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IN AMAZON'S FLAGSHIP FULFILLMENT CENTER, THE MACHINES RUN THE SHOW

At BFI4 outside Seattle, the retailer uses algorithms and robots to ship more than a million packages a day – vastly changing the jobs of humans in the process.

By Matt Day
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One recent morning, inside a cavernous Amazon.com Inc. fulfillment center outside Seattle, Evan Shobe positioned himself before a bank of nine computer screens. Known internally as the quarterback desk, or QB, the command center lets Shobe monitor the intricate workings of a building the size of about 15 footballs fields. Thousands of blue dots show robots ferrying products around the facility; yellow figures that look a little like restroom signs represent the humans who load and unload the robots. A maze of green lines shows conveyors speeding orders to stations down the line and, ultimately, to waiting delivery trucks. The system is running smoothly on this early August morning, as it mostly does seven days a week at more than 900 Amazon logistics facilities across the US

BFI4, located in exurban Kent, Wash., is Amazon's flagship fulfillment center and regularly hosts senior company leaders – Chief Executive Officer Andy Jassy dropped by recently – who want a better understanding of what happens after a shopper clicks "Buy Now." It was the first facility of its kind capable of processing more than 1 million items a day, three times what was possible at the company's state-of-the-art warehouses a decade ago. Improving technology means Amazon can stay several steps ahead of brick-and-mortar rivals Walmart Inc. and Target Corp., which are now adopting many of the practices Amazon has worked on for years.

More than the physical robots, the stars of Amazon's facilities are the algorithms – sets of computer instructions designed to solve specific problems. Software determines how many items a facility can handle, where each product is supposed to go, how many people are required for the night shift during the holiday rush, and which truck is best positioned to get a stick of deodorant to a customer on time. "We rely on the software to help us make the right decisions," says Shobe, BFI4's general manager.

Automation has made it possible for each fulfillment-center supervisor to manage dozens of employees, a factorylike operation becoming standard in the industry. In 2012 a logistics warehouse manager supervised about 10 workers, according to the US Bureau of Labor Statistics. In 2020, after Amazon had become the industry's biggest employer, there were almost twice as many frontline workers for every supervisor.

The company's competitors strive to imitate its operations, but its approach to automation is also a focus of its critics, who bemoan the working conditions for hourly employees. Amazon's algorithms tell workers what to do on the warehouse floor, set productivity targets, and flag employees who fail to meet them. In interviews workers describe feeling like cogs in a giant machine that can spit them out with little more than an automated termination email.

Amazon acknowledges its algorithms aren't perfect. It says most processes in its facilities allow for human oversight or intervention. Managers say they can accomplish more with the

powerful software behind them, and the company continues work on its operations. Maju Kuruvilla, a former Amazon engineering executive who left the company last year, says Amazon noticed several years ago that bosses sometimes became little more than "faces behind laptops," speed-walking through the facility on their way somewhere else. "Fulfillment-center managers were not engaging with associates," says Kuruvilla, who worked on automation tools designed partly to help foster human interaction. "If that doesn't happen, it can be a downward spiral for Amazon. This is when unions come in, when you're not taking care of people."

Jeff Bezos has sought to supplant humans with software ever since he was a mere bookseller. In one famous episode, editors working on book reviews and recommendations were replaced by code that did the same work by mining shopping patterns. Similar programs would come to manage many aspects of Amazon's operations, from ordering and placing inventory to keeping tabs on the online marketplace, a long-term bet that algorithms could perform some tasks better or more consistently than human employees.

In the mid-aughts, Amazon made automation a focus of the massive expansion of its packing, shipping, and delivery division. Even small improvements were celebrated; résumés of Amazon logistics veterans are sprinkled with references to how they knocked a penny or two off the cost of shipping an item.

In 2012 the company bought Kiva Systems, a maker of squat, automated robots based in North Reading, Mass. Up to that point, workers had walked the warehouse aisles, retrieving products from tall shelves, sometimes even using printouts to find certain products. Amazon wanted to use Kiva units to bring shelves of products to waiting employees, a plan that would require a complete redesign of its fulfillment centers.

