



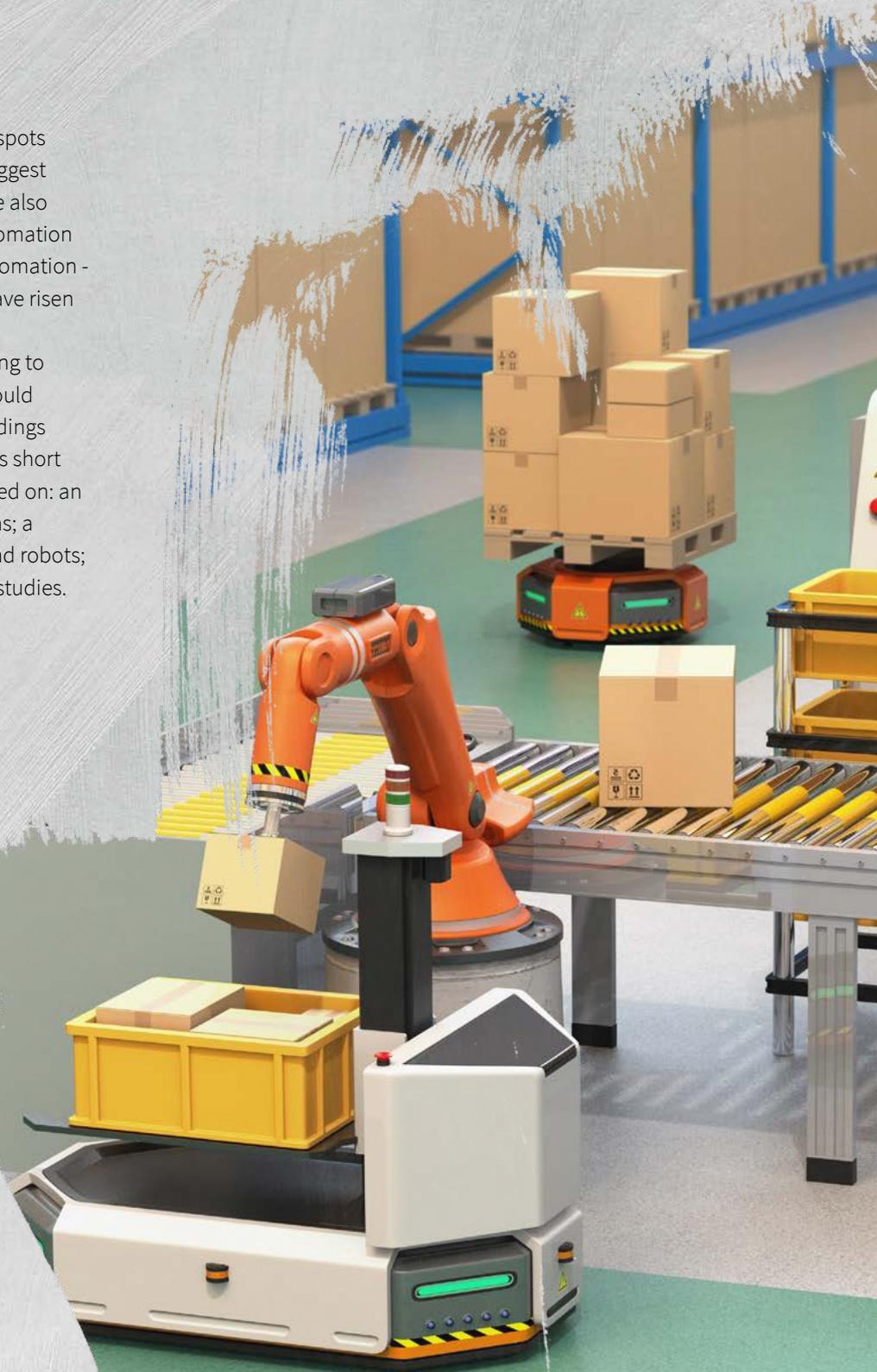
JLL EMEA Industrial & Logistics

Labour & automation and the rise of robots in logistics

Will automation and robots change logistics
buildings and locations in Europe?

