

LOGISTICS 4.0

Warehouses and the robot age

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CUSHMAN & WAKEFIELD

FOREWORD



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In a connected world where technological advances moving at an exponential rate, traditional logistics has started to shift towards mechanisation and automation driven by increasingly sophisticated tools and greater use of robotics.

The race to improve performance is on, with the aim of increasing profitability, saving space, shortening lead times as well as reducing the burden of tasks... prompting the development of intelligent warehouses.

This change is gaining pace at a time when the profession is facing a series of real estate challenges (scarcity of supply and land), HR (recruitment complicated by the unattractive image of the jobs on offer, particularly due to the difficulty and repetitive nature of the work involved), and the economy (increase in market or rental values, inflation, salary increases).

This climate raises increasingly crucial questions regarding the adaptability of logistics warehouses to new operating technologies and their cost.

How do we approach logistics 4.0?
What issues are market players facing?

These are the questions we will aim to address in this report.
Happy reading!

Key figures

Logistics' role in the national economy

- 10% of GDP (source France LOGISTICS 2019)
- 150,000 businesses - €200bn of turnover (source France LOGISTICS 2019)
- Freight transport: 334.5bn tonne-kilometres (source SDES 2021)

Employment (source POLE EMPLOI 2023)

- 1.9m jobs - 10% of employment
- 76,320 jobs planned
- Unskilled packaging and materials handling workers in 9th place among the most sought-after jobs (companies deem almost half of vacancies to be difficult to fill).

Working conditions (source INRS)

- Manual handling is the cause of 50% of accidents at work, 75% of cases of medical incapacity and 100% of recognised occupational illnesses.
- A picker travels 10 to 15km every day and a handler carries 1 to 10 tonnes.

Real estate

Stock*
61m sq m

Vacancy rate
3.8%

Immediate supply
2.3m sq m

Av. take-up (2018/2022)
3.6m sq m

Prime rent
€70 per sq m/year

Investment
€4.9bn

2022 data sources:
Cushman & Wakefield warehouses >5,000 sq m, Class A, B, courier and refrigerated
**AFILOG estimate of warehouse stock >10,000 sq m*

Faster technological development

With strong demand from the e-commerce sector and a drive for re-industrialisation from the highest levels of government, logistics is now, more than ever, a vital cog in the national economy. The supply chain needs to rapidly adapt to the new requirements of its main customers while considering the ever greater constraints that are being imposed on development.

With the rise of e-commerce, the deployment of omnichannel solutions by major food retailers and the growing importance of urban logistics, the logistics industry is constantly striving to improve productivity and this is driving continued change in warehouse processes. In 2016, an SDES study noted that automation was still in its infancy with the uptake of mechanisation and the automation of logistics operations still largely in the minority. Today, however, warehouse operations are being upgraded at an accelerated rate in order to meet new occupier requirements, particularly through the implementation of technology.

Has "traditional" logistics outlived its usefulness? Are ever-larger, land-hungry warehouses still conceivable with zero greenfield development (ZAN regulations) and constantly rising costs per sq m? The difficulties operators now face in setting up and recruiting are such that, in order to meet their requirements, the deployment of new technologies within warehouses is essential - particularly as inflation, rising raw material prices and wages are driving the search for cost-savings to limit distribution costs.

Despite their complexity and considerable cost, projects to mechanise, automate and/or robotise existing or future warehouses are increasingly being considered and implemented by occupiers with the help of specialist consultants.

Given this climate, players in the logistics real estate market, (promoters, developers and investors), need to commit to supporting this change in warehouses operations. Consideration needs to be given to both the structure of buildings and the introduction of new legal and financial frameworks to facilitate operations and meet occupier needs.

A specialist's view

"Although automated systems have been used in warehouses for over 20 years, they have become more widespread in France over the last 10 years. Other European countries, particularly Germany, are some 15 years ahead of us. This lag is due to the fact that, until recently, real estate costs were lower in France. This process is currently gaining even more pace due to the growing difficulties in terms of set up (scarcity of allocated land), rising costs and recruitment difficulties. However, for some, this is a costly and complex undertaking which is being hampered by the lack of adaptability and standardisation of equipment, even though rapid advances in technology are beginning to make it possible to make more flexible sizing possible.

Deploying an intralogistics optimisation solution therefore requires a thorough study of the operator's supply chain strategy at a given time as well as forecasts for activity over several years, depending on the business. The project needs to combine real estate and operations, two different approaches that generally don't work together, by bringing them together to arrive at an overall costing (overall structure and operational equipment) so that ROI estimates can be as accurate as possible. Using this approach, the supply chain positioning and definition of the location results in a search for the most suitable building or land. Conclusions can therefore be based on the best proposal in terms of location and property cost.

Lastly, in addition to the issues of cost and complexity, automation still too often suffers from the perceptions that certain trade unions and local authorities have of its impact on employment. Automation does not eliminate jobs, it eliminates the repetitive tasks that employees no longer want to carry out on a daily basis. It also enables existing staff to develop their skills. But above all, it increases productivity and bolsters the volumes handled on site with the same number of employees.



Benjamin Letarouilly,
Advisory and Development Director
DELTA+ CONSULTING

The ideal size for a new operational project is as close as possible to common logistics standards, so that it can be used to cover most lines of business and respond to changes in activity or business.

The challenges

Save space by rationalising and increasing the density of activity, by exploiting the full height and reducing the width of aisles.

Boost productivity by drastically reducing the time wasted by human movement. Supply chain optimisation increases productivity and reduces costs.

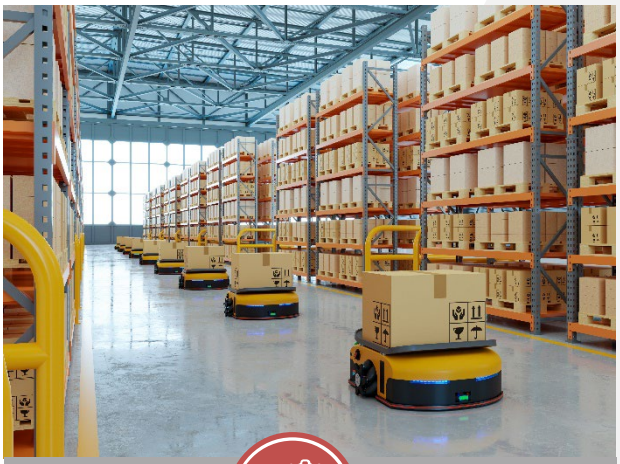
Reduce delivery times by increasing the speed of flow and limiting additional costs.

Favour *'just in time'* over *'just in case'* by making orders and stock management more reliable and offering new services.

Reduce drudgery by making products easier to grip and more ergonomic.

Responding to labour shortages and recruitment difficulties by reducing the number of recruitments and focusing operators on value-added tasks.

Meet CSR criteria by improving working conditions and controlling energy consumption, as well as other criteria.



Boosting productivity and profitability while responding to the lack of space and manpower.

Obstacles

High financial impact with long-term investment (5 to 10 years) and uncertainty in terms of ROI. Implementation complexity adds to costs, and the right balance needs to be struck between CapEx and OpEx.

A long-term strategy at a time when logistics functions are increasingly demanding flexibility, agility and rapid decision making in order to seize opportunities, absorb peaks in activity and adapt to temporary fluctuations.

The rigidity of mechanised solutions which require fixed, massive and expensive components.

The need to combine technologies: as robots and other automated systems are rarely multi-purpose, different solutions need to be combined depending on container and picking types within the same facility, again at substantial cost.

The social and human aspect: Despite a proven reduction in drudgery, the fear of job losses and the reduced value of workers are claims often put forward by disgruntled trade unions and employees.



These are major, complex and costly projects, with a long-term timeframe and which raise concerns regarding job losses.

Impact on market players

All logistics real estate, from XXL warehouses to urban logistics, is being affected by this drive to optimise operations.

Ultimately, whether upgrading existing warehouses or building new ones, all players from the operator (owner or tenant) initiating the project, to the investor, via the developer are affected by these projects.



Operator

- Costs
- Periods of use, depreciation and leasing need to be aligned
- Adaptability of the equipment over time
- Costly to dismantle and virtually impossible to reuse



Developer

- Obstacles due to planning constraints (height)
- The need to adapt existing construction techniques involving:
  - greater anticipation of needs at the design stage
  - higher construction or upgrading costs to meet specific requirements



Investor

- De-standardisation of buildings?
- Profitability and time frames to be adjusted
- Asset liquidity
- Equipment financing

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TECHNOLOGY

The warehouse is no longer simply a place where a company manages its stock; it is becoming a place that brings together different technologies to increase performance and productivity, while ensuring traceability throughout the supply chain. Software, PLCs, automatic systems and mobile technologies are therefore taking over warehouses.