BFI4, which opened in 2016, was one of the first facilities to be purpose-built for the little bots. It works like a giant assembly line, its 3,500 workers and 110 salaried managers laboring under the watchful eye of Amazon's precise productivity-tracking system. Workers wheel mobile conveyor belts to the back of trucks delivering inventory and, by pallet or box, feed products into a system that automatically scans incoming items, lists them for sale on Amazon.com, and triggers payment to suppliers. From there, workers stow items on shelves, standing alongside chain-link fences that separate them from the robots. The shelf is packed tightly inside the robots-only zone until, after an order is placed, a Kiva drives the rack to a picking station where workers pluck the right product, place it in a bin, and send it down the line for packing and shipment.

When managers wanted to figure out how many people they needed at each station to keep up with customer orders, they once used Excel and their gut. Then, starting in about 2014, the company flew spreadsheet jockeys from warehouses around the country to Seattle and put them in a conference room with software engineers, who distilled their work and automated it. The resulting AutoFlow program was clunky at first, spitting out recommendations to put half an employee at one station and half an employee at another, recalls David Glick, a former Amazon logistics executive who supervised initial development of the software. Eventually the system learned that humans can't be split in half.

In the spring of 2019, Amazon executives instructed the humans who ran BFI4 to rely on AutoFlow's recommendations, which refresh every 15 minutes. Managers could override the system if they saw something go wrong, but for the most part they were told to sit on their hands. "The message early on was to let the train run into the wall and let them learn from it," says Shobe, who then ran the warehouse's shipping department. "My team would operate better than the software. That was a really hard pill to swallow."

At first the software overreacted to modest shifts in demand, sending workers scurrying to new stations, only to order them back to their previous position after a couple of hours, a time-consuming and wasteful shuffle. But as promised, it got better over time. Instead of having someone based at each warehouse to troubleshoot, the company now handles that task from an office in Tempe, Ariz., where employees can monitor a handful of warehouses simultaneously.

Engineers have found other ways to make BFI4 faster and more accurate. Workers who stow products on shelves once physically scanned barcodes to figure out where an item should go. Now video cameras automatically identify what workers take from the bins as projected green beams illuminate cubbies where the products might fit.

The pandemic presented a major challenge for Amazon, when Americans hunkered down at home and began shopping almost exclusively online. The company added 400,000 workers, a feat made possible by computers that scanned résumés for disqualifying factors, video apps that helped train recruits, and software that guided newbies through simple, repetitive tasks. Engineers had essentially created a plug-and-play workforce that can be adjusted almost instantly when circumstances change.

But Amazon's high-tech assembly line made life a grind for some employees. When workers at an Alabama warehouse tried unsuccessfully to form a union last year, they said they were being held to unreasonable productivity goals – metrics imposed by managers but also recommended by algorithms. One longtime Chicago-area worker, who asked for anonymity because he's not authorized to speak to the media, says typical guidance from his supervisor boils down to "get your rate, get your rate, get your rate." A swing of a second or two in the average time to complete a task can make the difference between getting kudos from a manager or a warning about job performance.

This month, California's legislature passed a bill that will give warehouse workers the power to fight so-called speed quotas. Proponents of the legislation, which the governor hasn't yet signed, say the pace of work pushes employees to skirt safety rules and skip rest breaks. One employee, who joined a Nevada warehouse during Amazon's pandemic hiring surge, recalls seeing colleagues piling so many items on shelves that they were in danger of collapsing. "You have to do unsafe things to make your numbers," says the worker, who asked for anonymity because she's not authorized to speak to the media. "It just feels like constant pressure." Regulators in Washington state fined Amazon earlier this year for its conduct at a warehouse in the city of DuPont, saying there was a direct connection between the fast pace of work and injuries at the facility. Amazon, which is appealing the fine, says it is modifying its productivity-tracking tools to better identify problems employees face.