Introduction

In many of Europe's logistics property hotspots sourcing labour has become one of the biggest challenges confronting companies, but we also hear more and more about the rise of automation and robots. These issues - labour and automation - are connected to a large extent. As they have risen up corporate agendas, logistics property developers and investors have been seeking to understand how warehouse operations could change and how this might affect the buildings occupiers require and their location. In this short paper, we present some observations based on: an analysis of labour statistics and projections; a review of recent studies on automation and robots; and a series of warehouse visits and case studies.



In many logistics hotspots the current *labour shortage* is likely to get worse

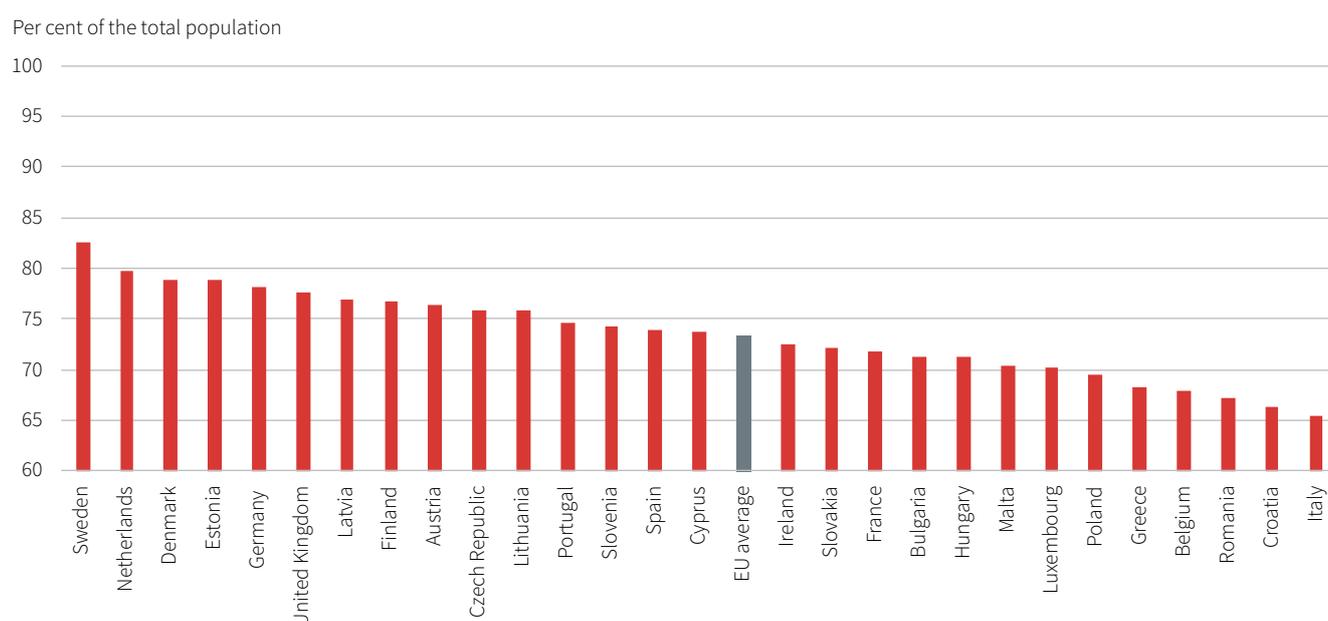
The supply of labour has become a key challenge for companies in many logistics markets because the demand for warehouse workers, and drivers, has continued to grow while many of Europe's major economies have very high levels of employment and economic activity, and low levels of unemployment and economic inactivity.

Across Europe, we estimate that more than 300,000 new warehouse jobs have been created over the past three years, before taking account of any displacement effects. This estimate is based on the level of new warehouse

completions, and the application of an employment density of 1 job per 100 sq m to the newly completed and occupied stock.¹

As for wider labour market conditions, data from Eurostat highlight high levels of employment and low unemployment in many countries across the European Union (EU). For the EU as a whole the employment rate in 2017 was 73.4%, the highest annual level since 2008, and the unemployment rate was 4.9%, the lowest level since 2009.

