A mobile robot, likely a Locus robot, is shown in a warehouse setting. The robot has a white upper section with a black top and a black lower section. The word 'balloon' is visible on the black top section, and 'LOCUS' is visible on the white section. The robot is positioned on a light-colored floor with yellow safety lines. The background shows a blurred warehouse environment with yellow safety railings and industrial equipment.

ROBOTICS IN THE WAREHOUSE: AUTOMATION IN THE SUPPLY CHAIN.

Robots enhance human capabilities. They can undertake the tasks that humans dislike, are capable of operating 24 hours a day, and will bring both automation and efficiency gains in the warehouse.

Developments in technology have brought rapid advances in warehouse automation. Robots optimise workflows, breaking through process bottlenecks to bring greater order and efficiency to operations.

The global market for pick and pack robotics is expected to be worth \$23 billion by 2023[1], and a

survey of customers by warehouse software specialists, HighJump, showed that 74% of its customers indicated that they were currently investing – or were planning to invest – in automated material handling equipment in the next five years.

It's clear that robot deployments are reaching new levels of sophistication and that they have a vital place to play in the supply chain of the future.

“ The global market for pick and pack robotics is expected to be worth \$23 billion by 2023. ”

THE HISTORY OF ROBOTICS IN THE WAREHOUSE.

Warehouse robots have their roots in manufacturing. Robots were first used in manufacturing in the 1950s and 1960s, initially to assist with moving materials. Car plants, in particular, were known for using programmable industrial robotic arms that carried out the more hazardous tasks, or those that could easily be undertaken in an automated, repetitive manner.

Automated guided vehicles (AGVs) were the first mobile robots in the factory. These followed predetermined routes around a facility, using the magnetic field generated by wires embedded in the floor. They were effectively driverless vehicles that could carry loads around the factory or warehouse. As technology progressed, AGVs were guided by magnetic tape, then optical strips and finally by laser.

Following the laser-guidance AGVs of the 1990s came more automated systems. These Automated Storage and Retrieval Systems (ASRS) began to be more widely deployed in warehouses in the early 2000s and persist to this day. They are computer-controlled systems that can automatically place and retrieve goods. Used in conjunction with high-density storage, they make for an efficient warehouse system and are used for putaway and picking.

The market for warehouse robotics shifted in 2012, when Amazon purchased Kiva Systems. The company produced 'goods to picker' robotic systems. In the Amazon system, the robots transport shelving units around the warehouse, bringing stored items to workers for picking, and then return the shelves to a dynamic location back in the warehouse before autonomously going to find the next unit to bring for picking and packing.

It was quickly apparent that Kiva Systems' entire production capability was being used up by Amazon, as the company massively expanded globally and upgraded its warehouses to run on robotic technology. This allowed other companies to step in and fill the void that Kiva Systems left. It's around then, from 2015 on, then that a number of startups began to develop and supply robotic solutions for warehouses.

Along with Kiva Systems, these companies have driven the technological development of autonomous mobile robots (AMRs). AMRs are modular mobile machines that are capable of autonomous navigation in a dynamic environment. They don't require physical or magnetic guidance, but instead can perceive their surroundings and are self-guided. They use a variety of sensors to do this, including systems that



use visual, audial, thermal and touch-based sensors. AMRs can undertake a variety of tasks. Some carry goods to pickers, while others are autonomous mobile carts that follow pickers around or lead them to the next pick. Although they have obvious value for picking, AMRs can also be used for putaway and sortation.

From 2018, there was some early adoption of AMR technology. Then, more widespread deployment and market acceptance happened in 2019. We're now beginning to see more rapid growth of AMRs in the warehouse.

At about the same time as AMRs began to come to the fore, the supply chain industry saw the evolution of full systems and the integration of a number of technologies that enable today's "smart warehouses". In 2016, Ocado first deployed its Smart Platform in one of its fulfilment centres. The Ocado Smart Platform is an advanced storage and automated picking system that features up to 1,100 robots working on a grid roughly the size of a football pitch. The grid houses 250,000 storage

locations, and the robots pick crates from this grid and take them to stations where they are assembled by packers into the customer orders. Ocado has since struck deals to supply its platform to Morrison's in the UK, and to well-known grocery outlets in France, Canada, Australia and Japan.

