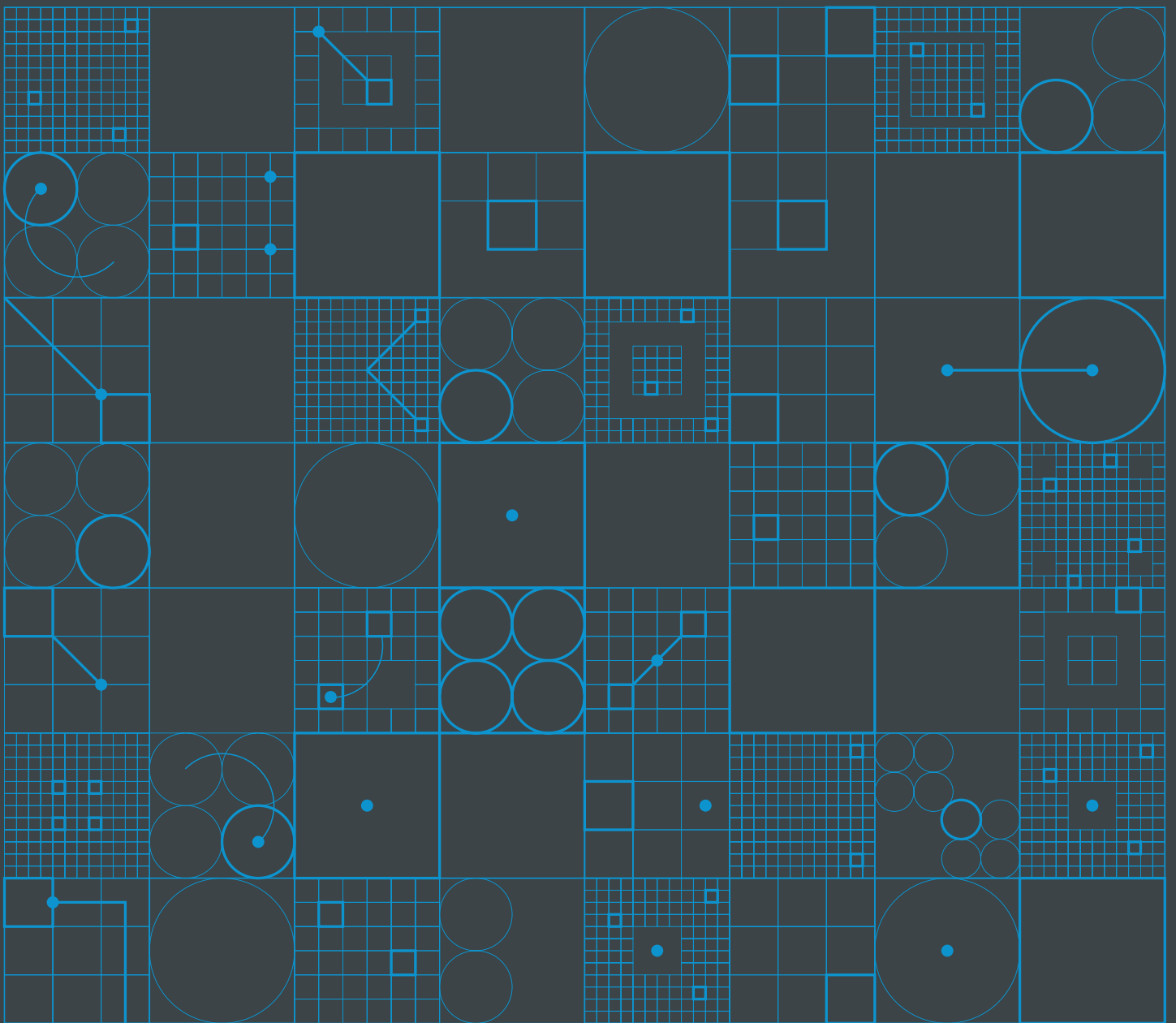


THE GREAT EXPLODING WAREHOUSE - HOW TRUE HUMAN-ROBOT COLLABORATION IS THE ONLY SOLUTION



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AUTOMATION CREATES JOBS

New research shows that the received wisdom that automation destroys manual jobs in warehouses is wrong. In fact, automation represents a virtuous circle of warehouse job creation: more advanced warehouse automation results in quicker and more efficient eCommerce fulfillment, leading to greater demand for online orders and thus greater demand for warehousing. Though automation will displace some manual warehouse jobs, it will, for the foreseeable future, certainly create more manual jobs than it displaces.