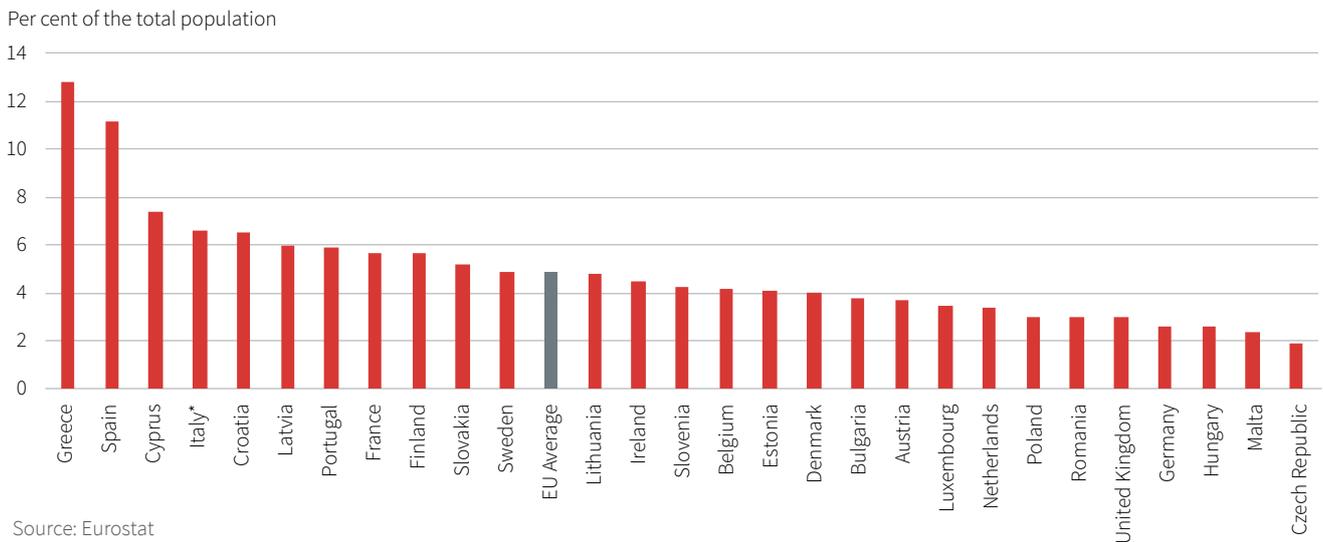
Figure 1: Employment Rates, 2017



Source: Eurostat

¹ JLL warehouse completions data based on buildings of 5,000 sq m and over in 11 countries including UK where we count buildings of 10,000 sq m and over. An employment density of 1 job per 100 sq m could be considered conservative as some research suggests higher densities.