In 2017, ecommerce giant Alibaba – China's biggest online commerce company, and the world's largest retailer – unveiled its own smart warehouse, in Huiyang. Receiving instructions via Wi-Fi, and employing laser sensors to avoid collisions, 60 robots collect and move racks of goods, transporting them to human operatives, who then pack and distribute the orders.

Robots have become far more commonplace in the warehouse over the past ten years. They are no longer seen as the cutting-edge or risky choice and instead are viewed much more as a necessity for any forward-looking distributor.



THE BENEFITS OF USING ROBOTS IN THE WAREHOUSE.

WAREHOUSE EFFICIENCY

Efficiency is one of the key drivers of a warehouse operation – and distributors are always looking to do things faster or with less effort. Automated picking systems certainly bring greater efficiency to the warehouse.

Robots help save time by limiting human effort, such as reducing the number of steps that warehouse operatives need to take. Through the elimination of humans walking long distances around warehouses, large labour-saving efficiencies can be made. For Alibaba, for example, robots reduced the labour needs by 70%, resulting in a three-fold increase in output.

And for Ocado, the time savings have increased efficiency. Its platform runs three million routing calculations a second to direct the robots around the grid. They travel at four metres a second and can

pick and pack a full customer order in five minutes, which is many times faster than if done by humans. This proficiency of the robots means that the company's automated fulfilment solution prepares 65,000 orders a week, making it extremely fast and efficient. Ocado states that automation has doubled the productivity of its warehouse operations[2].

An IDC survey[3] showed that robots brought at least an 11-15% improvement in productivity in the warehouse for 88% of respondents. Certainly, robots don't take lunch breaks, chat idly at the water fountain, or become fatigued near the end of a shift. They can work non-stop 24 hours a day, seven days a week. They can move more quickly than people, bringing goods to packing areas faster than humans can.

ACCURACY

Humans are fallible and make more mistakes than robots do. Human errors can result in inaccurate stock counting, or wrongly picked items. This can be costly for businesses. Not only are they likely to need to pay to refund or replace items, but shipping errors also result in a lower level of customer satisfaction.

But with robotic systems, a warehouse can

expect to see fewer errors. There is a better guarantee of a higher level of order fulfilment accuracy and fewer stock issues.

Ocado runs its own order fulfilment service - but also provides the platform as an outsourced service to grocery retailers worldwide. It is confident in its accuracy levels and promises 99% order accuracy and 0.4% waste as a percentage of sales.



COSTS AND RETURN ON INVESTMENT

An automated warehouse uses far fewer staff than a typical warehouse does, so overall labour costs are dramatically cut. A robot “worker” costs far less than a human one. While many fear that robots will replace staff, there is still a need for humans to work in warehouses, and not all jobs can be replaced by robots. With dramatic advancements in technology like this, there is always a resulting shift where some human

jobs are supplanted by technology, but at the same time, other roles – often to programme or manage that technology – will be created.

In terms of return on investment, market intelligence company IDC estimates that there is a 13+ month payback period with robot deployment. After that though, the ROI seen is typically more than 10%.

IMPROVED STAFF SATISFACTION

Through automation of the more mundane, repetitive or manual tasks, robots alleviate the tedious or tiring work in the warehouse. Workers can focus on the more satisfying and rewarding tasks, which maintains staff morale.

Robots can also free up time for humans to concentrate on what they do better than robots.

These might be tasks that require flexibility, or the aptitude to respond to an unexpected situation, or anything requiring the resourcefulness of a human. Robots can largely only do what they are programmed to do. Although machine learning and artificial intelligence are gradually changing this, there will always be roles in the warehouse that require human input.