INTRODUCTION

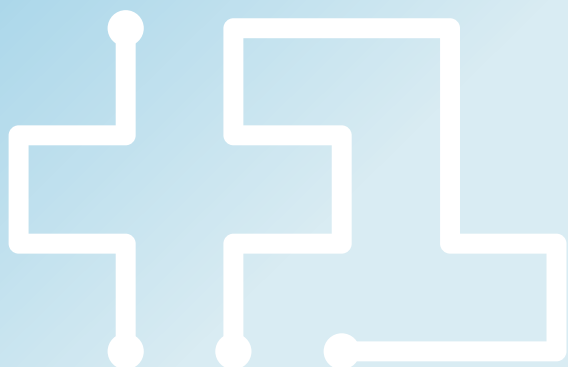
This whitepaper is a joint collaboration between Plus One Robotics – a San Antonio-based specialist in vision software for logistics robots; and global market research firm Interact Analysis – the world’s leading authority on supply chain automation markets and trends.



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Part 1: Understanding the wider transformation in logistics

A note from Ash Sharma, senior research director at market research firm Interact Analysis...

Counterintuitive though it may be, the story of warehouse automation is also a story of sustained jobs growth

Received wisdom has it that warehouse automation will destroy manual jobs in warehouses – bringing down the total number of such jobs over time. Often, we hear of possible dystopian future scenarios where robots destroy manual jobs, and any new jobs created are either for highly trained engineers or white collar managers – arguably jobs that would be out of reach of the manual workers who have just had their jobs automated. The picture that can emerge is that future societies will be highly divided between a well remunerated and well educated managerial class, presiding over teams of robots doing all the manual work, and with the former manual workers themselves pushed out of employment altogether. One of the most positive things we've learnt from this research is that nothing could be further from the truth.

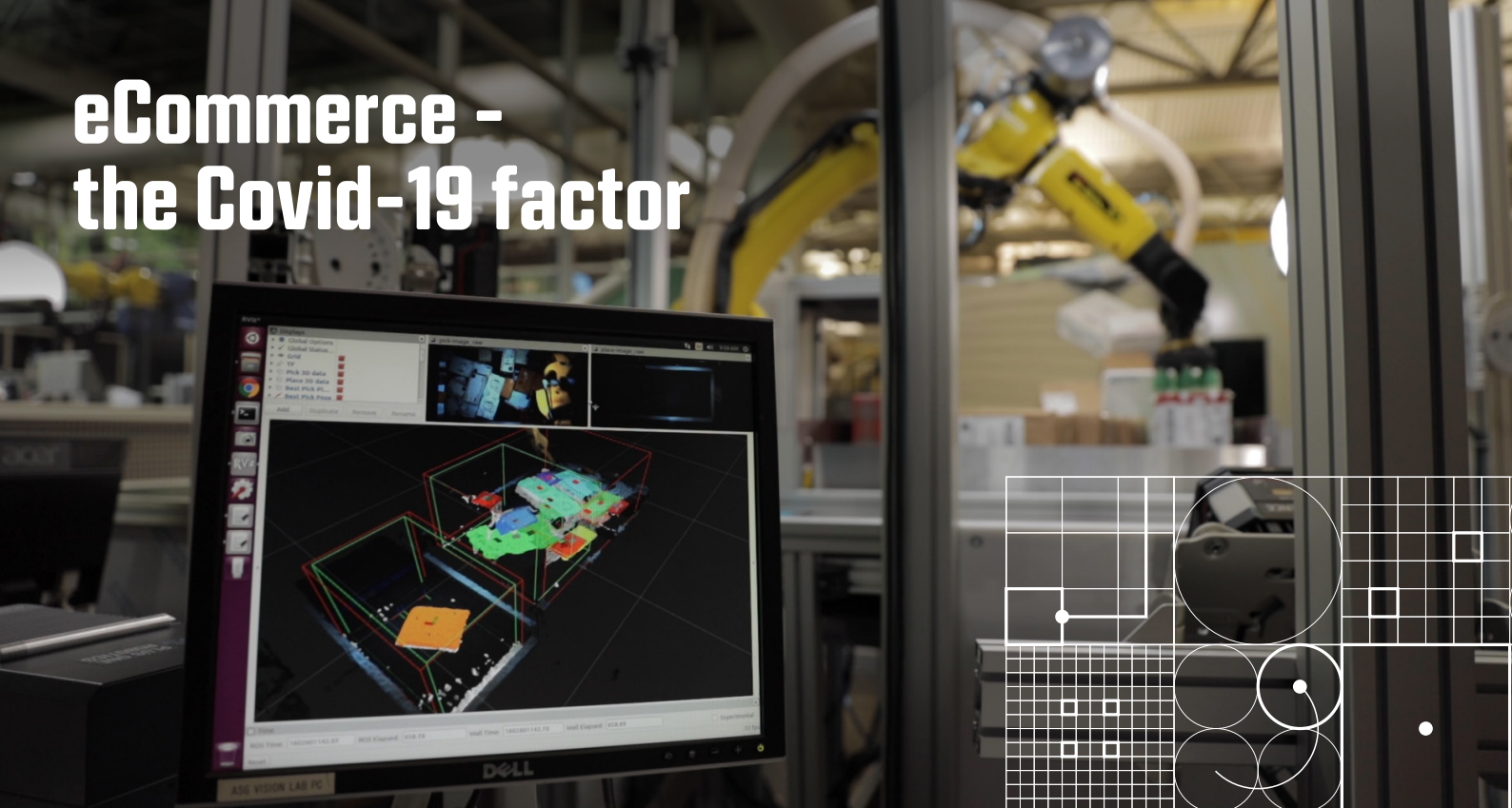
While we'll go into our findings in more depth later in the whitepaper,