In a few words

Mechanisation: widespread use of machines to replace human power. **Machines helping human beings, who remain at the core of activity.**
Automation: the use of machines to autonomously carry out the tasks for which they have been programmed. Resulting in a redefinition of processes, **a total or partial elimination of human intervention, particularly for the most difficult and repetitive physical tasks.**
Robotisation: the use of automatic devices capable of manipulating objects or carrying out tasks according to a fixed, modifiable or adaptable programme. **This adaptability gives the robot the ability to act alone or as part of complex mechanised or automated systems.**

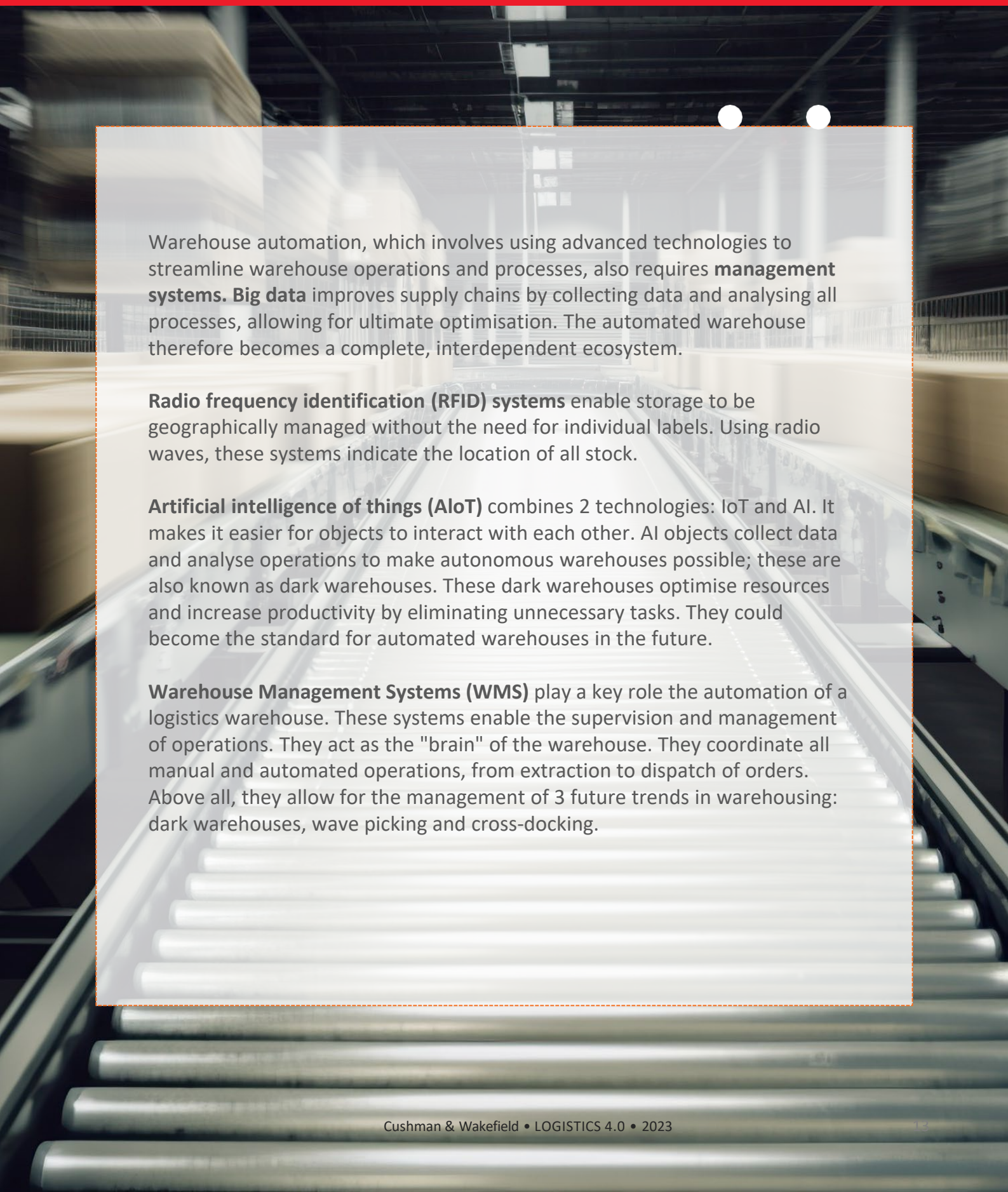
Within a single warehouse, depending on requirements (manual, automated and/or robotised), several types of flows can coexist particularly due to the use of digital tools (information systems, data management, artificial intelligence, etc.) which can be used to manage the overall process (**global management**).

Financial comparison

	Investment	ROI
Mechanisation	€0 to €2 million	<5 years
Automation	€5 to €70 million	From 8 to 10 years
Robotisation	€1 to €20 million	From 3 to 8 years

Source: DELTA + Consulting

SPOTLIGHT ON OVERALL WAREHOUSE MANAGEMENT



Warehouse automation, which involves using advanced technologies to streamline warehouse operations and processes, also requires **management systems. Big data** improves supply chains by collecting data and analysing all processes, allowing for ultimate optimisation. The automated warehouse therefore becomes a complete, interdependent ecosystem.

Radio frequency identification (RFID) systems enable storage to be geographically managed without the need for individual labels. Using radio waves, these systems indicate the location of all stock.

Artificial intelligence of things (AIoT) combines 2 technologies: IoT and AI. It makes it easier for objects to interact with each other. AI objects collect data and analyse operations to make autonomous warehouses possible; these are also known as dark warehouses. These dark warehouses optimise resources and increase productivity by eliminating unnecessary tasks. They could become the standard for automated warehouses in the future.

Warehouse Management Systems (WMS) play a key role the automation of a logistics warehouse. These systems enable the supervision and management of operations. They act as the "brain" of the warehouse. They coordinate all manual and automated operations, from extraction to dispatch of orders. Above all, they allow for the management of 3 future trends in warehousing: dark warehouses, wave picking and cross-docking.

Mechanisation

Mechanisation is a solution for carrying out repetitive tasks in a shorter time. It replaces human effort by helping to move or carry heavy loads, limiting travel and increasing speed. Mechanisation means that certain logistical processes are carried out by machines at all stages of in the process: reception, preparation or dispatch.

However, mechanisation alone is not enough **and overall warehouse management is required.**

The machines





AGV forks/AMR: equipment designed to move pallets and all other heavy loads on the ground, such as containers, pallet boxes (if they have fork access) and lifting and handling equipment designed to transfer loads in factories or warehouses.

Simple conveyor: a mechanism or machine used to transport a single load (cartons, trays, bags, etc.) or bulk products through the warehouse.





Sorter: mechanism or machine that separates items and packs them based on their destination

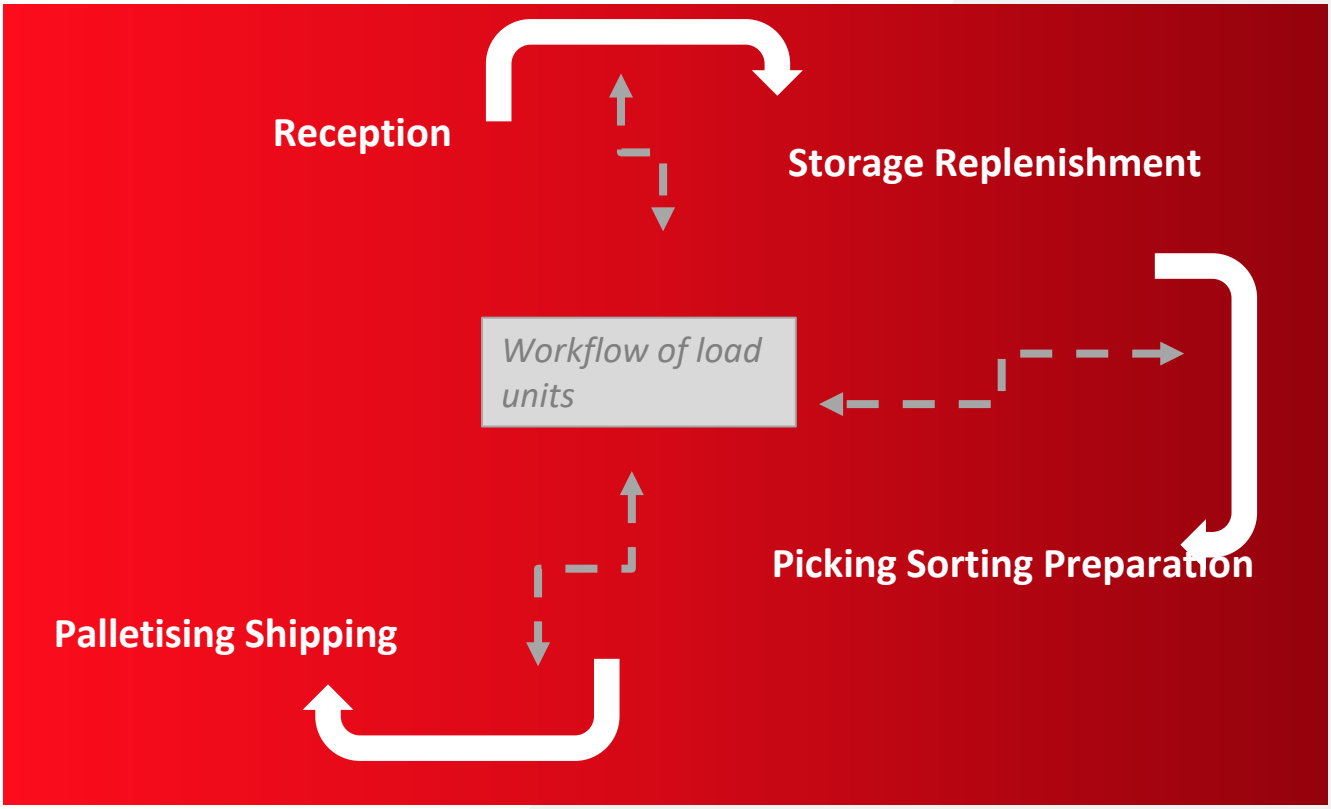
Automatic packaging machine: machine that formats cartons, seals packages and prints labels



Source: DELTA + Consulting

Automation

Automation is defined as "making a process automatic, making it work by itself" (which implies without human intervention). It gives a mechanical system the ability to perform tasks autonomously. This ability is primarily physical, as in the case of packaging machines or stacker cranes, but it can also be IT-based. For the latter, the system incorporates the notion of intelligence and decision-making based on algorithms which enable it to respond to constraints, criteria and objectives. From goods receipt to order preparation or product storage, every automated system forms part of the supply chain.



Source: DELTA + Consulting

While a large number of execution and control actions are still undertaken by humans, the expansion of automated processes in a warehouse requires **an overall supervision system** capable of providing detailed feedback on progress and equipment performance.

