

**CASE STUDY: *Welcome to the Automated Warehouse of the Future***

**They call it “the hive,” or “the grid.” Or sometimes just: “the machine.” It’s a huge structure that fills a warehouse on the outskirts of Andover, a small and quiet town in southeast England. It’s impossible to take in at a single glance but standing on a maintenance walkway near the building’s rafters, you look over what seems to be a huge chessboard, populated entirely by robots. There are more than a thousand of them, each the size and shape of a washing machine, and they wheel about, night and day, moving groceries. Their job is to be cheaper and more efficient than humans, and they are very good at it.**

The hive-grid-machine is the creation of Ocado, a British online-only supermarket that’s made a name for itself in recent years designing highly automated warehouses and selling the tech to other grocery chains. When fully up and running, Ocado’s Andover operation will be its most advanced yet, processing 3.5 million items or around 65,000 orders every week. It’s also a perfect example of the wave of automation slowly hitting countries around the world. The tasks being undertaken by Ocado’s bots are so basic they’re best described by simple verbs — “lifting,” “moving,” “sorting” — and that means they exist in various forms in a range of industries. And when the price is right, someone will want a machine to do those jobs, too.

Although robots are the main attraction at Andover, there are still plenty of humans knocking about. One of those is Ocado’s chief technology officer, Paul Clarke, who joined the company more than a decade ago and has been tasked with developing its automated operations.

He explains that Ocado’s goal is to “disrupt itself;” to continually upgrade its technology so it can’t be overtaken by competitors. In the company’s older, now-outdated warehouses (which Clarke claims are still some of the most advanced in the world) groceries are processed in a roughly linear fashion. Deliveries are unpacked into crates; crates are placed onto conveyors; and conveyors carry the crates to shelves, where human “pickers” take what they need to fill customers’ orders. The new paradigm, though, is all about using space as efficiently as possible. Items are still placed in crates, but those crates are now stored in huge stacks, up to 17 boxes high. Their position in this stack seems to be at random — a box of razors next to cod fillets, for example — but it’s algorithmically decided; with frequently accessed items placed on the top and rarer purchases near the bottom. On top of this hoard, the robots do their work.

Each of the bots has a central cavity and a set of claws it uses to grab crates and pull them up into its interior, like an alien abduction in a supermarket aisle. It can then move the crate to a new location or drop it down a vertical chute to a picking station. At these stations, human employees grab the items they need from the crate (a screen in front of them tells them what to take) and places them in a shopping bag in another crate. Both these crates are then sent back into the grid, to be refilled with shopping items or moved on to the delivery bay. Imagine a huge machine, with groceries going in one end and shopping orders coming out the other. Humans do the unpacking and packing, while in the middle, robots sort and rearrange this vast inventory 24 hours a day. Deliveries arrive at the warehouse in bulk. They’re unpacked by human employees. And then stored and distributed by robots. “pickers” sort them into shopping orders. Which are bagged and sent out to customers.

Individually, the bots aren’t intelligent; they don’t make decisions for themselves. But their actions are all coordinated by a central computer. Clarke explains that this system means the robots can be used as efficiently as possible. For example, by teaming up to quickly dig down through the stack and retrieve uncommon items. “If you want to pick a typical, 50- item Ocado order, they will help each other,” he says. A group of robots can come together in a huddle, split up, “and pick that order in a matter of minutes.” In a traditional warehouse where items are scattered around on distant shelves, this process can take hours.

As well as the boost to speed, the hive-grid-machine has the advantages of being scalable and modular. If customers want to increase the size of their operation, they just add more crates and robots. And if any individual robot breaks down, it doesn’t matter, because any of the other bots can do its job; they’re all interchangeable. This means Ocado has just one robot to “design, evolve, manufacture, and support,” adds Clarke. “And that leads to economies of scale, because we’ve reduced all that mechanistic diversity down to one common component.”

This sales pitch obviously has something to it, as over the last year, Ocado has made deals with supermarket chains in France, Canada, and Sweden to upgrade their warehouses. Such deals should make it easier for these firms to offer online grocery shopping (the UK is a relatively early adopter of this trend) and will help stave off fears of technologically savvy rivals muscling in on their territory. See, for example, Amazon buying Whole Foods. But while the focus here is on technological advances, on more and more automation, we shouldn’t forget that in the middle of these machines — metaphorically and literally, in the case of the Andover warehouse — there are humans.

You may have seen some pretty impressive headlines about artificial intelligence trouncing humans at this or that task, but it’s worth remembering that nothing stumps a robot quite like a bag of oranges. They just can’t deal with it. The bag moves in too many weird ways, there are no obvious bits to grab hold of, and if you squeeze too hard you end up with orange juice instead. That’s why Ocado still employs plenty of humans.

They work in a number of key positions in the warehouse which are also, if you know what to look for, technological bottlenecks. Robots can’t yet unpack the wide variety of bulk deliveries that arrive in Andover every day; nor can they speedily move pallets around a busy warehouse on forklifts. And although they can’t yet handle bags of oranges (or any other delicate, or irregularly shaped items), Ocado is working on a solution.

Placed — somewhat insensitively some might say — next to the picking stations crewed by humans, is an experimental booth where a robot arm is learning to do what comes naturally to its fleshy colleagues. Namely, picking items out of crates and putting them in shopping bags. The arm is equipped with a suction cup, which is great for grabbing hold of objects with stiff, flat surfaces, like cans and cartons, but still can’t deal with more delicate items. For that, Ocado is developing a soft robotic hand that uses rubber fingers filled with pressurized air. Watching it grasp a lime is an unsettling experience, with its synthetic fingers curling around the fruit like pythons.