the bottom line is that the US and Europe alone are projected to create **one million new manual warehouse jobs** between 2019 and 2024: that represents 25% job growth over five years. And it leads us to a very different conclusion about the impact of warehouse automation on jobs. The International Federation of Robotics has often pointed out that Germany and Japan have some of the highest concentrations of industrial robots per head of manufacturing workers in the developed world. And yet it will come as no surprise to most to learn that Germany and Japan also have amongst the largest numbers of manufacturing jobs in the developed world.

The same logic would appear to hold in warehouse automation. Robots aren't being used to displace manual workers: they are being used to augment their productivity in a desperate struggle amongst warehousing and logistics companies to meet the ever increasing demands from customers – demands that far outweigh anything that could be met with human manpower alone.



eCommerce - the Covid-19 factor



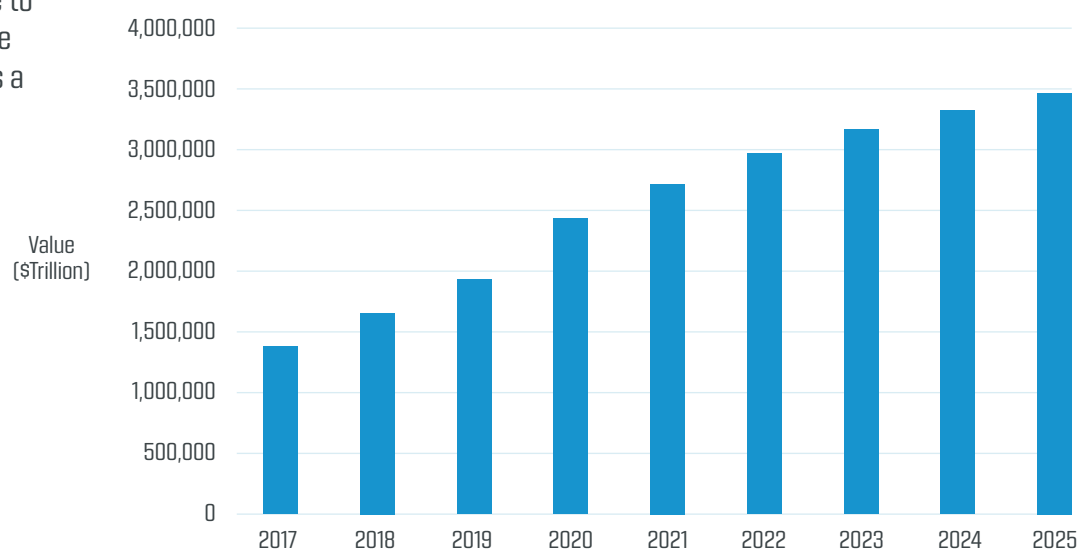
COVID-19 will cause a significant and long-term shift in the direction of eCommerce. Localized lockdowns across the world meant that, for a period of months, eCommerce was the only option for consumers in most of the world's biggest markets, including most states in the USA, almost the entire EU, and Great Britain. As well as many other countries besides. This caused massive short-term growth in eCommerce, but it's the long-term picture that is the most interesting.

There is overwhelming evidence to suggest that many of the people who switched to eCommerce as a

temporary measure during COVID-19 are going to stick with it permanently. One Plus One customer - a major 3PL provider - has reported that COVID-19 has permanently pulled forward three years' worth of eCommerce growth. Of course, we were all engaged with eCommerce to some degree before the crisis, but lockdowns were so extensive that huge numbers of

consumers explored the possibility of buying essentials – from light bulbs to pet food to prescriptions – that they wouldn't previously have considered buying online. And now that they've done it, for many, there will be no going back. Additionally, a whole new demographic – the elderly – has converted to eCommerce from a standing start.

Projection for eCommerce revenues



Source: Statista

The consequences of growth in eCommerce will be highly significant for warehouse operators