Figure 2: Unemployment rates, 2017



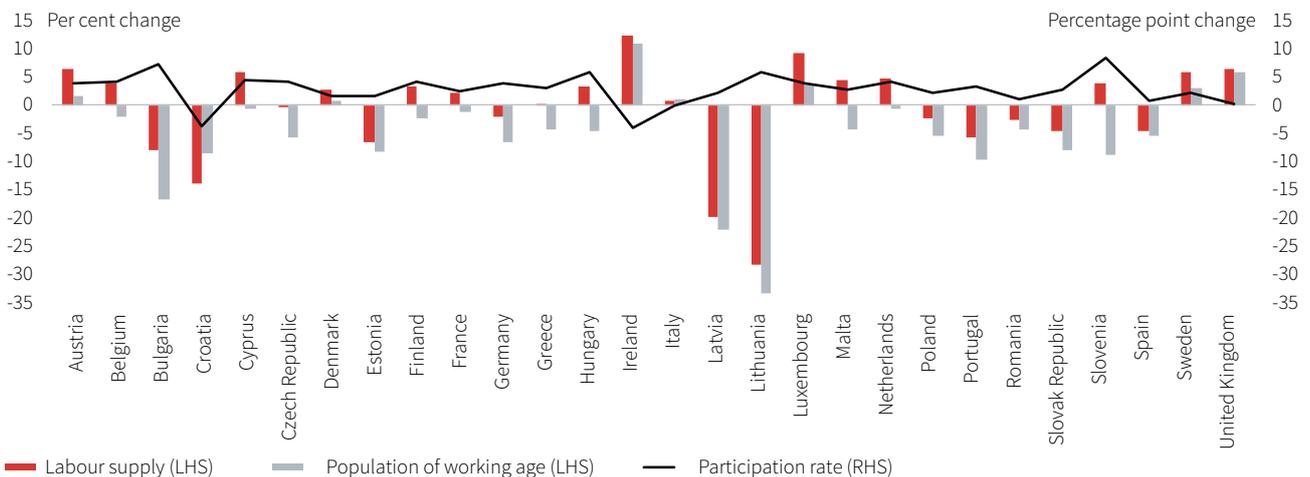
Source: Eurostat

Forecasts indicate that the current shortage of labour will worsen in many countries because ageing populations will result in a contraction in the population of working age.

For example, according to Oxford Economics, Germany, Poland and Spain, which are all major logistics markets, will each see a marked decline in their population of working age between 2016 and 2031 and an overall contraction in their labour supply, see Figure 3.

Even in countries where the labour force is forecast to increase this is often at a slower rate than their total populations. In the UK, where this is the case, the labour issue looks likely to be exacerbated by Brexit, due to a slowdown in the number of immigrants from the EU and an increase in the number of EU citizens leaving the UK.

Figure 3: Projected change in population of working age, labour force participation rates and labour supply, 2016-2031