Neither the suction cup nor the rubber hand is ready for prime time just yet, but Ocado says robots like this should be integrated into its warehouses in the coming years. And it isn’t the only company working on the problem. Amazon organizes an annual “picking challenge” where teams vie to create the fastest robot pickers. (They’re competing for prize money and prestige, but some are also hoping Amazon will pick them as an acquisition.) Well-funded startups are also building their own solutions. One named Embodied Intelligence uses AI to create robots that learn by watching humans. Another, Kindred, uses traditional robot arms, but has human engineers that can operate them remotely using virtual reality when they get stuck. "“these solutions will be picked up and transferred to other industries.”

" It may seem like a lot of effort to solve a relatively trivial task, but the better robots get at mimicking humans’ capacity to manipulate delicate objects, the more use they are to pretty much any other manufacturing process you can think of. A recent study found the field of logistics has been an early adopter of robots and AI, mainly because the tasks involved are relatively routine and therefore easy to automate. But experts say the technology being incubated here will be adopted by other sectors.

“[Picking] is an issue that people are trying to solve for lots and lots of different use cases,” Euan Cameron, an analyst at PWC, tells The Verge. “And these solutions will be picked up and transferred to other industries.”

Estimates for how many jobs might be lost to robots and AI vary, but a recent study by the OECD suggested that around 14 percent of occupations in developed countries (like the US, Canada, and Japan) are at high risk. And a big chunk of these are in logistics and related fields like warehousing, distribution, and fulfillment. A report by PWC found that in the UK alone, just under 1 million logistics workers are at risk of having their jobs automated in the next 15 years.

When I ask Clarke if the end-goal for the company’s factories is to have no human workers at all, he offers a balanced answer: “In theory. But that’s not something we’re going to get to in the foreseeable future.” He points out that even in industries that have invested heavily in automation, such as car manufacturing, there are still lots of humans involved. “And for us, it’s just the same journey we’ve been on since day one: to look for the next thing to automate, whether that’s putting plastic bags in crates, or moving goods around our sheds. We start with the obvious thing and move on to automate the next thing and the next thing. You never get to the end.”

There are certainly jobs at the Andover warehouse that will be resistant to automation for a while. Fixing the robots that fix robots, for example. Up on the maintenance walkway, I see a huge rescue wagon that’s designed to be driven out onto the grid to grab the smaller robots when they break down. When I ask engineer Dean Tharme how they recover the rescue wagon if it breaks, he just replies: “With difficulty.” "“You start to recognize some of them.”

Tharme, 29, has been working at Andover since January. He used to be an electrician before being hired by Ocado to tend to the warehouse’s robotic flock and is one of a number of engineers whose workbenches line the perimeter of the grid, crammed in alongside scattered kitchen facilities and a control station. (For keeping an eye on the robots, not the humans). Here, Tharme and his co-workers replace broken wheels, re-solder antennas, and generally make sure the robots can keep on trucking. Broken bots file in at one end of the walkway and exit back out onto the grid at the other. It reminds me of watching sheep getting sent back to the pasture after shearing.

Tharme says he takes a lot of pride in his work, and that he prefers it to his old job as an electrician. “Every repair you do has your name on it, so you want to be sure the fixes you make are good,” he says. “Sometimes you repair one, send it out, and it just comes right back again in thirty seconds because you didn’t do it right. It’s a disappointment.” He compares the bots to a “fleet of children,” but says he doesn’t have much of a personal connection with them. “You start to recognize some of them though,” he says. “Specific numbers that have had faults in the past. You know they’re trouble.”

Being a robot repairman is a career with a future though. While estimates about whether or not automation will be a net destroyer of jobs vary, economists agree that technology is likely to polarize the labor market, dividing work into two camps: high-paying and highly skilled jobs at one end, and low-paying, low-skilled jobs on the other. Think of the contrast present in a company like Uber, which employs computer engineers in Silicon Valley on six figure salaries, but also hundreds of thousands of drivers working hours for uncertain rewards. It’s hard not to see a similar dynamic in Ocado’s warehouse, albeit with less extreme separation. The company says it’s never destroyed any jobs; in fact, it claims, it’s just the opposite. Because automation has been part of its business from the start, it’s created more than 14,000 jobs that wouldn’t exist without robots. But that doesn’t mean its future warehouses will employ as many people, or that there isn’t a divide between its employees who bag groceries and those who design the robots. And in the same way that Ocado’s human employees are contributing to the running of a machine much bigger than themselves, the company is just one part in the vast engine of the technological and social change we refer to as “automation.”

When I speak to one of the warehouse workers sitting outside for his lunch break, he tells me he’s not worried about a machine taking his job. He says the work is pretty boring, and at any rate, he’s seen the experimental robot arm in action and thinks it’ll be a few years before it can take over from a human. And after that, I ask: What about when the technology is good enough? “Well,” he says, “I’m training to be an engineer anyway.”

*Source:* <https://www.theverge.com/2018/5/8/17331250/automated-warehouses-jobs-ocado-andover-amazon>

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**ASSIGNMENT: (Worth 60 points)**

1. Watch the video – Inside Ocado’s Automated Warehouse (<https://www.youtube.com/watch?v=_psDSX-7P1s>)
2. How is Ocado’s Automated Warehouse like a human body?
3. How is the automation making Ocado more competitive in the market?
4. What other types of automation could Ocado use in their warehouse?
5. After reading the article, answer the following in complete sentences:
6. The Challenge (s)
7. The Solution(s)
8. The Result(s)