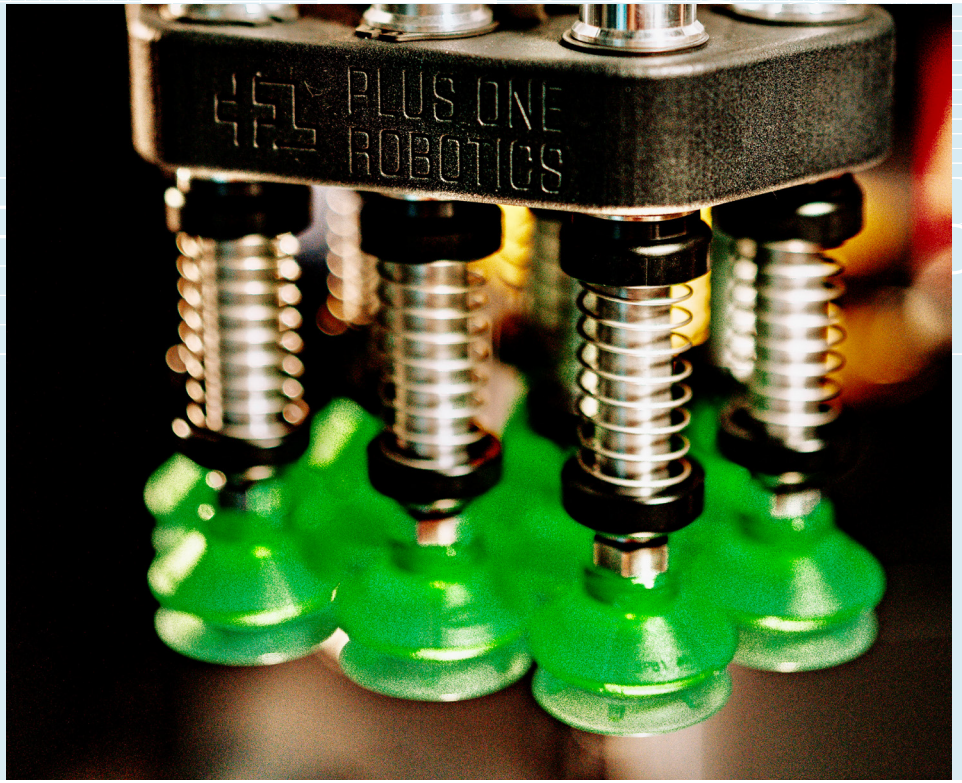
As a result of the significant growth in eCommerce, we've seen demand for warehousing space soar as companies like Amazon look to increase their warehouse footprints in order to process online orders. According to commercial real estate services firm JLL (as reported in this [2020 CNBC story](#)), the US alone will need an additional 1 billion square feet of warehouse space by 2025 as eCommerce booms.

Warehouse automation is going to be the key solution for logistics managers to cope with significant long-term growth in demand. Our research shows that orders of new warehouse automation equipment grew by 8% in 2020 - although local and regional lockdowns have, in some cases, forced project commissioning to be pushed out to 2021. Indeed, despite localized lockdowns, we have seen

many retailers push ahead with remote deployments wherever possible. One such example is US-based MSC Industrial, a leading industrial equipment distributor, who rolled out order-picking warehouse solutions for customers between June and August - at the very peak of the COVID crisis. And, when we look beyond the short-term, the picture for warehouse automation becomes very positive indeed.

For retailers, adapting to this new world is now an imperative, and there is an untold number of challenges for them to face. Our extensive research into the warehouse automation market - which has involved speaking to almost every single significant warehouse automation provider globally - has revealed three fundamental challenges that underpin and drive the need for warehouse automation:

1. Extraordinarily complex networks of distribution channels, often involving multiple warehouses of sizes unheard of just a few years ago
2. Extreme competitive pressures driven by rapidly evolving consumer demands for ever cheaper delivery costs and to ever more exacting time slots
3. And finally, labor - or rather, the lack of it



A note from Erik Nieves, CEO and co-founder of Plus One Robotics...

My colleagues Paul Hvaas, Shaun Edwards and I decided to establish Plus One Robotics precisely because of this third challenge that Interact Analysis has identified: the shortage of available labor for warehouse work. The problem, of course, is not that there are no willing workers out there, but rather that the warehousing industry is simply growing too fast for the labor supply to realistically keep up. Our technology is designed to mitigate this persistent shortage of manual labor (which is particularly pronounced in the main markets for warehouse automation of the USA and Europe), and allow many warehouse personnel to move away from monotonous tasks and into higher value roles. Roles which, because our technology makes

each worker more productive, are also often better paid. Our technology offers a completely new approach to human/robot collaboration through a framework of on-demand supervised autonomy that ensures a human is in the loop when needed to keep systems fast, accurate and scalable.

We've published this whitepaper with Interact Analysis in order to inform our readers about the true picture of the situation in the warehousing industry across both the United States and Europe. The reason for commissioning this work was simple: we couldn't find a dedicated research project on the market that looked at the impact of warehouse automation on warehouse jobs. And we believe that this is crucial information that our customers need in order to make informed decisions about whether and how to automate,