SAFETY

Robots improve safety in the warehouse. They can take on the more risky or dangerous tasks, like carrying heavy loads, or doing putaway or picking stock from heights. And programming protocols mean that they follow strict guidance, ensuring they do not make the same judgements

that a human might make that could lead to an accident in the workplace. This avoids trips and falls, or injuries from falling stock. Robots sensors eliminate other accidents too: robots don't collide with each other or get in the way of a forklift.

LESS NEED FOR WAREHOUSE SPACE

Many robot solutions can employ dense storage systems, which maximise space utilisation in the warehouse. Storing goods in bins stacked on each other – like the Ocado system – which are accessed from the top by robots eliminates the need for aisles in the warehouse. This means a much larger volume and variety of products can be stored.

Eliminating aisles like this optimises the storage space, meaning both the land and warehouse space required is far smaller – and therefore less costly. Additionally, with a smaller warehouse, operations don't always need to be established in out of town areas. Smaller warehouses can be set up closer to, or even inside, towns and cities, reducing transportation costs.



ROBOT USE CASES.

There are different types of robot available, each of which is suited to different applications in the warehouse.

EACH PICKING

Picking is a task that is commonly undertaken by robots. It is something that can fit in with an existing warehouse without too much alteration to processes or warehouse layout.

A common use is for robots to move around aisles, actively guiding an operative to the next pick location. This optimises the worker's productivity as it eliminates unproductive movement

around the warehouse, perhaps searching for the next location. Robots can find the most optimal routes around the warehouse, directing workers to pick items or orders in the fastest way.

[Locus Robotics](#) is a prominent supplier in this area. Its robots can be deployed in just four weeks and improve picking productivity as much as three-fold.

GOODS TO PERSON

With goods to person picking, a whole shelf or storage bin is brought to the picker. This requires that the entire warehouse is designed to accommodate the method.

It speeds up picking as it eliminates all human movement around the warehouse, speed-

ing up the picking process and making it more productive. It is this method that is used in both the Ocado and Alibaba warehouses.

Robot manufacturer [Geek+](#) states that its goods to person robots can improve warehouse picking efficiency by more than 200%.



MOBILE MANIPULATION

Mobile manipulation robots incorporate a manipulation arm or extendable gripping system with a mobile platform. Typically, such robots select and pick goods out of storage using a gripper system on

the end of a rotatable and retractable arm. After grasping the object, the robot can either store and transport it itself, or pass it on to another robot or to a human worker at a packing station, for example.



One example of such technology is [Magazino](#)'s development of a specialised robot that uses lasers and cameras, plus vacuum suction technology to pick and transport goods – especially shoe boxes. Another company, [Fetch](#) employs two robots in

picking. The first uses its jointed arm and gripper, plus a depth camera for “vision” to select and pick the item from storage. It places the goods into the other robot's crate. Both robots can navigate the warehouse, avoiding obstacles and learning routes.

PUTAWAY / REPLENISHMENT

For putaway and replenishment, robots can manage the labour-intensive returns and restocking processes, often with task interleaving functionality.

Putaway robots are similar to goods to person

picking AMRs, taking goods to workers for restocking storage locations. With task interleaving, they can self-determinedly automate several different warehouse processes, guiding workers to pick or to replenish, according to what is required.

ROBOT ENABLED AS / RS

A robot-enabled automated storage and retrieval system (AS/RS) is the Ocado and Alibaba type of system, whereby robots bring pallets, totes, trays or bins to pickers and then return them to storage afterwards. They automate the stock management

entirely, storing and retrieving goods on demand.

They eliminate human travel time, and move more quickly than humans, dynamically facilitating the picking process.

SORTATION

Where goods have been batch or zone picked, they need to be brought together into their individual customer orders. This task – usually done manually by humans - can be improved and hastened when done by robots. Robots automate the process by scanning and automatically identifying goods, sorting them accordingly and transporting them to the relevant area of the warehouse

floor, or to the correct operative for packing.

Equally, robots can be used to sort for replenishment and returns purposes, can store cross-docking goods, and can sort parcels after they have been packed. With their fully automated process management, Geek+ estimates that its robots are ten times more efficient than manual labour.

