

Robots *Slowly* Take on *White Goods*

A new generation of robotics technology will transform appliance manufacturing.



Six-axis robots are used to assemble washing machine parts. Photo courtesy Gorenje Group

For information on how to obtain reprints/e-prints of this article, please contact Cindy Williams at williamsc@bnpmmedia.com or 610-436-4220 ext. 8516.

■ **By Austin Weber**
Senior Editor
webera@bnpmmedia.com

When it comes to applying robotic technology to new product designs, the household appliance industry has been quite innovative. Robo vacuums are a great example. Robots are also available for applications ranging from floor washing to gutter cleaning and grass cutting to pool cleaning.

At the recent Hannover Fair in Germany, a kitchen equipped with two robotic arms attracted a lot of attention. The device can cook a wide variety of meals—cleaning the dishes afterwards is another story.

Robots are used to assemble many components that go inside appliances, such as circuit boards, compressors, fans, motors and pumps. However, when it comes to using robots to assemble dishwashers, dryers, ovens, refrigerators and washing machines, appliance manufacturers lag behind other industries. Manual and semiautomated assembly is the rule rather than the exception in most plants.

Robots are used to assemble small appliances, such as irons, toasters and vacuums. In factories that mass-produce large white goods, however, the machines are typically only found in nonassembly applications, such as machining, stamping, painting and product testing.

But, due to changing market conditions and a new generation of robots, the

appliance industry is ripe for assembly line automation. Manufacturing engineers are eager to invest in robotic technology to boost productivity, improve flexibility and reduce costs.

That positive outlook bodes well for suppliers of robots, grippers, vision systems, parts feeders and other automation systems. In fact, a recent study conducted by the Boston Consulting Group Inc. (BCG) claims that robots currently perform only around 10 percent of all manufacturing tasks.

By 2025, BCG predicts that number will increase to 25 percent. And, one of the sectors that it believes is “most likely to lead global adoption” of robotics, due to high wages and automatable tasks, is the electrical equipment and appliance sector.

Adoption rates will be primarily driven by economic factors, such as relative wages vs. robotics costs. Robots will boost productivity by up to 30 percent and lower labor costs by 18 percent or more within the next 15 years.

Unique Industry

Appliance manufacturing is similar to the auto industry. Manufacturers bolt and weld together a steel frame; cover it with sheet metal; stuff it with motors, pumps, tubing, circuit boards and wiring harnesses; and then add different types of controls and features to distinguish one product from the next.

Like automakers, appliance manufacturers typically build multiple varieties of products that are intended for several different market segments, such as low, middle and high-end consumers.

Subcompact sedans are basically assembled the same way as luxury sedans, sports cars and sport utility

vehicles. The same is true for dishwashers, refrigerators and other white goods.

A low-end and a high-end appliance share basic components and are assembled the same way. The products are differentiated by built-in features, such as storage shelves, water dispensers and temperature controls.

However, when it comes to using robots, the appliance industry shares several characteristics of aerospace manufacturing, which only recently began ramping up its automation efforts.

"The appliance business is a lot like the aerospace industry," says Chris Blanchette, national account manager for assembly and aerospace at Fanuc America Corp. "Many manufacturers adhere to old production processes and traditional ways of doing things.

"Appliance and aerospace engineers are used to assembling their products manually," adds Blanchette. "But, global pressures, shorter product life cycles, product quality concerns and growing demand are driving the need for more flexibility and more robotics in both industries today.

"In appliance manufacturing, there's a lot of demand for variation in the process," says Blanchette. "Functionally, refrigerators and other appliances are mostly the same inside. But, aesthetically, there are multiple features, [and that] drives variation in the assembly process.

"That's something that has been hard to address with traditional fixed automation," notes Blanchette. "Adaptable robots equipped with vision systems and flexible parts feeding systems are better able to tackle product variation challenges."