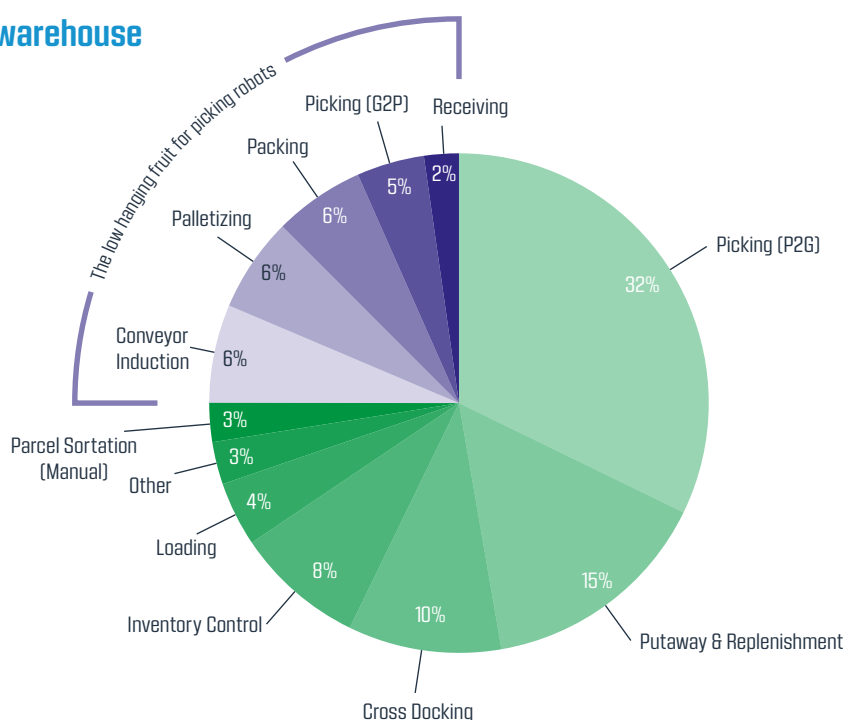
and what technologies to use. Our joint research project has shed particular light on statistics regarding warehouse workers; on the distribution of labor within warehouses; and on the future potential for smart robot arms.

Part 2: Warehouse workers – the vital statistics

The research covers warehouse workers in the United States and Europe where, at the top level, we see impressive growth in manual warehouse jobs in both markets. On most issues, there are few differences between the two markets, with the largest disparity being the overall size of the sectors: in 2019 there were 2.6 m warehouse workers

in Europe and only 1.6 m in the USA. By 2024, these figures will be 3.2 m and 2 m respectively. But, while those market sizes are quite different, in terms of growth, we see a CAGR of 4.3% in both regions – suggesting similar market dynamics are in play. Additionally, when it comes to looking at employee roles by function, we see few notable differences between the two regions.

2019 Europe and US warehouse workers by activity



Source: Interact Analysis
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The combined US and EU market – jobs aren't disappearing, they are changing

In the illustration below, we see that three job roles stand out as showing high growth: picking (G2P)*, packing, and conveyor induction. **Taken as a whole, these three sectors represented 17% of all warehouse roles in 2019 (over 693,000 jobs), but this figure will be 21% by 2024 (over 1,000,000 jobs) – a CAGR of 9.3%.** This is more than twice the CAGR of the total growth in all job roles as a whole – which is only 4.3%.

At the other end of the scale, the three job roles with the lowest growth rates are picking (P2G)**, loading, and parcel sortation (manual). These three taken together represent far more jobs in real terms than those with the highest growth rates: 1.6 m jobs in 2019, rising to 1.8 m jobs in 2024. However, the CAGR of 2.1% is low compared to

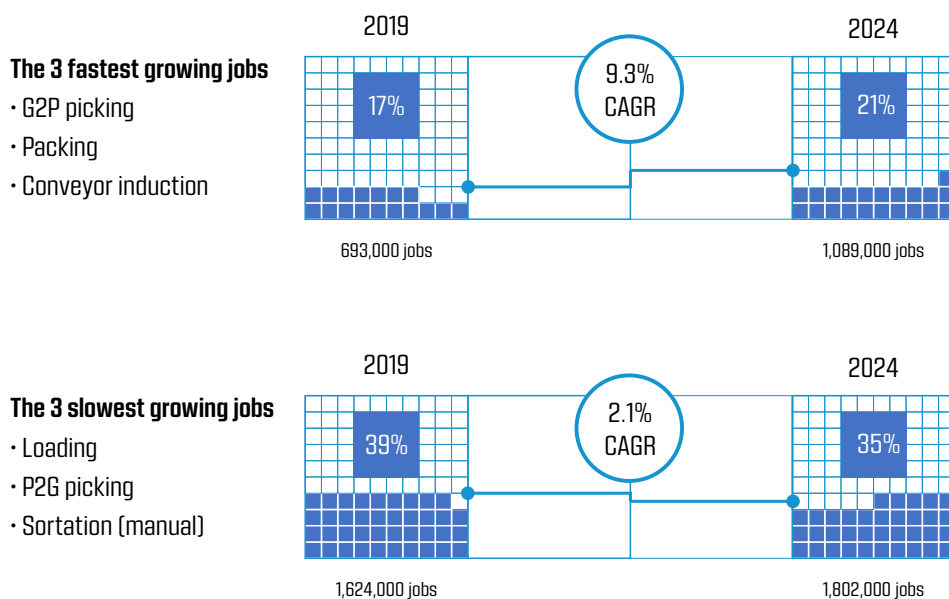
growth in overall warehouse jobs. Of course, this is still growth, and there is no sign even in these slower growing areas that there is set to be any sort of real-terms decline in overall job numbers. Although, interestingly, these three roles combined are actually losing share as a % of overall warehouse jobs: **in 2019, picking (P2G), loading, and parcel sortation (manual) represented 39% of the total, whereas by 2024 this will have fallen to 35%.**

