Warehouse of the Future

Optimal use of square and cubic metres

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Warehouse of the Future
Optimal use of square and cubic metres (part 1)

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Foreword

In the past 4 years, we have supervised a number of projects by students at companies in collaboration with Rotterdam University of Applied Sciences. Due to the open-mindedness of the students and therefore creative/innovative approach to bottlenecks, this has provided interesting insights into how to deal with logistics in the future. What we have particularly noticed, however, is the fact that we (logistics consultants, real estate companies and logistics parties), together with (local) governments, are not able to give a clear vision of how we see logistics in the Netherlands in the future.

That is why we have come up with the idea to give a (practical) impetus for that vision:

> *The Warehouse of the Future. The starting point of the Warehouse of the Future is that it makes a positive contribution to the requirements of sustainability, well-being and efficiency for the user, taking into account the increasing complexity as a result of scarcity, regulations and social transformation.*

The white papers outline the range of possibilities that exist in the various sub-facets, with which the 'warehouse of the future' can be designed. The purpose of the whitepapers is to provide the various stakeholders with practical ideas and tools to work with and, where necessary, to provoke discussion/ exchange of ideas. We realize that no overarching blueprint or 'Grand Design' is described here. Although the whitepapers are written from a Dutch perspective, we believe elements can be used internationally as well.

It is more important to us that we stop looking at each other or trapping each other because of outdated concepts or regulations. The Future is always different from what we think, in any case not what it is today: so, get moving and take steps for that future.

Happy reading.
Annemieke, Eric, Raymond, René and Radboud.

Table of contents

Introduction

Space is at a premium. And yet, in urban areas, and beyond, almost exclusively single-layer distribution centers are built. In doing so, the Netherlands is missing out on opportunities. By combining logistics functions, building multi-layered and smart automation, available space is optimally used, and energy is saved. These warehouses of the future also offer countless other advantages.

Consumer behavior is constantly changing. And that has an impact on logistics chains and warehouse operations, inside and outside the cities. In addition, the population of the Netherlands continues to grow. Combined with the government's desire to build fewer (large) distribution centers, the increasing distribution volume in the future must largely be absorbed within the existing distribution infrastructure.
Add to this the lack of available personnel, a development that is expected to continue in the coming years due to the increasing ageing of the population, it is clear a fresh look at distribution capacity is needed. In collaboration with, among others, the Top Sector Logistics and the Rotterdam University of Applied Sciences, René Geujen (Next Level Development), Radboud olde Scheper (Riverland Supply Chain Consultancy), Raymond Tukker (TICM) and Eric Hereijgers (St. Onge Company) provide this different view in a series of white papers.

The starting point for the vision is that it should make a positive contribution looking at sustainability, well-being and efficiency, of course taking into account the increasing complexity as a result of scarcity, regulations and social transformation.

Leading in this are:

- scarcity (personnel, space, energy, etc.);
- clustering of functions;
- flexibility;
- innovation;
- social relevance and acceptance;
- no sacred cows are spared and
- concrete steps (now and not in 10 to 20 years).

That is why we looked at better, sustainable use of space, better use of operational hours, the possibilities of energy transition, robotization and mechanization, and a sustainable use of materials.

This vision is laid down in three white papers - under the umbrella title 'Warehouse of the Future'. The triptych outlines the palette of possibilities to shape the warehouse of the future.

Developments and challenges

The vision takes into account the challenges that logistics organizations will face in the coming years as a result of various developments. In addition to the aforementioned developments such as the ageing population, lack of space and the 'dumbing down' of the landscape, mechanization, robotization and digitalization were also examined. And to legislation, sustainability, organizational set-up, training and experience of logistics managers. Developments that all have an impact on the design and processes in the warehouse of the future.

Moveable racks using robots

Mechanization and robotization

The number of large-scale, mechanized warehouses is growing. At the same time, the application of mechanization and robotization is becoming increasingly accessible and small-scale. Large, automated distribution centers require huge investments, while implementation often takes more than two years. Partly as a result of centralisation, the number of large-scale, mechanized DCs has risen sharply over the past 20 years. Until five years ago, the main driver was reducing costs. Nowadays, the ageing of the workforce and the shortage in the labour market also play a role and the desired logistics service and security of supply are increasingly a reason for applying mechanization and robotization.

