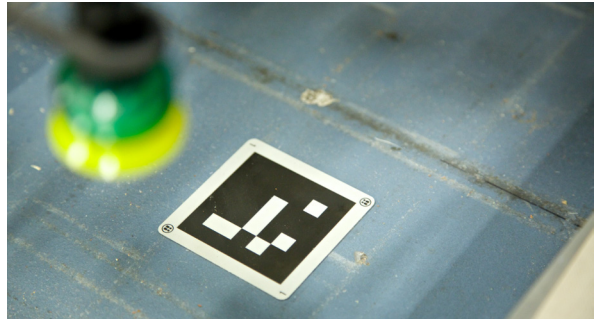
Flexibility for Real World Environments

Caged robots protect humans from collisions and impacts that can cause serious harm. They also protect the robot and its precisely configured environment from bumps, jiggles and anything else that can throw it out of alignment even a fraction of a millimeter.

For humans, who can readily adapt to changes in the environment, a fixture, part, table or box that becomes slightly out of alignment is no big deal. It works the same for Baxter.

Incorporating Rethink Robotics' groundbreaking Robot Positioning System, Baxter easily adapts to the common variations of the production floor.

Using square aluminum adhesive markers, called Landmarks™, in conjunction with the robot's embedded vision system, a worker marks the location of fixtures or other elements associated with a task. Baxter recognizes the original locations of the markers, and when the locations change slightly, marks the new locations and adjusts its movements accordingly without having to be retrained.



BAXTER ADAPTS QUICKLY TO WORKSTATION CHANGES OF UP TO +/-50MM HORIZONTALLY AND WITHIN +/- 10 DEGREES OF ROTATION.

The Robot Positioning System allows workers to train Baxter to perform a task, redeploy the robot for a new task, and then move the robot back to the original task – all without having to worry about precisely re-positioning the workspace elements and thus reducing considerable production downtime.



See the Robot Positioning System in Action!

Watch the video at: <http://bit.ly/1yzdB4C>

Collaborative Robots Redefine Automation

At Rethink, we didn't build a robot based on old ideas and assumptions. Instead, we went to factories and watched people work. We saw the challenges they faced day in and day out. We came back and asked, "What if...?" and kept refining until we figured out how to make a robot solve these challenges. It's this collaborative process that makes the robot smarter and thus our customers innovative and competitive.

Smart, collaborative robots help manufacturers gain new flexibility and productivity. And, by their very nature, they redefine automation. By working side-by-side with humans, an interactive robot like Baxter is a workforce multiplier as it frees up humans to focus on the work best performed by them versus lower-level "robotic" tasks that are best automated.

Instead of trying to make traditional robots fit into the new ways of manufacturing, smart, collaborative robots like Baxter allow manufacturers to fit them into existing production lines and replicate current methods of working. Because it's safe, flexible, adaptable, and trainable, Baxter helps manufacturers cost-effectively meet fluctuating demands while driving continuous innovation.

To learn more about Baxter and how this new breed of automation robot can help you extend your workforce, increase innovation and meet new production demands, visit the Rethink Robotics website at www.rethinkrobotics.com. Here you'll find a wealth of resources, including videos showing Baxter in action where it counts – on the production floor.



See What Others Have to Say About Baxter

Watch videos at: <http://www.rethinkrobotics.com/videos/>



ABOUT RETHINK ROBOTICS

Founded in 2008 by robotics pioneer Rodney Brooks, Rethink Robotics is redefining manufacturing automation with a new breed of technology – smart, collaborative robots that safely and efficiently handle many of the repetitive production tasks that couldn't be practically automated before. In the same way that PCs changed the way people used computers, Rethink Robotics is changing the way automation can be used and deployed in production environments.

For more information about Rethink Robotics, please visit www.rethinkrobotics.com.

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