Ultimately, it is this change in the share of the warehouse jobs market that is one of the key findings of this research. **Broadly speaking, we see a shift of workers away from P2G and into both conveyor induction and G2P picking.** In 2019, there were 1.3 m warehouse jobs in the US and Europe but by 2024 this will have grown to 1.5 m – a CAGR of only 2.1%.

In stark contrast, conveyor induction will have grown from 245,000 to 374,000 jobs; and G2P picking will have grown from 183,000 to 323,000 – CAGRs of 8.9% and 12.1% respectively.

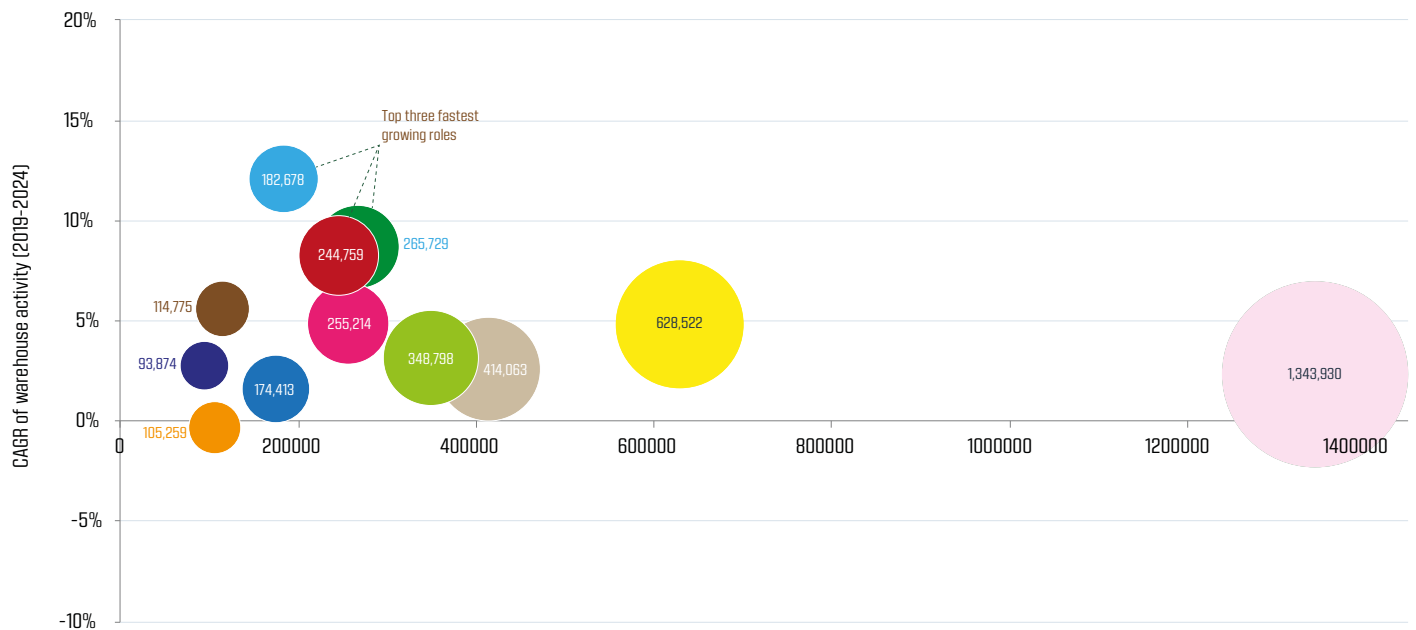


Share of warehouse labor activities in 2019 and 2024

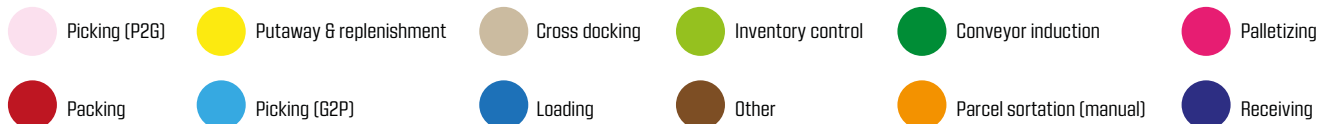


*G2P = goods-to-person **P2G = person-to-goods

2019 US and European warehouse workers by activity and forecasted growth rate (2019-2024)



Number of Equivalent Warehouse Workers



Note: Both the x-axis and the size of the bubbles correspond to the number of employees.
The CAGR corresponds to the expected growth rate in the warehouse activity between 2019 and 2024.