“ Geek+ estimates that its robots are ten times more efficient than manual labour. ”

BULK MATERIAL MOVEMENT

Bulk material movement robots are used for moving large items, or bulk quantities of stock around a warehouse.

They are heavyweight robots, similar to the

AGVs of old, but with AMR-type capabilities such as autonomous movement, direction and obstacle avoidance. With strong pulling capabilities, they can also be used to handle large carts or to tow several carts at the same time.



LEGACY EQUIPMENT AUGMENTATION

Where a warehouse has legacy materials handling equipment that it does not want to replace, there are robotic solutions that can augment the existing equipment. This involves extending the equipment's capabilities by using additional tools, such

as sensors, without completely replacing the old equipment.

In this way, robots can help automate material handling equipment like forklifts and pallet trucks.

WHAT IS THE FUTURE OF ROBOTICS IN THE WAREHOUSE?

Much as the COVID-19 pandemic and the resulting lockdown restrictions have interrupted trading for many companies, there has been a surge in the demand for goods purchased via ecommerce. For companies to both increase ecommerce throughput and perhaps to meet staff shortages caused by the virus, robots are a good replacement, even if only used temporarily.

Some companies were already offering AMRs in a 'robots-as-a-service' way, offering robots on a subscription basis. This is a trend that is likely to pick up due to the pandemic. But it is also advantageous for companies anyway, especially where they may want to scale up or down according to seasonal requirements. With the subscription model, the initial investment is lower, maintenance is included, and the service can be bought into on a short-term basis. This relative low cost and flexibility is attractive to many distributors.

Locus provides its robots in this way and asserts that most of its customers see a return within a month. They can generate a two to three times uplift in picking productivity, so reducing the expense of picking by 25-40%. But as they do not have the huge upfront capital costs, returns are very quickly made.

A tough challenge for the future will be to solve the problem that robots are not able to adaptive-

ly handle different items. Picking irregular-shaped goods, or even switching between different types of goods, means that a single robot cannot be used for situations where there is a wide range of goods, in all sorts of shapes and sizes. Humans can recognise and adapt to this, but robots can only respond according to how they are pre-programmed. The challenge here will be to create robotic warehousing systems that can address this picking issue and automate it at scale.

One solution being employed to tackle this problem is to use the product volumetrics. In this way, the weights and dimensions of the goods provide the robotics system with information so it can determine which container or robot should be used. A warehouse management system such as HighJump provides this functionality and can feed the information to the AMR system.

Another future trend is the growth of dark warehouses. These are almost entirely run by robots and automation - and are known as dark warehouses because they can operate without lights. For some industries, it's easy to see that robots and automated equipment could handle every process in the warehouse. So, it's possible to envision a future where a warehouse is entirely "staffed" by robots.

Another future trend is the growth of dark warehouses. These are almost entirely run by robots



and automation - and are known as dark warehouses because they can operate without lights. For some industries, it's easy to see that robots and automated equipment could handle every process in the warehouse. So, it's possible to envision a future where a warehouse is entirely "staffed" by robots.

Certainly, it's entirely plausible that AMRs will be able to employ artificial intelligence and machine learning, giving them an even greater, self-deterministic level of autonomy - like self-driving cars. This will mean that they can learn about their environment, can classify objects and perhaps even identify workers that are available, passing tasks or inventory to them.

The automotive industry's progress in developing driverless vehicles is also driving other, positive changes for warehouse robotics. The cost of AMR components like sensors is coming down, thanks to greater uptake in the vehicle automation industry. Research in this area

- and also for similar components - means manufacturing costs are reducing as production requirements increase and technology improves.

Collaboration between workers and robots like this is certainly in our future. Although some see robots as rivals, they should instead be viewed as allies; there to help us out. Working alongside humans, collaborative robots - known as cobots - can enhance human labour. We already see these developments in the use of AMRs that follow personnel around, or guide them through tasks. With a robots-as-a-service model, using robots like this - or even just trying them out - is likely to demonstrate to many that robots can improve productivity.