Mechanized DC

Robots - moving pallets or rollercages

However, for smaller logistics operations, the large-scale solutions are not cost-effective. For this much bigger market, the number of mechanization and robotization options is steadily increasing. In addition to the large suppliers, there are now also small suppliers - more innovative, faster and more flexible than large players - and they are developing and introducing smart material handling solutions, often using proven techniques for new application areas. The innovative solutions are often flexible to fit in, scalable, movable and can be used in manual warehouse environments without any problems.

Examples include autonomous mobile robots (AMRs) that bring shelving units to order pick stations, order pickup trucks that automatically follow the operator, reach trucks and narrow-aisle trucks that automatically store and retrieve pallets, and AGVs that take care of horizontal transport fully automatically. Other examples which are improving the efficiency of the operation are:

- Lifts and automatic shuttles (for small-scale, automatic storage of pallets).
- Continuous lifts for pallets and bins (whether or not in combination with AMRs or AGVs for the supply and removal of goods).
- Simple sorting installations in combination with put-to-light sorting racks.
- Floor chain systems, for the transport of roll containers between floors.

Characteristic of these small-scale applications is that manual work often does not disappear completely. However, the solutions do help to improve ergonomic working conditions. In this way, transport over long distances can be automated and repetitive work is avoided. As a result, the physical strain on employees decreases, while productivity increases.

Moreover, thanks to continuous technological development, mechanized solutions are becoming relatively cheaper. As a result of standardization, and improved integration possibilities of IT systems and control, the costs for complete AGV solutions are now about 50% lower than they were 25 years ago.

A closer look at process steps

Developments in the field of mechanization and robotization, as well as developments in Digitalization, are influencing logistics processes. They make it possible to deliver a comparable or even better logistical performance on a smaller footprint and with less energy. However, the developments are very diverse in nature and have a different impact on the number of employees required, the level of knowledge and management of those employees, the energy requirement, and the required space.

Receiving planning and processing

Digitalization makes it possible to better plan the goods to be received, and to group deliveries from different suppliers more often. For example, the aim can be to have trucks that transport goods to customers pick up goods from suppliers on the way back.

The concept is not new, but it is often difficult to implement when there is no dominant Supply Chain party present. However, if the need becomes greater, more organizations will start using it.

Better planning also ensures that arrival times for trucks are known earlier and more precisely, reducing waiting times. In addition, because the information about the goods that are being sent is known in advance, those goods can be processed faster. As soon as the goods have been unloaded and scanned, it is immediately clear which goods are on what pallets and these pallets can be stored or cross-docked more quickly.

Mechanization also improves the unloading process. With the help of flexible roller conveyors, connected to sorting installations, the unloading of sea containers - a physically demanding job - can be significantly improved. Heavier boxes can also be sorted and palletized by robots or transported from the unloading conveyor directly to an automatic carton storage system. The improved flow ensures that goods are available for sale more quickly and less space is needed.

Internal transport

The transport of the received goods to the storage areas is mainly done horizontally, and often over long distances. This transport is increasingly being automated, for example with the use of automated reach trucks or stackers. The converted trucks independently pick up the received pallets from the goods receipt and deliver them directly to the desired storage area. AMRs are also being used more and more. For example, for the transport of bins or load carriers to areas with shelving units, where the bins are placed in the correct location manually or directly by the AMR. Or for the transport of pallets to pick & drop locations, where the pallets are taken over by reach trucks or narrow-aisle trucks, whether automated or not.

Autostore system

Putwall

Order picking-goods-to-man

For picking goods, there are numerous mechanized or robotic solutions, which make the work more productive and efficient. In the goods-to-man concept, horizontal carousels, vertical lift modules and the popular Autostore system are well-known examples.

Micro-shuttle systems for put-away, storage and retrieval of totes are also being used more and more often and have become almost commonplace. There are both small-scale (5,000 totes) and large-scale (> 500,000 totes) solutions and technical developments follow each other in rapid succession. For example, in addition to 1D shuttles, which always drive in the same storage channel, and 2D shuttles, which change aisles but always remain at the same level, there are also 3D shuttles and even free-driving shuttles, which 'climb' into the racks and independently bring the goods to a workstation.

In addition, AMR solutions are increasingly being offered here as well. For example, such an AMR transports shelf racks to an order picking position, after which an employee picks the necessary goods. Nowadays there are also solutions in which the AMR does not grab an entire shelving unit, but only the required bin and transports it to a picking station or put wall.