Source: Interact Analysis © 2020 Interact Analysis

There are many reasons why we see these trends. The strong increase in conveyor induction roles is a result of the enthusiastic uptake predicted for conveyor automation systems in warehouses – most of which are still designed with a requirement for manual induction. Growth in packing roles is driven specifically by growth in the eCommerce warehouse sector, and packing roles are much less prevalent in other warehouse market sectors such as food & beverage and manufacturing. Meanwhile, the growth in picking (G2P) roles is happening as

a result of the very strong current and predicted uptake of G2P automation solutions in eCommerce warehouses such as AS/RS. This growth is coming at the expense of growth in picking (P2G) – one of the three slowest growing sectors.

The standout result from the research is that the highest potential for picking robotics solutions in warehouses is in the three fastest growing areas: picking (G2P), packing, and conveyor induction.



How warehouse automation impacts future jobs

As a side exercise, Interact Analysis modelled how the creation of new jobs would be affected if the penetration of warehouse automation did not increase between 2019 and 2024 - i.e. if the share of automated warehouses was to remain constant throughout the forecast period. In the graph below, the blue bar shows the number of warehouse employees that existed in the US and Europe in 2019. The pink bar shows the additional number of warehouse employees that will exist by 2024 as the number of warehouses in the world grows, and assuming that automation trends play out as currently projected.

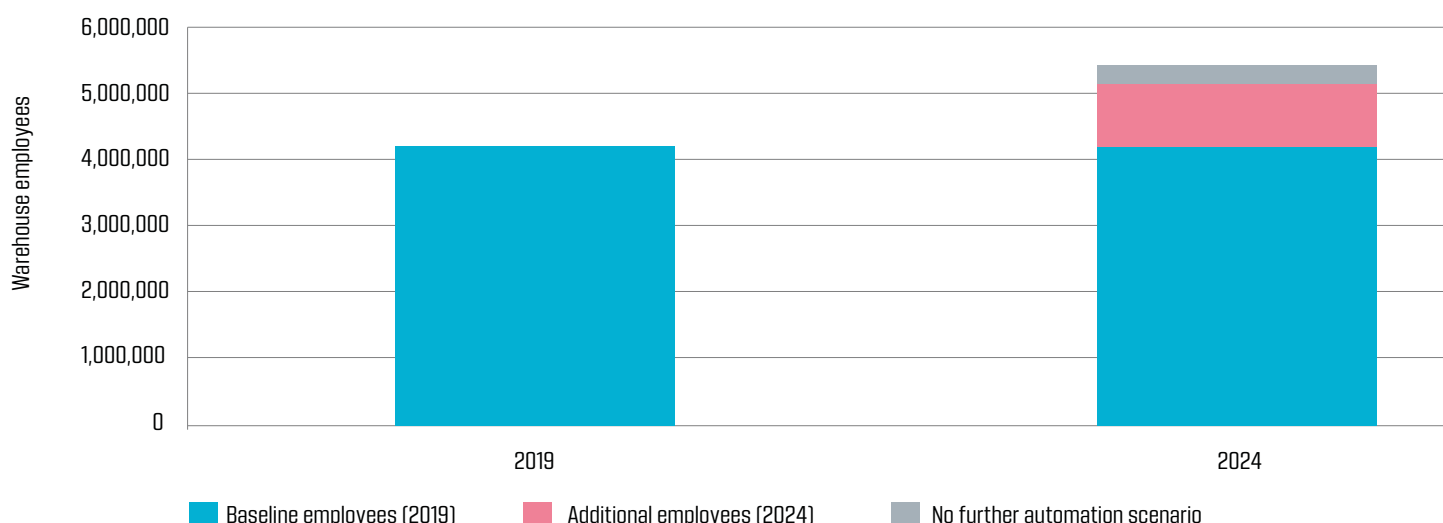
The grey bar shows the additional warehouse employees that would be required to handle the same throughput assuming that the share of automated warehouses doesn't increase throughout the forecast period. Importantly, this scenario assumes the same overall throughput (items leaving warehouses) which, in reality, may actually be less given the virtuous circle we refer to; more automation results in more efficient logistics which drives eCommerce sales which leads to higher overall throughput.

It's interesting to note that a reduction in the share of automated warehouses

in 2024 (relative to our actual projection) has a marginal impact on the number of warehouse employees; just a 5% increase in warehouse employees if the share of automated warehouses stays the same between 2019 and 2024.

Furthermore, the virtuous circle would suggest that a reduction in logistics efficiency (as a result of a lower share of automated warehouses) could lead to a reduction in eCommerce sales which would reduce overall warehouse throughput which may result in a net decrease in warehouse employees in 2024 as a result of a lower share of automated warehouses.

US and Europe warehouse employees in 2019 and 2024



Notes: No further automation scenario assumes that there is no further penetration of automation within warehouses throughout the forecast period.