Automation - Reception and Storage

Reception

Automatic unloading: chain conveyors integrated into semi-trailers and level conveyors on docks to enable pallets to be unloaded directly
Automatic de-palletising: 6-axis robots with a gripping system adapted to the loads at the facility, de-palletising possible layer by layer or individually
Telescopic: Extendable conveyor belt system for entering trailers and placing loads within. Only for parcels or bulk goods.













Storage Replenishment

Stacker crane: a device used to store pallets or packages in a rack, often at great height. A mast with a lifting platform
Miniload: stacker crane for containers and parcels
Atlas 2D®: deep pallet storage system combined with a loading shuttle. The shuttle can change lanes without an operator or any other handling equipment.

Source: DELTA + Consulting

Automation - Preparation and dispatch

Picking Sorting Preparation

Sorter: system for sorting/grouping of items by order wave or by reference. Operators place sales units in bulk onto trays and the system reads the barcode and selects the corresponding chute.
Shuttle/Miniload: high-speed buffer/bin sequencer system.
Goods-To-Person: ergonomic order-picking station for pickers. Bins arrive in the right order and supports indicate how many items and where the operator should place them
Pocket sorter: sequencing and scheduling system or very high-speed UVC sorting. The pouches are filled individually in bulk and taken out in the right order at Goods-to-Person stations.



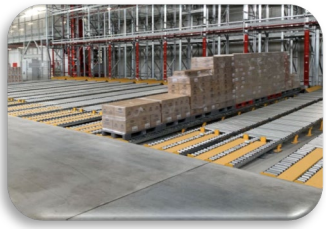












Palletising Shipping

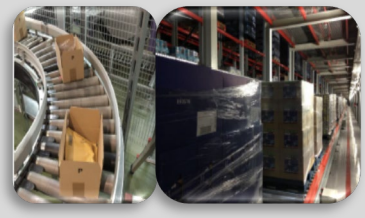
Shoe sorter: high-speed conveyors with shoe mechanism to sort parcels by dispatch zone
Automatic palletising: pallets are fed into the palletising zone to allow for order picking. Or parcels are brought into the area to be gripped and palletised
Dummy trucks: pallet buffers enabling trucks to be loaded in advance or “just in time” .

Source: DELTA + Consulting

Automation - automated materials handling



AGV/AMR
Robot transporting a load (pallets or parcels) from point A to point B without physical contact



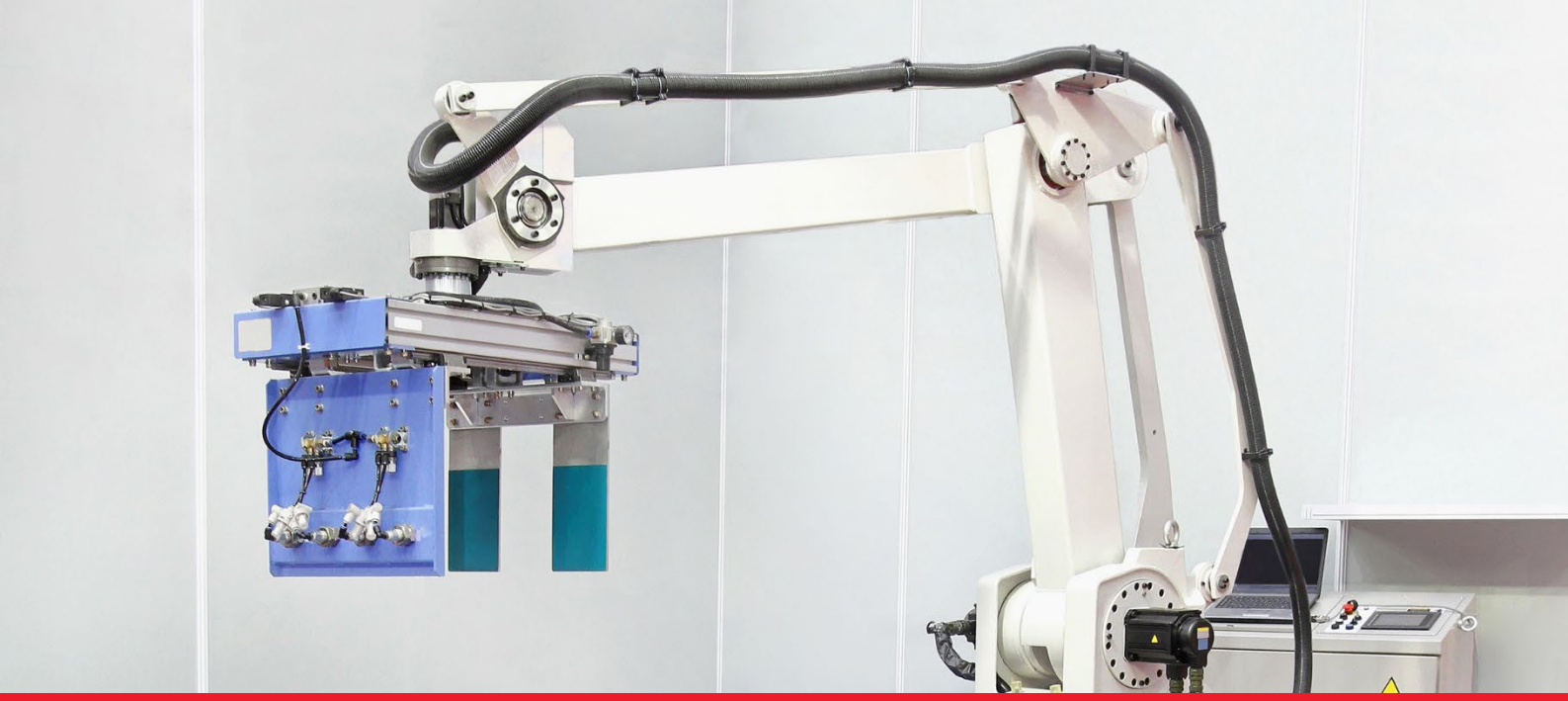
Conveyors
Single or double load transfer to take parcels or pallets to the right place