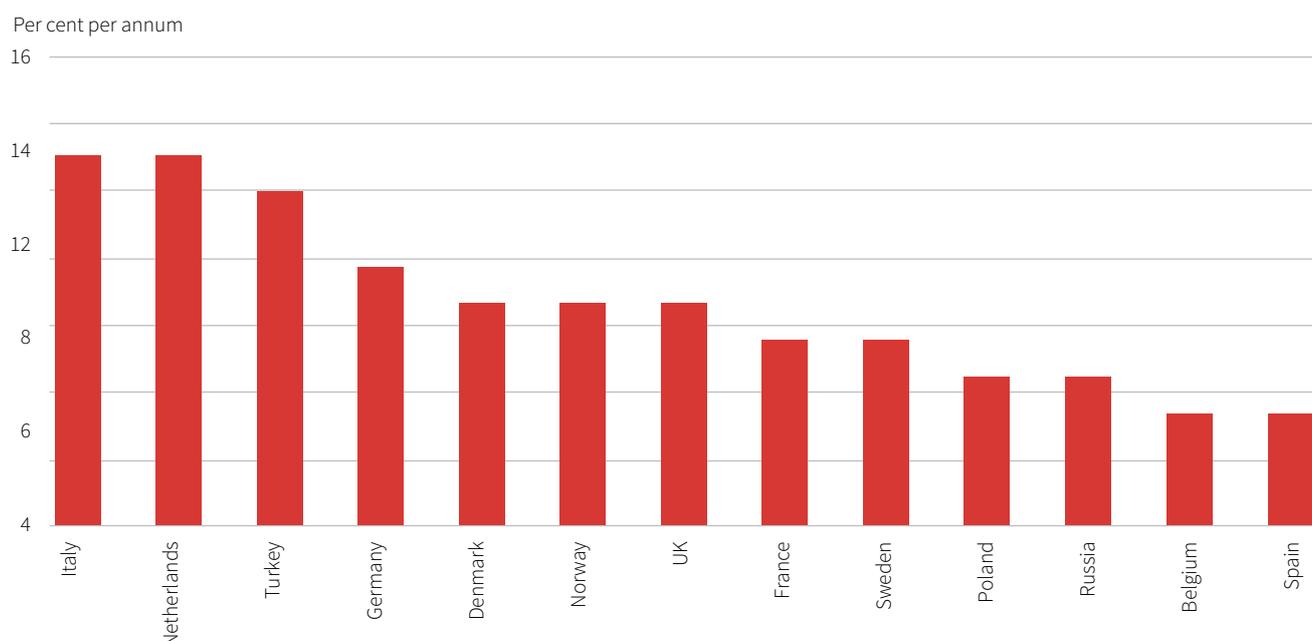
Source: Oxford Economics

The demand for *warehouse labour* will continue to grow in the medium-term

At present, there are no signs that the demand for warehouse labour will moderate in the short to medium-term, given expectations of on-going demand for new warehouse space. JLL's proprietary European Supply Chain Activity Index, which is a composite of four indicators that we use to predict short-term demand for warehouse space, points to another strong year of demand in 2018, following record take-up across Europe last year.

Moreover, e-commerce which is one of the drivers of demand, is also leading to more labour intensive warehouses than average, because e-fulfilment facilities often operate 24/7 and involve item picking and packing (and or labour-intensive returns processing). A global study by Wordplay indicates strong e-commerce growth in major European markets over the five years 2017-2021.

Figure 4: Growth of e-commerce in Europe, 2017-2021



Source: Worldpay, Global Payments Report, November 2017

Therefore, based on current operations and the predicted growth in e-commerce, the demand for warehouse labour will continue to grow.

Companies will introduce *more automation* as a response to labour shortages and to secure wider benefits

Warehouse automation is not a new or recent phenomenon, with the first automated storage and retrieval systems (AS/RS) dating back to the late 1960s. Since then automation has progressed well beyond the storage and retrieval of unit loads, with systems developed for a wide range of roles including sorting, picking and packing – all assisted by developments in computer technologies. Over recent years, the growth of e-commerce has encouraged the use of systems that support the picking of high volumes of small, multi-line orders, such as high-performance shuttle systems for goods-to-person picking.

Evidence of the current use of automation and robots within warehouses is limited. A 2016 study by DHL refers to a survey which showed that 80% of current warehouses are manually operated with no supporting automation; 15% are mechanised and use some type of materials handling automation; and 5% use more advanced automated systems including robots.² Although it is not clear what geography this survey is based on, it does highlight that levels of automation and robots are generally modest.

We are not aware of more robust data specifically for Europe. However, based on warehouse visits and case studies and our knowledge of major warehouse occupiers, we believe the use of automation and robots is also limited overall, although adoption varies between industries and countries. Traditionally, it has been higher among manufacturers than retailers and in countries where land and labour are constrained and costly. As a result, warehouse automation is more widespread in Germany and in Scandinavia than in central and eastern Europe for example.

We believe that difficulties in sourcing labour, among other factors, will encourage companies to invest in more automation in their warehouse operations as this generally reduces labour requirements and costs while improving efficiency and lowering costs overall. This view is supported by a range of research studies into the potential impact of automation, which highlight that the jobs that are most vulnerable to automation are typically those that are relatively routine, predictable, low skill and manual. In one such study, the transport and storage sector (i.e. what we would refer to as logistics) emerged as most at risk from automation due to the attributes of its different jobs.³

In our opinion, the short and medium-term potential for automation within this sector is higher with respect to the storage component, i.e. within the warehouse, than it is within the transport component. The widespread use of autonomous trucks and other autonomous vehicles, such as drones, appear longer term, due more to legal and other constraints than technology limitations.

With more automation on the horizon, the nature of certain warehouse jobs will change with demand for higher skilled workers required to oversee, operate, maintain and repair the automated systems. However, based on our warehouse visits, we believe this shift should not be exaggerated. In facilities we visited, the number of people currently required for these roles is typically relatively small compared with the number of ‘standard’ warehouse jobs at around 10 per cent of all jobs. The higher skilled logistics jobs that will be created by more automation (and robots) will mostly occur outside of warehouses.

² DHL, Robots in Logistics, March 2016

³ PwC, ‘Will robots steal our jobs? The potential impact of automation on the UK and other major economies’ in UK, Economic Outlook March 2017.

Case Studies

These are a selection of case studies undertaken as part of our research.