Order picking-man-to-goods

An increasingly common way of order picking according to the man-to-goods principle is with the help of autonomous order picking trucks. These (small) trucks drive to the desired location, or follow the operator, who often picks the required orders within a designated, limited area. Employees no longer have to get on and off at every picking location, or travel long, unproductive distances. They can fully concentrate on their core task: picking orders.

In a less automated variant, employees still drive themselves from pick location to pick location, but order picking is controlled by a smart WMS and 'route navigation'. The system takes into account actual distances, congestion and desired lead times, allowing order picking times to be minimized.

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When the goods are picked in batches (in larger quantities per item and/or per area), the orders can be sorted into putwalls, which can be equipped with displays and putlights for even greater efficiency and sorting quality. The displays and lights indicate at a glance to which location - and in what quantity - the items need to be sorted. The system also indicates when an order is ready and when a new order can be assigned to a consolidation position.

Sorting systems can also be used to sort the picked goods at order level. These can be traditional sorting installations, but also pocket systems, where orders are consolidated with traditional overhead conveyor systems. The benefits of these systems are mainly due to the smart, advanced software.

The various developments and new techniques result in a significant efficiency improvement of the order picking process. Where previously most employees were working in the order picking process, more employees are now working in the to the consolidating and packaging of goods. In addition, ergonomic working conditions for order pickers have improved and often less space is needed to enable the picking process.

Consolidation

Traditionally, consolidating items for a single order has been a bottleneck in many warehouses. After all, the items are usually spread throughout the warehouse, but must be brought together into one location. The simplest method is for one employee to go through all the picking locations and consolidate the order. However, this is also the most time-consuming approach. And far from efficient. For efficiency reasons, orders are therefore often picked in batches.
With smart consolidation or cluster picking software, efficiency gains can be achieved and the lead time - and thus the waiting time - can also be shortened. This software can be present in the WMS, but also in separate optimisation software - which can be linked to WMS systems, so that customization of the WMS is not required.

Packaging

The packaging process has long been neglected. Over the past ten years, however, developments have been set in motion that streamline and simplify this sub-process. Ergonomic, lean-based packing tables are no longer an exception and often improve efficiency by more than 50%.
Smart software can further improve efficiency, for example by splitting orders into partial orders based on the dimensions and physical characteristics of the items, which fit exactly in a pre-calculated box. This saves filling material and increases the filling rate of trucks.
By collecting the goods directly in the shipping box, according to the pick-to-shipping box principle, the process is accelerated and the work more ergonomic. As an extra check, the box can be weighed just before packing and the same software is used to check whether all order lines are actually in the box.

In addition, there are developments in packaging machines, which make it easier to set up boxes and deliver them to the packer. For intensive use, there are even fully automated packing lines.

If possible, goods are increasingly packed in plastic bags, with the process being simplified by Autobagging systems. The bags are then provided with a packing list and shipping label and can be transported to simple sorting installations.

Autobagging system

The packaging materials used can greatly increase the CO_2 footprint if the filling rate of the boxes or bags is too low, or the packaging material is not easily reusable. Packaging techniques are therefore increasingly aimed at minimizing the volume of the packaged product. Where possible, residual materials and reusable materials are also used.

By packing goods smartly and with the right materials, packaging material is saved, the volume to be shipped is limited, and environmentally friendly packaging is increasingly chosen. However, this requires an integrated approach in the Supply Chain.
Packaging is required to prevent damages to the products, resulting in unsatisfied customers and returned products. So, the packaging must be suitable for the next steps in the Supply Chain. When the quality of the (commercial) product package is strong enough, additional shipping cartons can be prevented. This can be more sustainable overall; especially for products which are sold more and more via E-commerce.

Sorting & Shipping

Shipping goods to customers often requires a lot of manual sorting and moving work. Better control of the picking and packing process, where orders are released, picked, packed and consolidated in shipments per truck, results in a more streamlined logistics process.
In addition, simple sorting systems are increasingly being used, even for operations where only 500 to 800 parcels per hour need to be sorted. The use of this type of sorting facility is cost-effective for a growing number of logistics operations. The sorting solutions use more and more independent identification solutions, which eliminate the need for a complex link between WMS and the sorter.

The use of sorting systems and a streamlined process saves space on the shipping floor and energy - because fewer pallet/parcel handling takes place. This way of working also allows for better planning of outbound transport.
Better agreements can be made about when shipments are ready, so that waiting times for drivers are avoided, docks are used better, and a smaller loading pit is needed. Where in the past only 1 truck per day was loaded per dock, now up to 3 to 5 trucks are often loaded per dock at larger DCs.