Workflow of load units

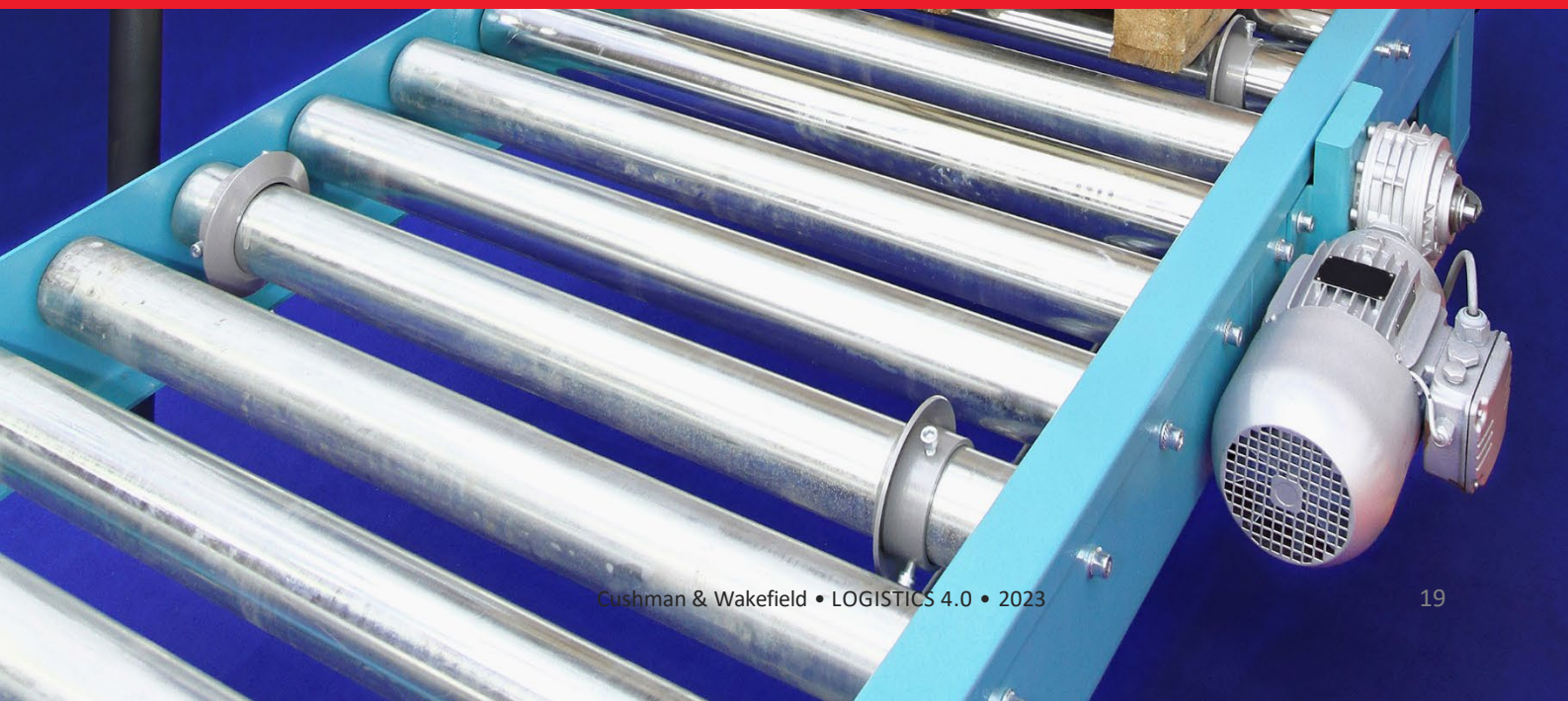


Shuttle
Shuttle loop system with rails carrying a single load

Source: DELTA + Consulting



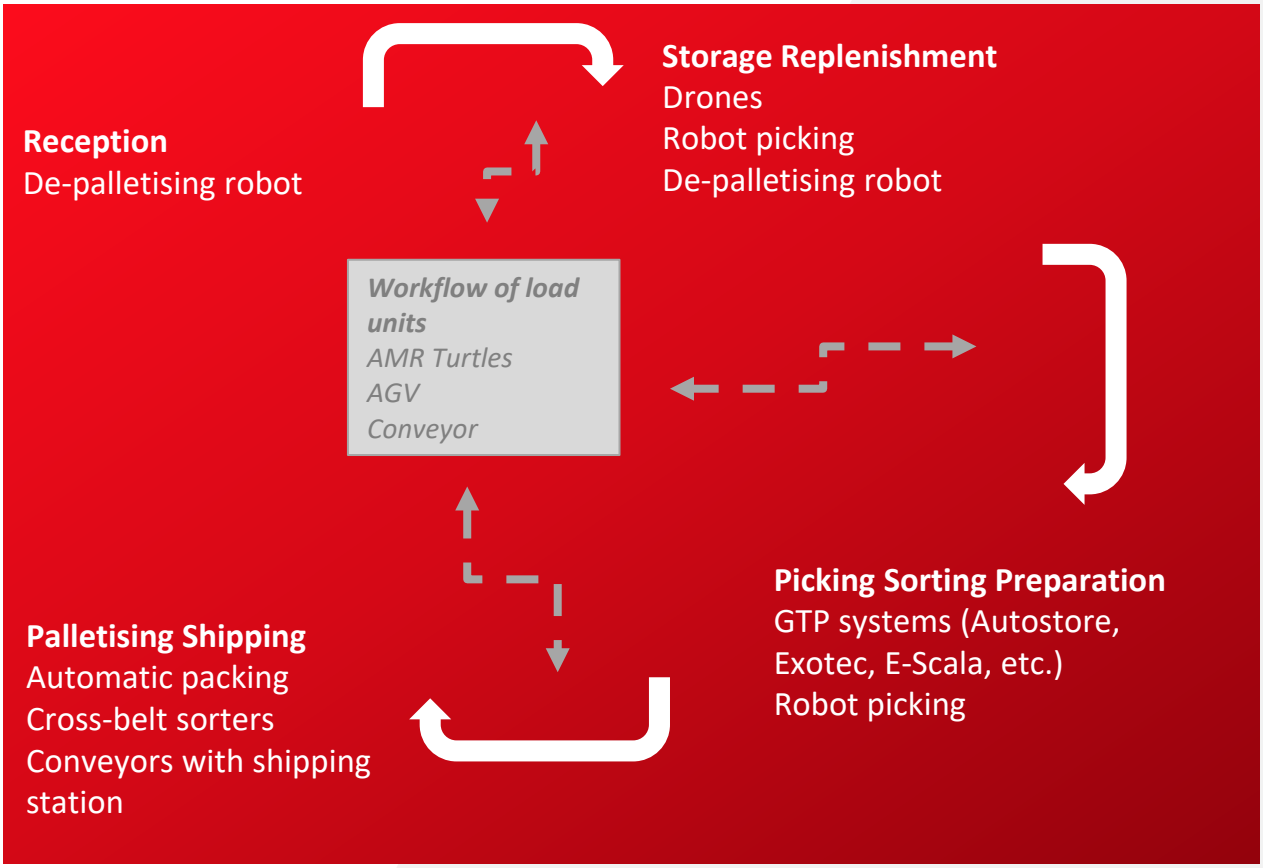
In the future, we won't see any major physical technological developments inside warehouses, but functional innovations using robotics, digitalisation and artificial intelligence.



Robotisation

Robotisation can be defined as the introduction of robots into a structure. Robotics, in a wide variety of forms, is an efficient and cost-effective way of automating internal handling and transport tasks in a warehouse. A 100% robotised logistics process is a totally autonomous process, with no human intervention, either in physical operations or in the organisation and synchronisation of flows. **Robotisation is therefore the ultimate stage in the evolution of mechanisation and automation**. The human role is to provide added value in terms of analysis, decision-making and strategy, while robots carry out arduous and repetitive tasks, whether physical or intellectual, at ultra-high speed.

Robotisation in the warehouse currently mainly involves:



Source: DELTA + Consulting

Robotisation from reception to dispatch



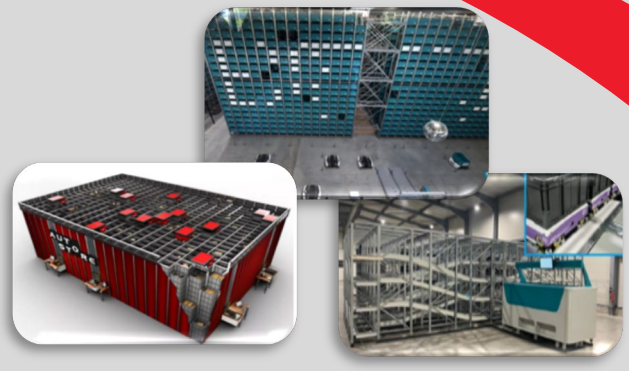
AMR turtles: autonomous mobile robots for transporting loads on trailers and load carriers. Due to their low height, these robots can fit under most load carriers and transport them to their destination.



Drones: inventory preparation. Frequent stock checks are just one of the tasks for which drones can play a vital role, including counting stocks and cycles.



Robot picking: a machine designed to speed up order preparation, handling products of different and new shapes and allowing automatic handling for pick & place.



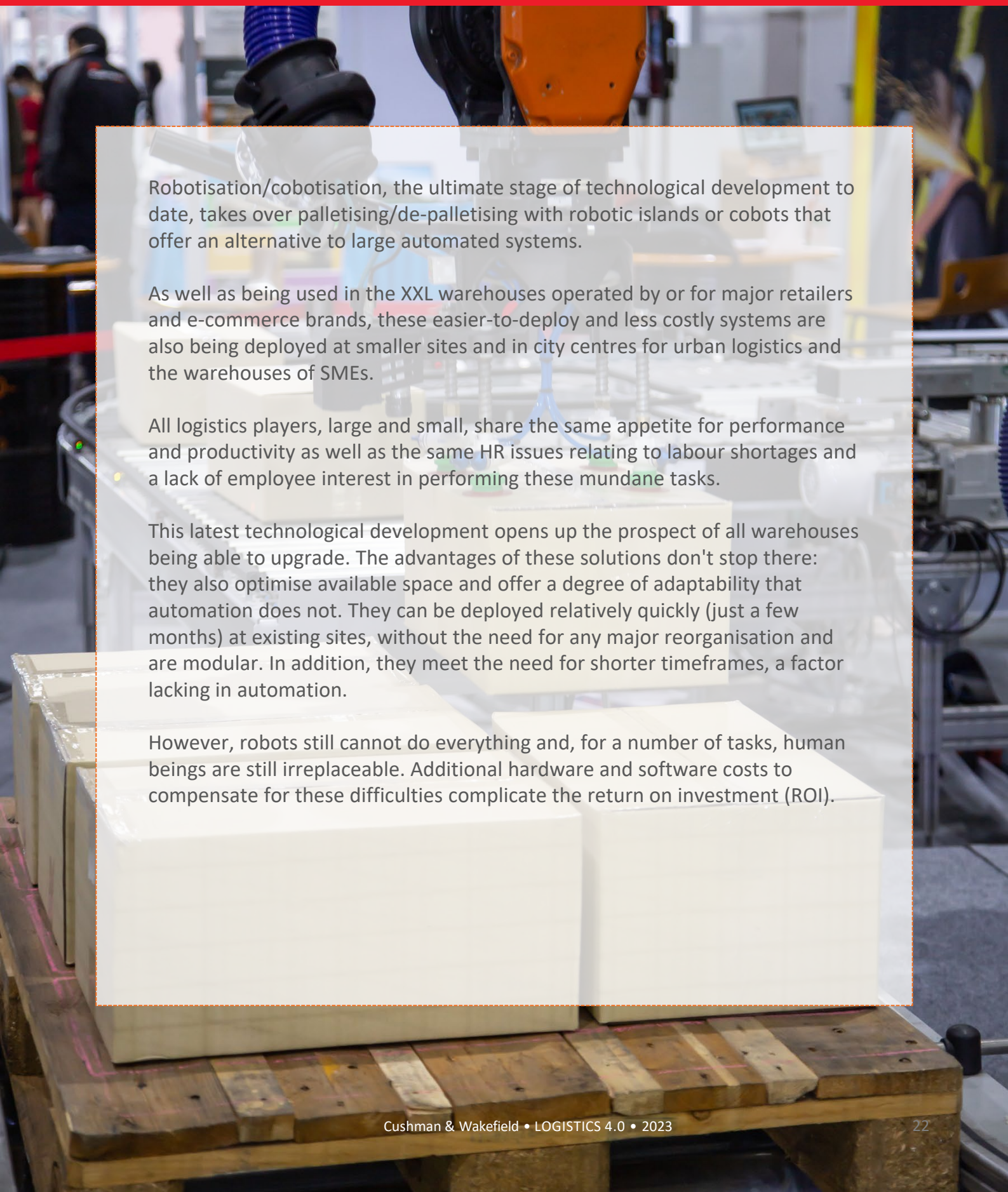
Autostore: an independent system, the robots deliver bins containing items to the picking stations (GtP) so that pickers can select the right products in the right quantities for order picking. **Robot Exotec®**: autonomous mobile robot operating in a closed environment without human intervention**. E-Scala®**: a scalable, fully automated robotic system for person-to-person order fulfilment. It replaces lifts and sequencers.



CVP: automated packaging solutions

Source: DELTA + Consulting

SPOTLIGHT ON ROBOTISATION IN PALLETISING OPERATIONS



Robotisation/cobotisation, the ultimate stage of technological development to date, takes over palletising/de-palletising with robotic islands or cobots that offer an alternative to large automated systems.