Many workers, who spend their day taking orders from computer terminals or a smartphone app, say the environment leaves them feeling isolated from colleagues. In interviews frontline workers say they often struggle to name their facility's manager and describe it being tough to build relationships with colleagues, a dynamic made worse by the pandemic's masking and social-distancing mandates. Such criticisms frustrate Shobe, a people person who advises new hires to go out of their way and learn the names of everyone in their unit.

Alicia Boler Davis, a former General Motors Co. executive who runs Amazon's fleet of fulfillment centers, believes more automation will free up managers like Shobe to engage more with workers. "I'd love for them to spend the majority of their time on the safety and people side of the business," she says. "My mental model is, you know, where can we reduce the burden? To simplify things and make decision-making easier, but also to reduce the physical burden and have our people working on different things."

People who helped Amazon build its operation bristle at its reputation as a brutal workplace. "It's not that they're inhuman and want people to be treated poorly – never in a million years," says a former Amazonian, who worked on warehouse technology and requested anonymity because she's still in the industry. "It's just when you're so narrowly focused on solving a mathematical problem, you forget that human element and you need to be reminded."

Like their employees, Amazon managers can find themselves at the mercy of a system built to run fast and lean. One warehouse shift supervisor in Oregon says he wanted to get to know the hundreds of people who report to him, but time pressures kept him scrambling all day instead of talking with employees about career goals. Breaks, he says, "were never an option. It was almost like using the bathroom to Jeopardy music." The manager, who left the company last year and asked for anonymity because he signed confidentiality agreements, says he occasionally took naps in his car after 12-hour shifts so he could feel fresh enough for the drive home.

Amazon says such experiences aren't typical. In July it announced it was making employee welfare one of its guiding principles, pledging to become Earth's best and safest employer. The company recently said it would spend $1.2 billion on job training and coursework for its frontline workers, including paying the full cost of college tuition for some.

Shobe believes his employer could do a better job of educating entry-level employees about opportunities for advancement at the company. "Not everybody is a career fulfillment-center person," he says. "We need to be much more thoughtful on how we're showing people, 'Hey, here's this new piece of equipment that we can teach you about if you're interested.'"

Amazon's assembly-line-like practices are already becoming commonplace in the rest of the logistics industry, which is racing to retool operations previously geared to sending pallets to retail stores. "Amazon's the platinum standard," says Glick, the former Amazon logistics executive, who's now chief technology officer for Flexe, a warehousing startup. "And then there's the silver standard. They're so far ahead there is no gold standard."

Walmart is tacking highly automated warehouses onto existing stores. Kroger Co. is piloting robotic depots for grocery delivery. And Instacart Inc., which built its grocery delivery business with an army of gig shoppers, is building its own robotic warehouses. Even smaller operations like Cargo Cove, a 4-year-old warehousing startup with 80 employees, thinks it can replicate Amazon's automated efficiency. The company is planning in the coming months to introduce robots and software that automatically routes orders and monitors employee productivity. "It's the same kind of concept that Amazon has," says Robert McFaul, Cargo Cove's founder. "The only way to do that is to have standard processes that are very simple."

Back at the BFI4 warehouse, Shobe is speed-walking down a corridor to supervise workers freeing a yellow product tote that's gotten stuck on a conveyor. He taps a few keys on an app to note when the jam is cleared properly – part of a regular safety audit designed to decrease the number of injuries at the warehouses.

Amazon's technology teams have a long-term goal of building a fully automated fulfillment center that would make such human intervention less necessary. The aspiration is years away – held back mostly by the challenge of getting robotic arms to grasp objects of different sizes and textures – and executives say humans will remain necessary for the

foreseeable future. In the meantime, the company’s engineers are focused on moving ever more products through each warehouse. That’s good news for customers expecting faster and faster delivery. The test for Amazon will be finding a way to make its workers think it’s good news, too.