Ongoing consolidation in the appliance industry will also force manufacturers to invest in automation. For instance, two industry giants were recently gobbled up by rivals. Electrolux AB acquired General Electric's appliance unit for \$3 billion, while Whirlpool Corp. purchased Indesit Co. for \$1 billion.

"Robots arrived in the white goods industry later than in other industries, such as automotive," says Gaetano



Due to changing market conditions and a new generation of robots, the appliance industry is ripe for assembly line automation. Photo courtesy Gorenje Group

Sauli, CEO of Robotech Automazioni, a division of Comau S.p.A. that specializes in systems integration in the appliance industry.

"Today, the pricing pressure that is affecting the household appliance business is driving the need for high productivity automation, together with performance and quality," notes Sauli. "Robots will be increasingly used in the appliance industry because [manufacturers need to] improve both their performance and quality, while increasing their cost competitiveness."

"To compete globally, appliance manufacturers will be forced to do things differently," adds Blanchette. "Even companies with factories in traditionally low-wage countries, such as China, are starting to automate their assembly lines."

Midea Group recently announced that it plans to invest more the \$900 million over the next five years to automate its factories in China that produce air conditioners, freezers, refrigerators and washing machines. It installed 800 robots late last year and plans to add 600 more six-axis robots this year to address chronic labor problems. The company predicts that it will boost its revenue from \$22 billion to \$32 billion over the next few years, while slashing its workforce in half.

Robotic Applications

Several types of robots, including four-axis, six-axis and SCARA designs, appeal to appliance engineers.

"We typically see customers utilizing four- and six-axis robots for packaging, finishing, material handling and some assembly," says Don Maddox, vice president of the robotics division at Simplimatic Automation. "Customers utilizing SCARA-type robotics are typically making subassemblies that will be inserted into an appliance further down the line."

"Articulated robots are used in this industry due to the dimension and weight of the pieces treated," adds Sauli. "Flexibility is another factor that favors six-axis robots.

"Robots are used in the white goods industry for several applications, including painting (both powder and wet), gluing (both silicones and resins) and welding," notes Sauli. "Robots are also commonly used for material handling, loading and unloading applications."

Sauli believes that ergonomic requirements make robots ideally suited for assembling large appliances, where weight and dimension can be a constraint. "With a set up time almost close to zero, robots help increase flexibility, which is highly requested in the white goods industry," he points out.



A new generation of collaborative robots will allow machines and humans to work alongside each other on appliance assembly lines. Photo courtesy ABB Robotics

“Most robotic applications we see in the appliance industry are for machining, tending stamping presses and welding,” says Jesse Hayes, automation group manager at Schunk Inc. “Product assembly tends to use manual or semiautomated production processes.”

“Six-axis robots provide the controls and programmability needed for the machine tending, material handling, painting, welding and finishing applications that are part of the production of household appliances,” adds Samir Patel, director of product development and emerging technology at Kawasaki

Robotics (USA) Inc.

“From tending stamping machines and manning body and frame assembly stations to applying precise coats of paint and sealing sensitive finished components, appliance makers and parts manufacturers use adaptable robots to enhance productivity and quality,” explains Patel.

A considerable amount of sheet metal stampings are used in appliances such as clothes washers and dryers. “Robots do an excellent job of press-to-press handling of sheet metal parts as they get formed from blanks to final parts,” claims Patel.



Engineers at BSH Hausgerate GmbH use robots to test dishwashers. They also use robots to apply silicone liners inside refrigerator doors. Photo courtesy Sick AG

“Many household appliance parts are injection molded; robots are used to remove the parts from the mold by grasping a sprue and runner assembly,” Patel points out. “Robots are typically used in plastic injection molding workcells when the parts are too fragile to be dropped out of the mold, or production runs are too short to go through the expense of building a fully automatic mold that drops the part through the bottom of the machine.”

“Key improvements in sensing and calibration technology, along with enhanced programming and ease of use, have facilitated the use of robots for the welding of many household appliances, such as dishwashers, refrigerators and stoves,” adds Patel.