As well as being used in the XXL warehouses operated by or for major retailers and e-commerce brands, these easier-to-deploy and less costly systems are also being deployed at smaller sites and in city centres for urban logistics and the warehouses of SMEs.

All logistics players, large and small, share the same appetite for performance and productivity as well as the same HR issues relating to labour shortages and a lack of employee interest in performing these mundane tasks.

This latest technological development opens up the prospect of all warehouses being able to upgrade. The advantages of these solutions don't stop there: they also optimise available space and offer a degree of adaptability that automation does not. They can be deployed relatively quickly (just a few months) at existing sites, without the need for any major reorganisation and are modular. In addition, they meet the need for shorter timeframes, a factor lacking in automation.

However, robots still cannot do everything and, for a number of tasks, human beings are still irreplaceable. Additional hardware and software costs to compensate for these difficulties complicate the return on investment (ROI).

After robots and cobots, why not humanoids?



TECHNOLOGY SUPPORTING OPERATORS

In the race for performance and profitability, warehouse occupiers need to find solutions to shortages in human and real estate resources as they seek to expand while complying with CSR and environmental requirements.

Logistics jobs are changing due the upskilling of employees working alongside automated/robotised processes. A positive point which, in addition to improving productivity, could lead to greater acceptability of logistics by improving its image in terms of employability and, by the same token, play a role in facilitating new sites, provided that the environmental issues are also addressed.



Operational requirements

There are some concerns that seem contradictory as occupiers seek to optimise profitability and productivity, on the one hand, while facing the cost of addressing CSR issues, on the other.

Saving space by rationalising and increasing density, limiting the time wasted by human movement, increasing flows, making orders more reliable, improving stock management - all these are challenges for which automation/robotisation offers solutions and which tend to boost profitability and productivity (see examples of occupier experiences below).

The benefits of the technological solutions don't stop there. They also make it possible to do away with tedious and unrewarding tasks and, by the same token, jobs that are currently difficult to fill.

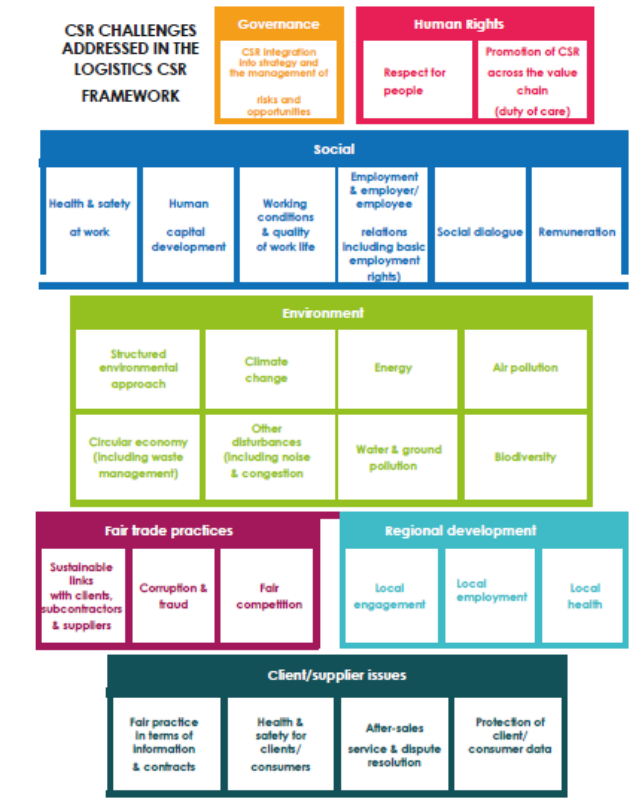
By offering new professions with more added value and less drudgery, staff retention through upskilling should be encouraged and recruitment should be made easier.

At a time when CSR criteria are demanding more ethical and sustainable practices, improving working conditions and respect for the environment are becoming increasingly important.
Here too, technology can offer solutions.

Under international standards, **CSR is broken down into 7 areas of concern: governance, human rights, social, environmental, fair practices, customer/consumer issues, and local involvement.**

By adopting more ethical and sustainable practices in the way they operate, businesses should be able to contribute to improving society and protecting the environment. For logistics companies, the implementation of a CSR approach therefore aims to improve performance from a global perspective, even though this may entail additional costs.

In light of this, **a reference framework has been drawn up for the logistics sector; it includes covering social and environmental issues and others, where warehouse automation can provide concrete solutions.**



Source: CSR reference framework for logistics published by the Ministry of Ecological and Solidarity Transition (2018)

Shift towards greater productivity and profitability

The subject of this report is a key concern for operators who are increasingly implementing automation or robotisation solutions in an bid to get ahead of their competitors (by developing their own solutions or by relying on the expertise of specialised companies). Here are a few examples…

Amazon



In the United States, **Amazon** has introduced robotics into its logistics centres and launched drone delivery. In a new development, the use of AI to analyse data is helping to reduce distances and parcel delivery times by making items stocked closer to consumers appear first in search results. This technology will result in a complete reorganisation of the supply chain while optimising delivery costs. A gradual roll-out is planned in France.

Amazon has also announced the acquisition of robotics company Cloostermans. The company designs and produces mechatronic robotic solutions for its warehouses, enabling pallets and products to be moved and stored prior to dispatch. The European Innovation Lab, which was started in Italy in 2022, has launched an autonomous mobile robot that uses safety, perception and navigation technologies to move around warehouses alongside employees.

In total, **Amazon** has deployed 530,000 robotic units since 2012. In France, at its Augny warehouse near Metz, nearly 30 million items are stored and managed by 3,800 robots and 3,500 employees.

To increase the productivity of its sites, **Amazon** uses robots and is transforming the jobs of its employees with some 700 new job categories being created. **Of the 3 billion parcels processed each year, 75% pass through the "hands" of a robot.**

Source: Challenges "Modern times according to Amazon"

Maisons du Monde



In 2022 the French home furnishings and decoration chain, **Maisons du Monde**, leased its 2nd platform in France with an initial 69,000 sq m in Heudebouville (Normandy), built by GEMFI on behalf of investor AMUNDI (€65 million). The site operates 3 manual units and 6 automated units with stacker cranes. The automated units allow storage heights of up to 22m, compared with 12m in the manual units.

From a technical point of view, the Viastore® solution developed for **Maisons du Monde** is an MMS (massively modular system). It consists of 12 automated zones which are effectively mini warehouses that contain their full range. The tool is designed to hold heavy and bulky products up to 2m long and 200 Kg. Automated storage solutions bring the items to the operators, who then simply scan them and complete the order. In addition, each reference is present in several automated zones with a capacity of 1,000 pallets per hour (according to Viastore®**). This tool reduces the overall volume of stock stored and dispatched while halving the storage footprint.**

According to the company's supply chain manager, this automation will not only *"optimise the space used for operational tasks, but also reduce breakages, which are inevitable when handling products"* and reduce the strain on future operators when handling heavy, bulky products.

In the end, the retail chain opted to outsource the site, entrusting the management of this B2B and B2C logistics platform to Kuehne+ Nagel. The duration of the contract with this service provider was not disclosed, but it is "less than 5 years" with **Maisons du Monde** bearing the entire cost of the IT and mechanisation investment.

In terms of employment, the 250 jobs announced when the project was proposed were reduced to around a hundred following the announcement of the outsourcing.

Sources: Usine Nouvelle, LSA – Mickaël Deneux , Supply Chain Magazine

Bardinet, La Martiniquaise group

Wine and spirits retailer, **Bardinet,** is developing a new automated warehouse in Blanquefort (33) close to one of its production sites: 10,000 sq m over 2 levels, 5 to 7 metres high.

For its future site, **Bardinet** plans to use 3 racking models (dynamic, pallet and accumulation) as well as stacker cranes designed for handling with double-depth shelving. Connected by a set of automatic conveyors and a lift, orders will be prepared in tubs or pallets on the upper level, before being routed to pre-loading channels on the lower level for sequential dispatch.

This intralogistics system, proposed by Mecalux®, will store 20,000 pallets and aims to **speed up handling and boost order preparation** in order to **respond more quickly to customer requests.**

Source: VoxLog

A solution to HR problems?

Against a backdrop of high recruitment pressures in logistics professions:
- warehousing and order preparation are in second place among the jobs most in-demand for future recruitment (almost 200,000 job openings in 2023), and also in the top 10 professions facing the highest recruitment pressure, with an estimated recruitment shortfall of between 25,000 and 50,000 people (Adecco barometer, September 2022).
- Order pickers and forklift operators are the two most in-demand temporary jobs (Synergie job barometer 2021).

Better working conditions and the reduction of arduous work therefore become important levers for companies.