Although robots are not yet mainstream in UK warehouses, the landscape is changing. Interact Analysis estimates that the UK warehouse automation market was worth approximately \$1.4 billion" in 2018 - and expects it to be worth \$2.4 billion in 2023[4].

FINAL THOUGHTS.

The global shock of the COVID-19 pandemic had a huge impact on the supply chain industry - in the UK and around the world. The cost gains of sourcing products globally became inconsequential as we saw how vulnerable the country was due to its reliance on global supply chains. With China so severely hit at first, imports drastically decreased and consumers were forced to source more goods domestically. Warehouse automation can come to our aid here, by advancing and future-proofing the warehousing industry, and encouraging distributors to reconsider their just in time strategies.

On top of this, Brexit caused a degree of uncertainty too. Together, these situations have caused a decline in the implementation of robotics. But after this short-term dip, the impacts of Brexit and COVID-19 will decline, and we are already seeing an uptake in interest and the robotics

sector is bouncing back. And robots will become the differentiator for companies in warehousing.

Businesses that seek to remain competitive will look to transform their operations through robotics.

By reducing the time and effort spent on moving goods around the warehouse floor, or retrieving and replenishing products, robots alleviate humans from tasks that are dull, dangerous and draining. Instead, they can concentrate on processes that typically require more dexterity, like packing and shipping, and on the management of the operation as a whole.

Investment in warehouse automation by deploying the right robots can drive productivity improvements, improve order fulfilment accuracy, increase capacity and drive operational efficiency.



[1] IDC Robotics and Drones Spending Guide Forecast 2018H2

[2] Automation and the future of work, House of Commons - Business, Energy and Industrial

Strategy Committee, September 2019, <https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/1093/1093.pdf>

[3] IDC Commercial Service Robotics Survey, August 2019

[4] <https://www.interactanalysis.com/uk-warehouse-automation-mmarket/>

LOCUS ROBOTICS.

As an official reseller for Locus Robotics, Balloon can supply, implement and integrate robots into your warehouse.

You can use “robots-as-a-service” on a subscription basis, or can implement a more permanent solution. LocusBots can help with the picking and transporting of your goods, using virtually any type of tote, box, bin, or container.

So, whether you want to prepare for a seasonal upsurge, or if you need to facilitate improved social distancing in response to COVID-19, we can undertake an analysis of your operation. We will evaluate the suitability of your warehouse, estimate the ROI you can achieve and

will respond with a recommendation and detailed implementation plan within a week.

There is even an all-inclusive programme that comes complete with everything you need to run ten LocusBot robots – including a server, help with strategic management and goals planning, training and set-up. It can be ready to go live in just 45 days and can be implemented without any disruption to your existing operation.

If you are looking for increased efficiency, improved accuracy, better safety and an upturn in your productivity, then get in touch with us today about implementing robots in your warehouse.

Balloon Contact Details:

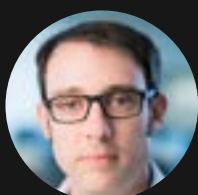
✉: info@balloonone.com

☎: +44 (0) 20 8819 9071

ABOUT THE AUTHORS



Craig Powell



John Burgess

Craig Powell is the Managing Director of Balloon One. With 31 years' experience in the IT industry, leading Hewlett Packard's ERP Services division before starting Balloon One in 2003. Craig is motivated by delivering IT growth platforms that allow MSEs to scale their business and reach their potential.

John Burgess is the Project Delivery Director at Balloon One. With a PhD in Supply Chain Strategy and a career spanning varying consultancy roles, John takes a strategic perspective to deliver tangible across customers' businesses. A strong believer in continuous improvement through the aggregation of marginal gains, John has been working in Supply Chain IT for over 10 years.



2003-2020

Balloon is a niche IT consultancy focused on Supply Chain solutions. With over 70 UK customers, Balloon leverages cutting edge technology in the Warehousing, Transport and Enterprise space; creating end-to-end solutions for their clients. Balloon's ethos of providing SMEs with technology to remain competitive in increasingly demanding markets has earned them international recognition; with customers in 18 countries across 3 continents.

