

Amazon Robotics

A case study of how smart machines transformed an Internet store

BY BRENDA WALKER

Back in the early years of the Internet, it seemed like financial experts chattered on interminably about Amazon's business strategy, and particularly when or if the company would ever make a profit. But more recently, the founder and CEO Jeff Bezos was ranked in July 2016 by *Forbes* as the third-richest person in the world, worth \$65.3 billion. So his plan of playing the long game of building the company infrastructure has paid off very well for him.

A big part of Amazon's ability to go big in volume and increased delivery speed has been its implementation of warehouse automation, starting when it purchased the Kiva robot company in 2012 for \$775 million. Before that, workers pushed carts around the warehouse, walking miles daily as they picked out items for orders. In fact, a 2011 article in the *Morning Call* of Lehigh, Pennsylvania, recounted employee problems with heat exhaustion as temperatures soared to 100 degrees and above in the summer. One worker in that warehouse reported walking 13 to 15 miles daily, which isn't surprising given the size of buildings needed to hold the massive inventory. Another "fulfillment center" (as Amazon calls its warehouse-distribution hubs) in Robbinsville, New Jersey, covers 1.2 million square feet, or around 27 acres.

But all that unpleasantness is fading into the past now that Kiva has entered the scene. The Kiva's little robots that look like squat orange ottomans on wheels are hooked up to a main computer system that tracks and moves everything in the warehouse. The robots scoot under mobile racks of stored merchandise and transport needed items to stations run by humans who package up the purchases for shipment to customers.

The robots greatly increase the company's ability to sell and ship massive amounts of stuff. For example, during the special sale on its July 12, 2016, Amazon Prime Day, the company sold more than 600 items per second, including 90,000 TVs and two million toys.

The robots also increase the company's bottom line by reducing costs. Senior Vice President Dave Clark estimated last year that the Kiva robot system reduced operating expenses by about 20 percent, so there's serious savings happening from the robots. A report from early 2016 says that the company has 30,000 robots in 13 distribution centers in the U.S.

CEO Bezos seems to be a dedicated tech nerd, as suggested by his December 2013 appearance on CBS's *Sixty Minutes* show, which did a glowing gee-whiz segment on the company. VP Dave Clark showed off the sorting and storage techniques in the Raleigh distribution center, which interestingly did not yet have Kivas and still used humans to collect customer selections using carts:

REPORTER CHARLIE ROSE: Once your order is placed, a so-called "pick ambassador" walks the aisles, plucking and scanning your items before placing them in bins. Those bins eventually wind up in front of a packer, who knows exactly how big of a box to use based on the weight and amount of items, your address is slapped onto the box and then a picture is taken of your address label, gadgets known as "shoes" sort and divert the boxes to the appropriate spiral chute, based on the postal code. This accelerates the delivery process. The boxes are then loaded onto awaiting trucks, which are assigned to particular regions — Raleigh, North Carolina, in this case. Amazon uses more trucks than planes because so many distribution centers have been built near customers.

After enthusing about the advances of technology in Amazon's warehouse system, Bezos pulled out

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a surprise for viewers — a drone delivery vehicle. With such machines, he said the company could do “half hour delivery, and we can carry objects, we think, up to five pounds, which covers 86 percent of the items that we deliver... These generations of vehicles, it could be a 10-mile radius from a fulfillment center. So, in urban areas, you could actually cover very significant portions of the population.”

A sky full of buzzing delivery drones may not be the future Americans envision for their cities, but billionaire Bezos would like to build it. He remarked in 2015 that delivery drones will someday be “as common as seeing a mail truck.”



Amazon warehouse Kiva robots fetch merchandise to deliver to employees who pack customers' orders. According to the *Robot Report*, “Over 15,000 bright orange Kiva robots are operating across the U.S.”

One little-discussed aspect of drones is the safety hazard of robotic flying machines running into people, events which are not that uncommon. Bard College runs the Center for the Study of the Drone, with an accompanying website (dronecenter.bard.edu) that posts tech, regulatory, and safety news. A few personal injury lawyers now advertise expertise in harmful drone-to-human encounters. The March 2015 issue of *Scientific American* had a list of injuries in a piece titled “5 Epic Drone Flying Failures.” A Google search for Drone Accident brings an assortment of unpleasant horror stories. Spinning blades and the human body are not a good fit.

Jeff Bezos also envisions an even more automated, less human warehouse environment. One side project is the Amazon Picking Challenge, which has twice invited robot inventors to participate in a contest to replicate the killer app of human intelligence plus hand dexterity. In 2015 the first such event welcomed 28 teams of robotic specialists with their machines to compete in recognizing specific objects and packing them efficiently into

boxes — that’s the “picking” part. It’s a big challenge for a robot, but success will be sweet for the eventual winner, remembering that Amazon purchased the Kiva system for \$775 million.

On the down side, when a robot can pick and pack just as well as a human, quite a number of workers will lose their jobs. Some Amazon centers have increased hiring this year because of good sales, but the long-term prospects are dreary for human workers in that company. Why don’t brilliant captains of industry like Bezos recognize that a healthy economy requires shoppers with money in their pockets? — aka workers, for the most part. Most of us aren’t heiresses like Paris Hilton.

The Picking Challenge has added to the general interest and activity now in robotics to perform similar tasks. However, another factor has inspired more research, namely Bezos’ tactic of holding on tight to his Kiva acquisition — now officially known as Amazon Robotics. Normally the purchaser of a unique company like Kiva would take over its existing accounts and continue to market the service to others. But Bezos chose to end the exterior business and move to keep the technology entirely within the Amazon house. The result of that strategy has been a prod for other engineers to invent different machines to do similar functions without violating the existing Kiva patents, a process that has taken a while but is beginning to show results.

The Hitachi company in Japan has produced a robot that can move around the floor, grasp an object on a shelf, and place it in a box for shipment. There are also start-ups in Silicon Valley and beyond looking to fill the warehouse-distribution niche left open by the exit of Kiva. One Valley hopeful is Fetch Robotics, which is working on a mobile picking bot that can place items in a separate freight robot that then moves to a packing station. Grey-Orange, a new India company based in Singapore, has constructed an apparent Kiva knock-off that is more square in appearance but performs the same functions.

For another warehouse chore, Wal-Mart announced in June 2016 that it was six to nine months from using drones to do inventory, cutting the time of that task from one month to one day. So interior robots aren’t even limited to the floor.

The upshot is that more diverse robots will be performing jobs formerly done by human workers in the warehouse and distribution environment. Most other industries have some form of automation, computerization, robots, or other modern mechanization that will lessen the need for workers over time. Amazon is a leader in the field, which develops technical strategies that signal trends that other companies watch and possibly follow. ■