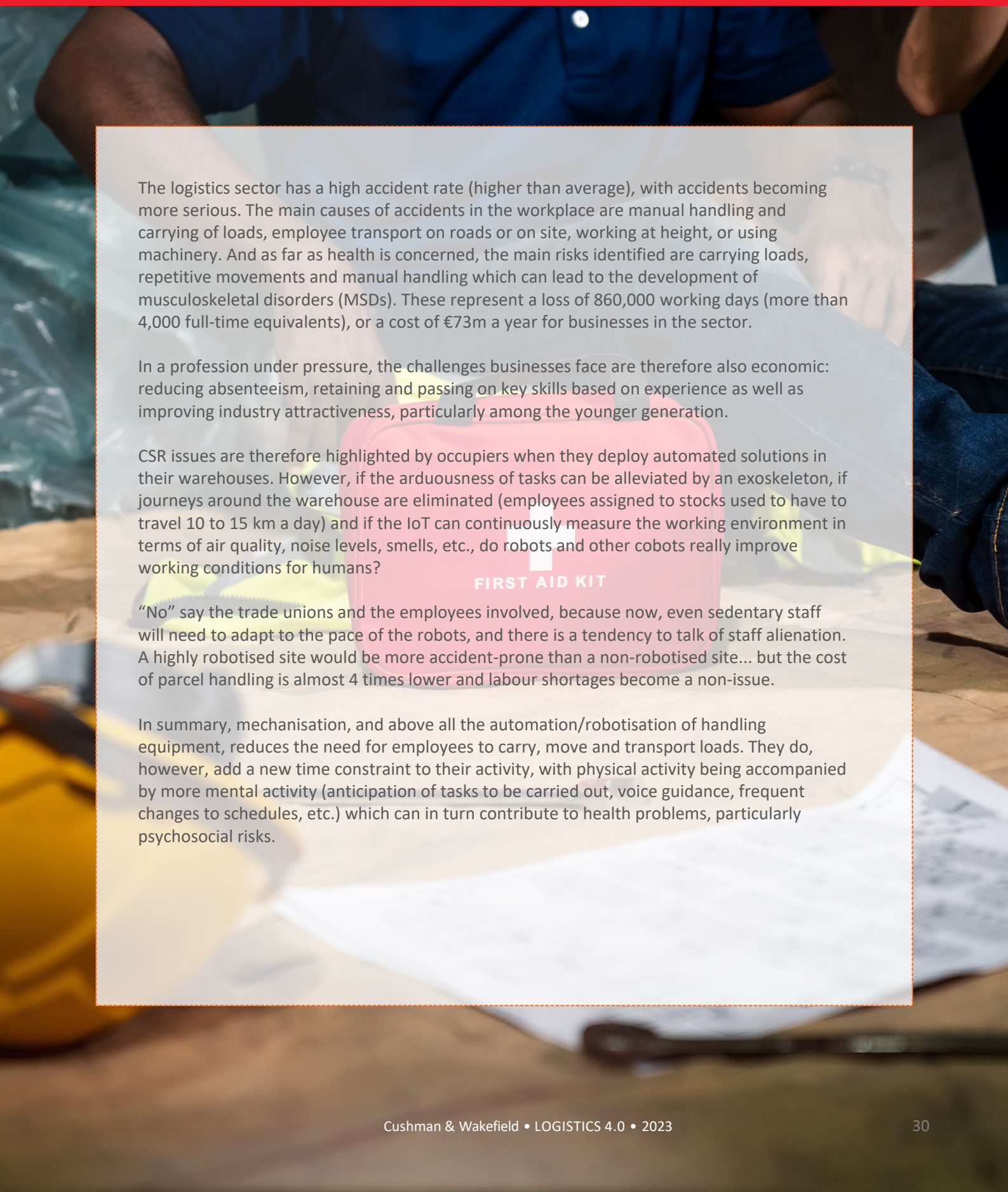
France Supply Chain's white paper *Pénibilité en entrepôt, risques et solutions (Arduous warehouse work, risks and solutions)* lists risk situations and the solutions identified to deal with them, including mechanisation, automation and robotisation.



Technological solutions – the answer to arduous work:

- Gripper arm
- Electric stacker
- Conveyors
- Telescopic conveyors
- Electric pallet truck
- Rotary table
- Pallet stacker/destacker
- AGV
- Wrapping line
- Automatic sorter
- Exoskeleton
- …

SPOTLIGHT ON SECURITY AND HEALTH



The logistics sector has a high accident rate (higher than average), with accidents becoming more serious. The main causes of accidents in the workplace are manual handling and carrying of loads, employee transport on roads or on site, working at height, or using machinery. And as far as health is concerned, the main risks identified are carrying loads, repetitive movements and manual handling which can lead to the development of musculoskeletal disorders (MSDs). These represent a loss of 860,000 working days (more than 4,000 full-time equivalents), or a cost of €73m a year for businesses in the sector.

In a profession under pressure, the challenges businesses face are therefore also economic: reducing absenteeism, retaining and passing on key skills based on experience as well as improving industry attractiveness, particularly among the younger generation.

CSR issues are therefore highlighted by occupiers when they deploy automated solutions in their warehouses. However, if the arduousness of tasks can be alleviated by an exoskeleton, if journeys around the warehouse are eliminated (employees assigned to stocks used to have to travel 10 to 15 km a day) and if the IoT can continuously measure the working environment in terms of air quality, noise levels, smells, etc., do robots and other cobots really improve working conditions for humans?

"No" say the trade unions and the employees involved, because now, even sedentary staff will need to adapt to the pace of the robots, and there is a tendency to talk of staff alienation. A highly robotised site would be more accident-prone than a non-robotised site... but the cost of parcel handling is almost 4 times lower and labour shortages become a non-issue.

In summary, mechanisation, and above all the automation/robotisation of handling equipment, reduces the need for employees to carry, move and transport loads. They do, however, add a new time constraint to their activity, with physical activity being accompanied by more mental activity (anticipation of tasks to be carried out, voice guidance, frequent changes to schedules, etc.) which can in turn contribute to health problems, particularly psychosocial risks.

Support for better environmental responsibility?

Companies need to play their part in the fight against global warming by reducing greenhouse gas emissions and adapting their practices to the impact of climate change. Logistics activities consume a great deal of energy, both during transport and during storage (particularly temperature-controlled storage), packaging and handling. Measures aimed at improving energy efficiency in order to reduce consumption by replacing fossil fuels with renewable energies should be considered and actions should be taken to optimise flows.

When combined with energy-saving measures (reflective white paint for roofs, solar panels, LED lighting, creation of openings to bring in natural light, etc.) **technological developments as a whole can help to achieve environmental objectives specific to logistics with equipment that consumes less energy and automatic warehouse control with intelligent management of energy requirements** (switching on/off lighting, recharging equipment and appliances, etc.).

A number of solutions are able analyse warehouse flows in order to optimise them. For example, they rely on connected objects to complement the WMS, or hybrid trackers that can operate both indoors and outdoors, enabling goods or a fleet of vehicles to be tracked outside the walls of the warehouse.

Technology also makes it possible to optimise parcel preparation and therefore to reduce lorry empty rates, which in turn tends to reduce the number of rounds. This makes procurement and delivery more efficient.

Finally, automation/robotisation allows for space saving and for more to be stored at the same site; this makes buildings and land more profitable and reduces the amount of greenfield development.

However, the acceleration of logistics flows that automation brings is transforming activity both in and around warehouses. The increase in inbound and outbound rotations can be a source of disturbance, visual and noise pollution and have a negative impact on a building's surroundings. Does this mean that automation simply shifts the problem of environmental impact to outside of the warehouse?

The evaluation of the environmental benefits and drawbacks of automation also need to consider the hinterland around warehouses.

Decarbonisation of the modes of transport used, another huge topical issue for the future of logistics, therefore also needs to be resolved alongside the technological development of warehouses and the increase in flows inherent to this development. This would also help to make the construction of new warehouses in and on the outskirts of our cities more acceptable by reducing the disturbance caused by logistics activity.

REAL ESTATE AND TECHNOLOGY

The transformation of operational tools to include more automation requires the adaptation of warehouse structures, both in existing warehouses and in future projects, with consequences in terms of construction and costs.

The character and transient nature of occupancy, as well as the "basic" nature of the warehouse may be overhauled by this transformation, whereas financing needs to change to take account of this paradigm shift.

Will the march towards intelligent warehouses transform the logistics real estate market?



Infrastructure: what are the building requirements to facilitate operational performance?

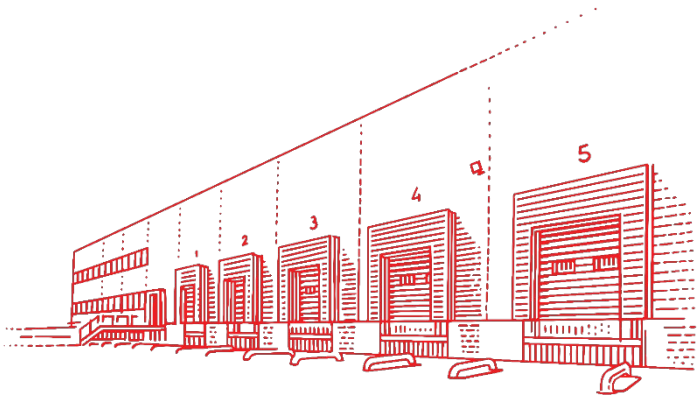
Technological developments for warehouses mean that buildings need to be adapted to accommodate them, but to what extent? It turns out that the various areas of concern in terms of infrastructure do not pose any major technical problems and, apart from a few exceptions, do not radically change basic warehouse standards to the point of making them too specific to be taken over by another operator.

Review of the various points in a warehouse's infrastructure that may need to be adapted to accommodate one or more technological processes:

1 - **Floor planimetry**: joints and flatness must be impeccable (to the nearest millimetre), particularly for automation and robots. Generally, in order to accommodate an Exotec® type automation system, the flatness requirement is limited to an area of between 1,000 and 2,000 sq m, rather than the entire warehouse.
Whether in an existing building or in a new project, it is possible to fit out an area of this size without any particular technical difficulties. The additional cost is around €15/sq m for pouring this specific flooring (French standard = DTU 13.3). However, for fully automated warehouses, the extra cost becomes more substantial.

2 - **The slab**: this must be able to withstand a floor loading of 5 tonnes/sq m, with load drops of 7 to 8 tonnes/sq m, or even more if mezzanine storage is in use. These characteristics are common in most warehouses, but existing warehouses and courier services still have slabs that can withstand only 3 tonnes/sq m. From a technical point of view, the solution would be to rebuild the slab or foundations for the anchor points. Once again, it's all a question of cost acceptability.