Jack Wolfskin *Germany*

Jack Wolfskin, a German outdoor apparel specialist, has its European Central Warehouse at Neu Wulmstorf, Hamburg. The warehouse has a total footprint of 45,500 sq m and is divided into a number of areas including two separate warehouses, an automated carton warehouse and a manual pallet warehouse. Warehouse operations are highly automated, based on TGW Logistics Group systems, and more efficient than previous manual processes. Overall, the warehouse employs around 150 permanent workers, with additional temporary workers taken on at peak times.

Leclerc *France*

Leclerc, a French cooperative society and hypermarket chain with more than 680 store locations in France, opened its first automated distribution centre (Premier Entrepot Robotise Leclerc) in 2014 at Niederhergheim, Alsace. This 32,000 sq m built to suit facility uses automated solutions designed by WITRON to service around 100 stores in the East of the France. The distribution centre employs around 120 staff with WITRON having its own technical team of about 10 people to maintain the automated systems. Leclerc now has four operational automated distribution centres, with another one of 90,000 sq m under construction at Castelnaudary.

John Lewis *UK*

UK department store retailer, John Lewis has a campus of three distribution centres totalling around 182,400 sq m at Magna Park, Milton Keynes. The first (MP1) is a semi-automated national distribution centre for small items and online fulfilment. MP2 is an automated hanging garments facility which also handles 'one-man' items that are too big to be delivered via the post or parcel network. MP3 handles larger 'two-man' items. MP1 includes two separate automated storage areas using Knapp systems - one for store replenishment and one for online fulfilment. MP1 operates 24/7, and employs around 500 staff (John Lewis Partners) with additional temporary workers taken on at peak times.

Wehkamp *Netherlands*

Wehkamp, a Dutch e-commerce specialist, opened a new automated distribution centre of around 35,000 sq m at Zwolle in the Netherlands in 2015. The new DC uses Knapp automated systems and has a storage capacity of 4 million articles and a maximum order picking capacity of 196,000 items a day. It replaced a former facility at Dedemsvaart. Improvements in speed and order accuracy provided by the new facility have enabled Wehkamp to offer same day delivery for orders placed by 12 noon. The distribution centre employs around 200 staff. The facility is currently being extended with an additional 25,000 sq m.

Poco Loco *Belgium*

Poco Loco (a member of Paulig Group) produces food products such as tortilla wraps & chips, spice mixes, salsa's and dinner kits, has it two main production plants at Roeselare in Belgium, and recently opened a third at Milton Keynes (UK). In 2018 it opened a new fully automated warehouse at Roeselare which connects to the production site via a bridge across the road. The new warehouse has a floor area of 10,000 sq m and is 43 metres high with a current capacity of 43,000 pallets, and the potential to expand this to 60,000. The automation systems sourced from Egemin Automation form an integral part of the building.

Lidl *Spain*

Lidl, one of Europe's leading food retailers, opened its largest and most technologically advanced logistics platform in Europe at Alcala de Henares (Madrid) in 2016 following a €70 million investment. The new logistics platform, which has a total area of 71,800 sq m on a plot of over 10,000 sq m, includes conventional storage, a refrigerated area and a fully automated storage warehouse with capacity for 50,000 pallets in a 40-metre high building. The warehouse started operations in 2016 with around 100 staff, but when fully operational in 2018 Lidl expects some 275 people to work here.

Human robotic interaction

will become more important

Studies of the impact of automation on workplaces generally include the rise of robots. Although there is no consensus, many experts define a robot around three key characteristics namely: sensing, artificial cognition and physical action. In one definition a robot is 'a machine that senses, thinks, and acts. Thus, a robot must have sensors, processing ability that emulates some aspects of cognition, and actuators.'⁴

To date, robots have been much more widely used in factories than in warehouses, mainly because the types of tasks they undertake in factories are less complex and challenging. For example, robots are widely used in car assembly, but these are typically anchored in place and do repetitive tasks by electronic memory, usually in assembly lines and they often operate inside a caged area for human health and safety. Advances in technology and lower costs will result in a much wider adoption of robots in warehouse operations and further ahead in transport.