Part 3: How can picking robots be applied to warehouse automation?

Picking robots can be used in a very wide variety of scenarios that require the selection, handling and manipulation of individual items in a logistics or warehousing context.

However, our research has revealed that repetitive and monotonous tasks, when they also have a high throughput, are particularly suitable for the application of picking robots. Picking (G2P), packing, and conveyor induction all fall into this broad category – and we view them as the ‘low hanging fruit’ for warehouse automation.

These areas are the simplest and cheapest in which to implement picking, and using the technology in these applications is where the best return on investment can be found.

1. Picking (G2P)

Our definition: The process of picking items or cases from a goods-to-person system such as an AS/RS.

Any logistics manager wanting to implement picking in their operations should consider picking (G2P). One

reason that it tends to be an easier function to automate is that the tote is a simple-to-define structure for the robot to understand and pick from. Another reason is that the system knows the sequence of items to be picked and understands what those items are, and so if a specific item has been tagged as difficult for a robot to handle, it can be sent to a manual picking station. A final consideration is batch picking. Batch picking is defined as the process of grouping multiple orders into smaller batches, allowing multiple individual orders to be filled at the same time. In batch picking scenarios, picking robots can be used to pick batches (often this is done overnight) – as well as to then consolidate these batches into the final orders. When picking robots are implemented in picking (G2P) at scale, these systems are referred to as goods-to-robot systems.

2. Conveyor induction

Our definition: The movement of goods onto a conveyor system [this excludes G2P pickers who may be picking from an automated storage system and placing onto a conveyor - which would fall within picking (G2P)].

Conveyor-based sortation systems are complicated assets, made more expensive – and more susceptible to human error – as they typically require goods to be manually inducted at the beginning of the process. Using picking robots to automate the induction process for conveyor sortation systems is an easy win for logistics managers – cutting costs, improving productivity and squeezing additional value out of an existing conveyor system. Some robot manufacturers report that, by implementing highly efficient picking robot setups for sortation system induction, they can increase overall throughput of a conveyor-based sortation system by 25-50%. We’ve also seen examples

of picking robots being successfully used to induct apparel goods into pouch sortation systems. Apparel is well suited to automated picking technology since the goods are lightweight and also relatively similar in size.

3. Depalletizing

Our definition: The process of unloading cases or items from a pallet

The depalletizing process can occur at different stages of the warehousing process depending on the operation of the warehouse. In a grocery warehouse, for example, pallets are received and stored in bulk before being retrieved and broken down into cases for short-term buffer storage.

Direct-to-consumer warehouses, on the other hand, tend to break down pallets as soon as they arrive at the distribution center ready for the putaway process. As a result, depalletizing forms part of several of our warehouse activity segments including Receiving and Putaway & Replenishment.

Picking robots are very well suited for depalletizing applications; advances in machine vision technology have given rise to robotic depalletizers which can identify in real time how best to pick unordered cases from a mixed-, layered- or full-case pallet.

Depalletizing is an essential part of many warehousing operations, especially within food & beverage and FMCG facilities where the cases tend

to be heavy. Using depalletizing robots coupled with a human supervisor can reduce the risk of repetitive strain injuries whilst promoting associates from mundane tasks to higher value work. Furthermore, the unit handling costs can be reduced significantly.

Picking – market forecast

Of all different warehouse automation functions, piece picking has far and away the largest CAGR. Between 2019 and 2024, the CAGR for piece picking is predicted to be 69.2% - growing from \$63 m in 2019 to \$877 m in 2024. The warehouse automation functions with the next largest 2019-24 CAGRs are storage/buffering and palletizing/de-palletizing which are both level-pegging at 13%.

The future of warehouse automation jobs

Overall, the message is clear: warehouse automation itself doesn't destroy jobs. Instead, it is an understandable necessity in a fast-growing market. This is the virtuous circle: as warehouse automation gets more advanced, it makes warehousing services cheaper and more efficient, causing increased demand for warehouses. On this basis, and certainly so long as the overall warehousing market keeps growing, we see a future of growth both in warehouse automation, and in manual warehousing jobs. Furthermore, we

argue that increased warehouse automation not only doesn't destroy jobs in manual warehouses, but is fundamental to the increase in jobs that we see. We mentioned earlier that Germany and Japan have some of the highest numbers of manufacturing jobs in the world precisely because they also have some of the highest densities of industrial robots per head of manufacturing workers in the world. We believe the same trend will hold for warehouse automation. It will be the warehouse companies that automate the most who also grow the most, and therefore it will be these companies that create the most jobs of all types – including manual warehouse roles.

We hope you found this whitepaper to be of interest.

To continue the conversation about the future of vision software for logistics robots, get in touch with Sheryl Seitz, marketing director at Plus One Robotics, today:
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Or, if you have further questions on the warehouse automation market, contact Ash Sharma, senior research director at Interact Analysis:
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