3 - **Fire safety**: ESFR standard sprinkler systems can meet the requirements of buildings with a standard ceiling height of 12 to 13 m. However, in some cases alternative systems need to be installed as, despite the introduction of common standards, each insurer, local fire service and DREAL may have their own requirements depending on the location and type of activity.
There are no additional requirements for fire-stop walls and floors compared with standard 2-hour fire-stop operation. Conveyor openings must be fitted with fire dampers.



4 - **Warehouse volume**: whether it's the unit size (ICPE standards) from 6,000 to 12,000 sq m (with a possible dispensation for up to 50,000 sq m in exchange for industry specific safety measures), fire walls, whether or not there are columns and wall recesses for conveyors, all these characteristics are identical to the standards for logistics warehouses. Conveyors which require openings between 2 units are technically feasible with fire-stop flap doors, the location of which can be modified in the event of a process change (opening with concrete lintel reinforcement in the existing fire-stop walls).

As far as the height of the warehouse is concerned, the minimum, i.e. 10 to 13 m clear height, also remains within the normal standards. However, the greater the height that can be used, the more profitable the site. However, at heights of 30 m and above, local development plans (PLU) may include provisions that apply, increasing the risk of refusal or opposition.

Despite this, one type of warehouse has seen sizes develop considerably in order to adapt to new technological processes: courier warehouses, where depths have increased from 30/40m to 70m, to allow for the installation of complex sorters and conveyors.

5 - Electrical power: over sizing is recommended, particularly for speculative projects. The upfront installation of 600 kVA (rather than 250 kVA) seems preferable, as it avoids the need to change transformers if high power is required for new operating technology. The installation of photovoltaic panels on the roof can help to power automation processes, but is insufficient in terms of continuous power supply in 3x8 rotations, due to the lack of night-time production and problems associated with energy storage, the technology for which is still being developed.

A developer’s expertise

"The adaptation or construction of a warehouse capable of meeting the requirements for the implementation of technological processes does not pose insurmountable problems from a technical point of view." Everything is practically feasible, even in existing buildings or by starting from scratch: you just need to anticipate a few points, such as over sizing the transformer. However, the easiest thing to do is to work upstream on a turnkey project, where the constraints have already been analysed and planned for: from the location of automated zones to obtaining planning permission and ICPE permits, as well as validation from the local fire service and the operator's insurer in terms of the safety measures that need to be implemented depending on the selected configuration for automated operations.

For these types of project, the obstacles are more economic: the cost, or rather the additional cost, and therefore the return on investment are the two points that can slow the technological adaptation of a warehouse, such as automation.

Finally, when an investor finances and owns the building, the modifications and improvements made to the structure of the basic warehouse must be acceptable to the investor. Ultimately, these are often adaptations that are not overly specific and do not alter the "standard" nature of the warehouse asset which investors are so fond of.

*However, the approach is different when it comes to the construction of bespoke buildings which are developed to accommodate a particular technology. These buildings are built around a process and are completely bespoke. This applies to warehouses developed for Amazon: the building is totally designed around their automation process, as in the case of the 4-storey building constructed by **Virtuo** in Metz (9m high ground floor plus 3 x 4 m high storeys).*

The reversibility and liquidity of these schemes when the tenant leaves are difficult to quantify and rental terms need take this into account. "



Jean Michel Lemius, Managing Partner VIRTUO INDUSTRIAL PROPERTY

Today's construction techniques allow for almost any adaptation to be made. The main points that that can slow a warehouse adaptation are cost, return on investment and investor acceptability.

Priority for property investment?



Investments in warehouse assets are mainly for the building, with few investors also financing operational equipment**,** often because their statutes prevent them from doing so, but also by choice. In addition to the specific nature of transactions and the lack of experience traditional logistics players have of this type of arrangement. In order to understand why investors are less interested in building + technology arrangements, the current market situation needs to be taken into account.

Difficulties in acquiring new assets and upgrading existing ones

After years of growth, the logistics investment market is now subject to a number of factors that are slowing progress: rising lending rates, inflation, regulations preventing greenfield development (ZAN), slower economic growth and rapidly approaching environmental constraints.

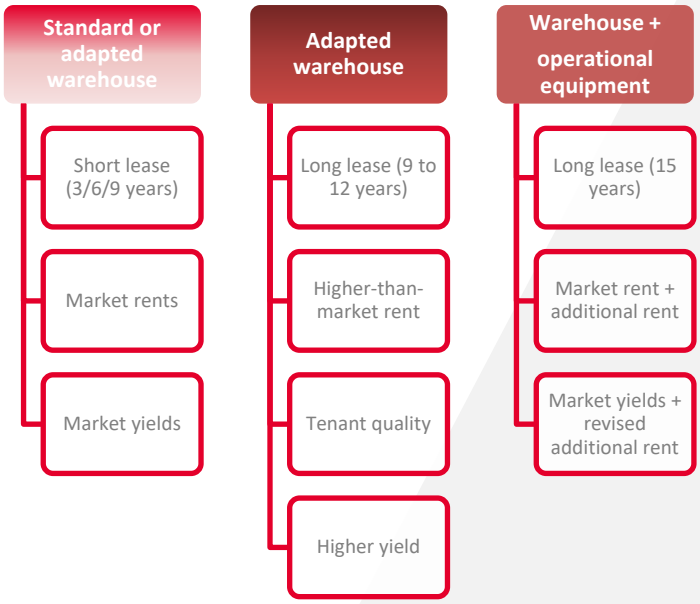
In response to this last point, investors are currently upgrading their assets, particularly older warehouses. Investments are focussing on improving the energy performance of buildings by switching from fossil fuels to clean energy sources (installation of rooftop photovoltaic panels, heat pumps, etc.). These are priority projects in investor strategies, proving that the world of logistics knows how to challenge itself and innovate. Building sustainability is also assessed in terms of reversibility and mixed use potential for new sites. Decarbonisation is also being driven by the refurbishment of old warehouses (provided that they are still structurally suited to demand, particularly in terms of height) vs. new construction, with opportunities to upgrade warehouses at the same time as improving energy performance.

The industry may be scaling back plans for XXL facilities in favour of smaller warehouses closer to towns but this is also because large warehouses are already well established. As a result of the supply difficulties seen in recent years, some players have decided to double their facilities rather than have one XXL warehouse (2 x 60,000 sq m rather than one x 120,000 sq m). Conversely, the last-mile logistics network is still growing. With difficulties in sourcing land land due to ZAN regulations and urban densification, the pursuit of productivity and profitability are weighing on the efficiency of storage methods and the need to automate operations is becoming more pressing.

Given this climate, project finance for new projects is split into two parts: the acquisition of the real estate on the one hand and the operating technology on the other, and the sources are still rarely found in the same place.

As a result, the property investors who are financing these new warehouses, which are both greener and better suited to new operational technologies, will have different requirements depending on the nature of the investment they are planning to make.

In addition to traditional real estate investments involving standard or adapted warehouses, which we have shown remain similar to traditional standards, there are 2 further types of investment: the financing of bespoke warehouses for specific technologies, or the financing of warehouses + the technology needed to operate it.



Standard or adapted warehouses are still the most popular type of logistics asset. Over the last few years, these have benefited from strong activity due to their sound fundamentals.

Against the backdrop of economic deterioration and rising interest rates and faster price correction than for other asset classes over H1 2023, the logistics sector suffered a severe downturn, with €550 million in investments (-84% year-on-year). This sharp reduction in volumes was due to sharp interest rate hikes. The market is already starting to balance out, with renewed interest from international investors, for whom logistics is now the most attractive and resilient asset class.



In an climate of continued uncertainty, where the prime yield could see further adjustment, investors are becoming increasingly selective. Core+ and value added transactions continue to offer real opportunities for players seeking a return on risk in line with the new yield environment. **The important factor for investors remains the spread between the borrowing rate and the rate of return, so why not look for it in more complex transactions?**