Figure 5: Swisslog's CarryPick robots



Copyright Swisslog

Robots are already being deployed in warehouses across Europe, particularly in goods-to-person roles to improve picking productivity. For example:

- Amazon has been rolling out the deployment of mobile robots in certain European fulfilment centres having originally pioneered their use in its US facilities following its acquisition of Kiva in 2012. One example where this is the case is its Winsen fulfilment centre in Hamburg, Germany.
- Ocado, the UK online grocery retailer, operates an automated warehouse at Andover - its third UK Central Fulfilment Centre (CFC) – which is based around a storage grid known as 'the hive'. This is serviced by swarms of robots that bring goods to pickers. It will use the same proprietary technology in its CFC4 in Erith, south London.
- Last year, Ocado's Solutions business reached agreement with Groupe Casino to develop the Ocado Smart Platform in France, including the construction of a new automated warehouse, with Ocado grid and robots, north of Paris to serve the Greater Paris area and the Normandie and Hauts de France regions. This warehouse will become operation in 2020.

⁴ Definition from George Bekey, quoted in John Jordan Robots 2016 Massachusetts Institute of Technology.

In addition, robots are being used to fulfil a range of other roles. For example, Swisslog's AutoPiQ solution, is based on a shared picking principle, where the robot picks the items it can and a human picker finishes the order; and DHL has deployed a number of collaborative robots, called Sawyer, which has an articulated arm and suction grabber, to help pack products in some of its warehouses.

As technology progresses and costs fall, robots will be increasingly used in a wide range of warehouse roles such as unloading inbound goods, putting goods into storage, picking, packing and dispatch. In many of these roles they will work alongside people and hence human robotic interaction will become an increasingly important factor behind warehouse productivity.

*The use of robots
in warehouse operations
will increase from
a very low
current base.*



Autonomous trucks

will take longer to deploy in transport operations

The use of robots in transport operations will increase with the development of autonomous trucks. However, while these already operate in controlled environments (like ports) and are being trialled on public roads, we think their widespread use is 10 years or more away.

There are different levels of automated driving, with the widely accepted SAE framework identifying six levels from no automation (level 0) to full automation (level 5) based on the extent to which the major functions of the driving tasks are automated and the situations in which a human driver is required to take control. All levels below levels 4 and 5 will always require a driver to be present in the cab and even in cases of higher automation (levels 4 or 5) drivers could remain in place to mitigate risks.

In a recent study, the International Transport Forum considered four scenarios for the deployment of autonomous vehicles (levels 4 and 5) on long-distance routes and in urban areas over the next 20 years.⁵ The scenario which led to the widest adoption on both long-distance routes (e.g. motorways) and in urban areas was the 'regulated adoption' scenario in which regulatory barriers are rapidly resolved and the road freight industry quickly takes up the available technology as it becomes available. In this scenario, the use of autonomous trucks on motorways rises sharply once regulations are approved, but their use in urban areas was expected to grow more slowly.

The impact on truck driver jobs, which totalled around 3.2 million in Europe in 2015, would vary according to the what type (level) of autonomous trucks we see and the pace of adoption. However, even in a future where autonomous trucks are widely used, and the number of drivers falls significantly, we do not see why this would lead to fundamental changes in Europe's major logistics locations.

Europe's main warehouse clusters are mainly in and around its major centres of population and industry or at gateway locations (such as large container ports or airports) or close to strategic transport infrastructure that connect these; and these centres, gateways and infrastructure are largely fixed. In most cases the key factors that influence where companies choose to locate their warehouses are the location of their customers, transport infrastructure and / or proximity to a parcel or pallet hub, and whether trucks are driverless or not will not radically alter this.



*Autonomous trucks
will not fundamentally
change Europe's key
logistics locations*

The greater use of automation and robots will shift *warehouse requirements*

In the short to medium-term (next five years) we envisage continuing demand for new warehouse space with significant labour demand even as more companies invest in automation and robots. Longer term, automation and robots will become more widespread, particularly in new buildings occupied by large companies and the number of warehouse workers required for a given volume of activity will diminish.