Traditionally, most robotic assembly applications in the white goods industry have been confined to small appliances, such as can openers, toasters and vacuums.

“Smaller appliances lend themselves more to conveyors, robotics and other forms of automation,” says Fanuc’s Blanchette. “You can feed parts into the assembly station easier. With larger parts, there are more material handling issues to contend with.”

Groupe SEB, a leading European manufacturer of coffee makers, fans, food processors, humidifiers, irons and other small appliances, is a good example. It operates a state-of-the-art plant in Erbach, Germany, that assembles Rowenta irons with more than 70 IRB 140 robots supplied by ABB Robotics.

Ten years ago, engineers decided to switch from using manually operated pneumatic tools to robots to be more flexible and guarantee quality in the company’s high-end products. Rowenta produces 14 million irons a year in more than 50 different varieties. Some of its products cost more than \$140.

“The machines are used for adhesive bonding, screwdriving and spot welding applications,” says Nicolas De Keijser, new applications business line manager at ABB Robotics. “The assembly line produces 9,000 irons daily and changes up to five times a day. That kind of changeover would be unthinkable without robots.”

Next-Generation Robots

According to De Keijser and other industry experts, today's next-generation collaborative robots are ideal candidates for appliance assembly applications.

"Space constraints and design complexities have hindered the adoption of robots in the past," notes Scott Mabie, general manager of the American region at Universal Robots. "That's something that collaborative robots are now changing.

"The robots can work without safety guarding," claims Mabie. "That is a significant space saver in many environments where space is scarce and does not allow for huge, safety enclosures to be erected in an ever-changing production layout.

"Our robots are now in operation with several global appliance manufacturers," adds Mabie. "One example is a BSH Hausgerate GmbH plant in Spain, where UR10 robots apply the silicone liners inside refrigerator doors. We expect to see an increasing number of small appliances being assembled

with our new UR3 robotic arm, which is an optimal choice for workbench assembly.

"Gluing and welding have always been tasks that made more sense to automate because consistency and repeatability matter greatly for quality assurance," says Mabie. "Now, applications like screwdriving are becoming increasingly feasible to automate because of the availability of six-axis robots. They offer benefits in terms of ease of use, redeployment, improved force control and cost."

Before robots are widely used on appliance assembly lines, however, engineers need to address several product design challenges.

To reduce raw material and shipping costs, appliance manufacturers are turning to thinner materials. Sheet thicknesses in the 0.024 to 0.04 inch range are not uncommon, and manufacturers are eager to use even thinner sheets of steel. Unfortunately, automation becomes more difficult to implement when that happens, because thin sheet

metal is flexible and can be tricky to work with.

"Large appliances are difficult to assemble with robots, because sheet metal components are usually not rigid until they're mounted in an assembly," says Schunk's Hayes. "Sheet metal can move around. Screw holes typically need to be manipulated by operators.

"Appliances also need to be designed for automation," adds Hayes. "That would make robotic assembly easier to implement."

"A lack of emphasis on design for robotic manufacturing and relatively low-production volumes make the appliance industry unique," adds Simplimatic Automation's Maddox. "Appliance manufacturers are attempting to automate production processes of older part designs that were not originally designed for robotic assembly. As a result, easily automated processes become difficult, due to robotic manufacturing being an afterthought." **A**

Weber Advanced DC Control

WEBER

Features:

- 7" Full color Touch-Screen display
- 31 Programs (Selected from pre-set strategies)
- 13 strategies for handheld and fixtured applications.
- Optional Emergency Stop
- Optional redundant transducer (VDA 2862, Class A)
- Available in ESD safe version.
- Full history log for system changes
- Simulation of inputs and outputs for diagnostics
- On board graph viewing along with USB export features
- Interchangeable communication cards including
 - Profibus
 - Profinet
 - DeviceNet
 - Ethernet (IP)
 - Other (Contact us for other protocols)

C30S Touch



Weber Screwdriving Systems Inc. | www.weberusa.com

Industry Leading Technology