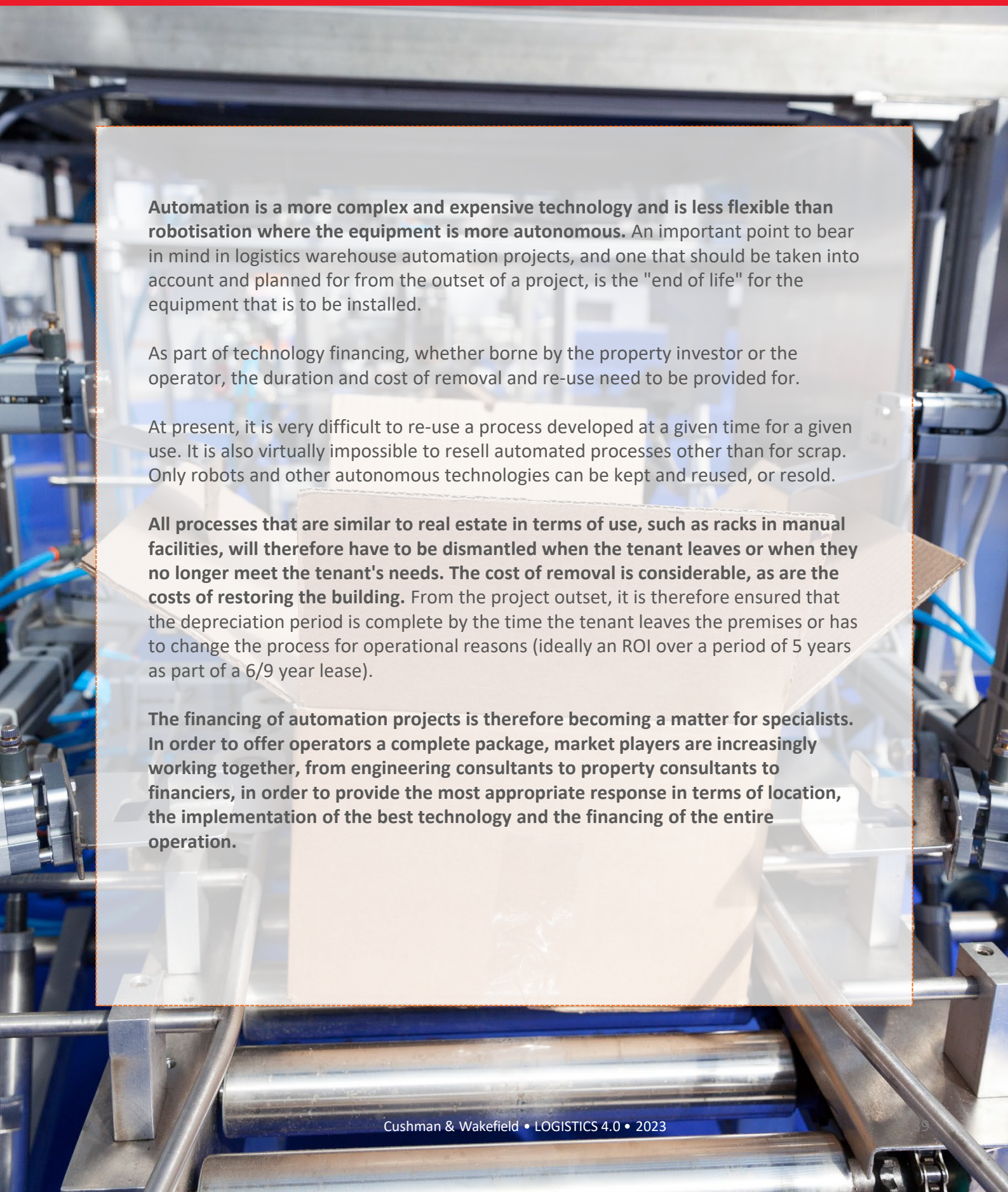
The "warehouse + operational equipment" type of investment, which is more akin to an industrial investment, requires investors to have a good understanding of the issues involved. For these investments, those who are used to financing factories or data centres appear to have a better grasp of the logic behind this type of investment. The majority of investors in logistics real estate will have neither the experience nor the option under their statutes to finance such projects. Other players, such as banks or banking pools, may also be involved in these investments as they are able to support their customers throughout the entire process.

These deals involve a combination of real estate and technological value, with the technological component representing 50% to over 100% of the real estate value. They are based on a long-term lease so that the technological equipment is fully amortised at the end of the lease by means of an additional rent to finance the cost of the investment in the equipment and technology. Tenant quality is also an important factor in the decision making process.

For "bespoke properties to suit a process", we find the same approach as above in terms of financing for these non-standardised assets: conditions for lease term and the amount of rent, as well as tenant quality. In order to accept a long-term lease, the tenant will need to be a shipper (whose has been in business for a long period, unlike 3PLs) who will finance the technology with a bank loan or mortgage, the rates of which will be more advantageous than those included in an overall package; stand-alone equipment can also be the subject of a lease with an option to purchase (LOA) which is much more suitable for this type of investment. And the investment will be all the more secure for the investor as the tenant will often spend far more on the equipment than the investor will on the building.

In the latter two cases, the expected rate of return will be higher, but the liquidity of the asset will be lower, or even non-existent in the case of bespoke investments. **However, this type of rather niche investment currently attracts mainly “specialists”. In a market where long-term leases are becoming increasingly rare for less tailored assets, it is conceivable that some “long-term” investors will become more interested in these very specific assets due to the secure cash flows that they offer - perhaps, given the amounts involved, leading to the creation of partnerships with occupiers.**

SUMMARY AND CONCLUSIONS



Automation is a more complex and expensive technology and is less flexible than robotisation where the equipment is more autonomous. An important point to bear in mind in logistics warehouse automation projects, and one that should be taken into account and planned for from the outset of a project, is the "end of life" for the equipment that is to be installed.

As part of technology financing, whether borne by the property investor or the operator, the duration and cost of removal and re-use need to be provided for.

At present, it is very difficult to re-use a process developed at a given time for a given use. It is also virtually impossible to resell automated processes other than for scrap. Only robots and other autonomous technologies can be kept and reused, or resold.

All processes that are similar to real estate in terms of use, such as racks in manual facilities, will therefore have to be dismantled when the tenant leaves or when they no longer meet the tenant's needs. The cost of removal is considerable, as are the costs of restoring the building. From the project outset, it is therefore ensured that the depreciation period is complete by the time the tenant leaves the premises or has to change the process for operational reasons (ideally an ROI over a period of 5 years as part of a 6/9 year lease).

The financing of automation projects is therefore becoming a matter for specialists. In order to offer operators a complete package, market players are increasingly working together, from engineering consultants to property consultants to financiers, in order to provide the most appropriate response in terms of location, the implementation of the best technology and the financing of the entire operation.

The approach of a specialist investor

*"A true logistics specialist, **Prologis** is an owner, operator and developer". It supports its customers in their logistics activities to help them reduce costs and increase efficiency through existing or custom-built buildings in strategic areas. The mission of **Prologis Essentials** is to gain an in-depth understanding of the customer's business, its strategies and objectives and to offer the best solutions to improve building operations and the work carried out within them.*

***Prologis'** teams therefore support tenants in their operations, from need identification through to selecting the most appropriate technical solution. And this support can also extend to financing the acquisition of operating technology on behalf of the tenant. Several financial packages are possible:*
> incorporating the cost of this investment into the rent,
> repaying the investment by means of a rent supplement.
***Prologis** can also offer lease financing through its financial partners.*

*For example, with its partner Exotec® **Prologis** supported **SAMADA** in its automation project as part of its move to Moissy-Cramayel park in a building designed specifically to accommodate it.*

As a specialist player in this field, the most important aspect of this comprehensive solution is tenant satisfaction and loyalty, which in turn ensures the long-term future of its investments".



Benjamin Foucault
Essentials Solutions Manager
PROLOGIS

Prologis Essentials supports its tenants as they consider new locations. All the technologies suggested or requested benefit from personalised support, from the definition phase through to implementation, while including a range financing options.

THE LAST WORD



ROMAIN NICOLLE
CO-HEAD LOGISTICS
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More than warehouse de-standardisation, the inevitable integration of new technologies into logistics operations currently poses the problem of a lack of adaptability and re-usability of automated processes in the event of a change of use.

Standard buildings, a guarantee of liquidity for logistics property assets, do not appear to be called into question by the technological changes underway, even if the cost of adapting certain older warehouses could be prohibitive and lead to accelerated obsolescence. However, it should be noted that some storage operations will continue to be manual, either because the technology is not yet able offer a solution, or because the ROI is not viable.

The real question is what will happen to custom-built warehouses built around a specific technology. The likelihood of obsolescence, often corresponding to the approximate duration of a lease, is high. As start-ups creating AI, robots and humanoids continue to innovate, they may create new solutions that ultimately call into question the value of existing facilities with the possibility of making them even less attractive. Investment in "tailor-made" real estate projects, including technology financing, is likely to remain the preserve of "specialists" (pure logistics players or specialists in industrial outsourcing) for some time to come.

Conversely, standard (or adapted) warehouses will play a more key role than ever in general investors strategies as they continue to offer a guarantee of liquidity and rental appeal in a market where there will be a structural shortage of available supply.

GLOSSARY

Barcodes: representation of numeric or alphanumeric data in the form of a symbol made up of bars and spaces, used for product traceability
B**uffer**: memory built into peripherals (hard disk, printer, CD-ROM drive, scanner, etc.) for temporary storage of data in order to facilitate information exchange and optimise data flows. In logistics, buffers are strategically used to ensure delivery times and to prevent delays due to a lack of materials.
Cobot (collaborative robot): non-autonomous robot working in direct collaboration with a human, with a view to increasing productivity and reducing the laboriousness of tasks. Unlike the classic **robot**, which works for humans, the cobot is designed to work with humans.
Cross-docking: a method of organising order preparation in which goods are distributed directly to the end consumer without going through a storage period. This method consists of moving goods from the arrival docks to the departure docks without having to transfer them to the warehouse.
Dark warehouse: warehouse in which no lighting has been installed because there are no operators working there. All processes in the facility are automated, so storage or order preparation and dispatch tasks are carried out by software-guided machines.
Wire guidance: automatic or semi-automatic guidance system enabling a transport vehicle to move without human intervention, simply by using the guide provided by a “wire”, usually buried in the ground.
Artificial Intelligence (AI): represents any tool used by a machine to “reproduce human-related behaviours, such as reasoning, planning and creativity”.
Internet of Things (IoT): describes the network of physical terminals, or "objects", that incorporate sensors, software and other technologies to connect to other terminals and systems on the internet and exchange data with them.
Intralogistics: an organised set of physical actions within a single entity with the aim of optimising the processing of flows. From reception to dispatch, everything needs to be organised, controlled and optimised for both physical and IT flows.
Picking: the key moment in order preparation when the picker collects the items in an order from the warehouse and gathers them in one place so that the parcel can then be prepared.
Supply chain: refers to the various stages in the supply chain, from the purchase of raw materials to the delivery of a product or service to the customer. It represents all stages involved in ensuring and optimising production. Its aim is to manage end-to-end flows - product flows, information flows, physical infrastructures and human organisations - from suppliers to end customers.
Workflow management: all operations for the automatic transfer of materials, products and information. Including computerised and robotised handling, i.e. all automated logistics resources.
CVU (Consumer Sales Unit) is a unit of product, as marketed. Corresponds to the product as sold to the consumer (by unit, by pack, etc.).
Wave picking: a warehouse picking strategy which consists of grouping orders according to a shared logistical criterion and assigning a specific place for their preparation. Orders can be grouped by end customer, by type of carrier, by volume or size of load, by dispatch times, etc.



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CUSHMAN & WAKEFIELD RESEARCH

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