This seems a safe bet on the general direction of travel, but how dramatic a shift this will be is much less certain. Some experts see a future in which a tipping point is reached and quickly followed by the widespread adoption of automation and robots in both warehouse and transport operations with the loss of large numbers of logistics jobs. Others see a future in which humans and robots work in partnership rather than robots replacing humans. Which of these scenarios proves more correct will influence how much change we see in warehouse buildings, locations and in future labour requirements.

In a future of higher levels of automation and robots and lower levels of employment, we think the types of buildings occupiers require will alter more than the locations. In particular:

- Warehouse buildings will be smaller (in terms of their building footprint) but taller than their manual counterparts. They will be smaller because automation and robots will enable occupiers to utilise the floorspace better, including via higher storage densities. They will be taller because occupiers will make better use of the cubic space, including by utilising multi-mezzanine levels.

- Smaller buildings will require less land. In addition, if warehouses employ fewer workers car parking requirements will be reduced. Indicative estimates suggest that plot densities could increase from around 33% for a manual site, to 40% for a semi-automated site to 50% in a highly automated site. If autonomous cars become widespread this could magnify this impact, particularly in a future of lower car ownership, where cars become a service.
- Mezzanine floors will become more important to support automated systems and robots. These structures will have to be able to support higher loads than standard mezzanine installations and provide greater stability with enhanced dynamic force requirements and lower deflection limits.
- Warehouse floor specifications will need to be enhanced to support higher uniform loads and higher point loading. Floors will have to be super flat to support more automated systems and / or robots.
- Labour considerations will have less effect on building requirements. Even if most warehouses never get to a 'lights out' situation, if labour requirements are reduced significantly this would alter warehouses in certain ways, such as reduced welfare amenities, office space and car parking.

These changes do not necessarily mean that all older buildings will become obsolete as it may be possible to improve their efficiency by retrofitting modular automated solutions that can be customised and fitted into all sizes and shapes of warehouse buildings. One example of such a system is Swisslog's PowerStore, a high density shuttle system for pallet warehousing.

By contrast, we do not expect higher automation and robots to significantly change Europe's main logistics locations. However, we would expect changes in the way companies assess specific properties or sites.

- The strategic warehouse location decisions that occupiers make when they decide where to site a new facility or redesign a whole network will not change significantly as these are generally driven by access to customers, transport infrastructure and / or proximity to a parcel / pallet hub more than any other factors.
- The advent of autonomous trucks would not make a significant difference in this respect and therefore should not herald a fundamental shift in locations or hotspots.
- Labour considerations (availability and costs) will become less important in micro-location decisions involving the choice between specific warehouses or sites. Some locations that currently have limited labour availability and high labour costs could become more attractive to occupiers.
- The availability of power will become a critical micro-location decision factor as access to sufficient power will become more important in a highly automated logistics environment. Requirements for power are also being driven by the increasing use of electric and battery powered equipment both in the warehouse and in truck and van fleets and cars.

The greater use of automation and robots will shift warehouse requirements but not alter strategic locations





Conclusion

From relatively modest current levels, we expect the use of automation and robots to increase in warehouse operations. In the short to medium term we anticipate continuing demand for warehouses and rising labour demand. But as more automation and robots are deployed warehouses will require fewer workers for a given volume of activity. Automation and robots will replace certain warehouse jobs even in situations where robots are designed to work in collaboration with workers.

The widespread use of autonomous trucks is further away and we think most autonomous trucks will still have a driver in the cab. This will mitigate the impact on driver jobs.

The combined effect of these shifts will be significant changes in warehouse and transport operations and big improvements in productivity across logistics and supply chains.

We also anticipate some modifications in the type of warehouse buildings occupiers will require, although these requirements will continue to vary according to the logistics functions the buildings perform. Overall, however, we do not anticipate fundamental changes in warehouse locations. Therefore, whilst automation and robots will usher in a potential revolution in logistics, Europe's logistics property markets will see more incremental changes. Occupiers, developers and investors should take comfort from this as we believe that many of the property market fundamentals that they are familiar with will not radically alter.

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