For even greater efficiency, AGVs can be used to load the trucks. Scanning the pallets at loading prevents the wrong pallets from being loaded. Accidentally loading a pallet into the wrong truck and the extra trips to correct the mistake are then a thing of the past.

Space utilization and sustainability

The aforementioned developments also have an impact on the CO_2 footprint of the logistics processes. This can be included in the annual CSRD (Corporate Sustainability Reporting Directive), in which larger companies will be required to declare the CO_2 footprint of their supply chain annually as from 2023. In the future, they will also have to report on the measures taken to reduce the CO_2 footprint.

Furthermore, from 2030 onwards, CO_2 production will have to be paid for, not only during transport to and from the warehouses, but also during the processes in the warehouse. This will have to be taken into account in the development of new warehouses. For example, mechanization can help make better use of the scarce available space, and more compact solutions can be implemented, which lead to less CO_2 emissions. More compact, integrated logistics solutions and digitized inbound and outbound planning also result in a more efficient supply and removal of goods, and thus in better use of space and a higher filling rate of trucks.

All this requires extra knowledge and attention from the logistics specialists. Just looking at logistics performance and cost reductions is no longer enough.

Rhesus solar panels

Interchangeable battery station Jungheinrich

Exchangeable batteries for better use of solar panels

Existing solutions will also have to be looked at differently. In more than 90% of all warehouses, most pallets are still transported by electric pallet trucks, forklift trucks, reach trucks and very narrow-aisle trucks. And although the trucks are increasingly automatic, the type of truck is expected to remain unchanged for some time to come.

The trucks run on batteries, which need to be charged daily to ensure uptime. Traditional lead-acid batteries wear out over the years and, depending on the use, need to be replaced after 4 to 6 years. Or rather; after an average of about 1,250 charging cycles. The number of charging cycles determines the lifespan of a lead-acid battery The trucks are mostly put on the charger every day, whether the battery is completely empty or still half full. This reduces the lifespan of the batteries.

However, more and more DCs are also equipped with solar panels. These generate energy during the day, while the trucks are usually charged at night. With interchangeable batteries, the self-generated energy is put to better use. Each truck is provided with 2 batteries: 1 in the truck which is being used; the other battery is being loaded during the day, when the solar panels are producing electricity, The batteries are then charged by the solar panels during the day, which also reduces the load on the external electricity grid.
Changing batteries does take more time, but this is offset by a longer battery life and a lower overall CO_2 tax. Especially if you have to pay for that CO_2 tax in the future, this is something to take into account.

Increase storage density, reduce space requirements

There are more (sustainability) themes that have an impact on the warehouse of the future. For example, space for large DCs is not infinitely available. And available space is also desperately needed for housing, recreation, organic food production, etc.

Conventional warehouses with wide aisles and shelves on the lower beams of the pallet racks require a lot of space, also because the space above the goods reception and dispatch areas is often not or hardly used. In a traditional warehouse, it is not unusual if no more than 10% of the volume is actually being used for the storage of goods. The vast majority is used for transport paths, manoeuvring space and workspace. In addition, the plot may often only be built on for 60 to 70%. Therefore, a lot of space is lost. Why not park underneath the warehouse? Or on the roof?

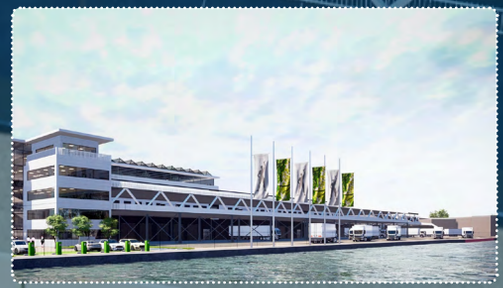
New and more mechanized storage techniques enable better utilization of warehouse space. This can be achieved in a number of ways, for example by:

- automated shuttle systems for bins and boxes;
- cubic storage and order picking systems such as Autostore;
- multi-deep pallet storage systems with 2D pallet shuttles;
- mobile pallet racking;
- vertical lift modules, in combination with carousels;
- multi-layer AMRs for the supply and removal of pick pallets to order pickers;
- VNA pallet racking with automated narrow-aisle trucks, which transport pallets to and from picking areas; or
- VNA pallet racks in combination with sorting systems for boxes and loose pieces.

More compact storage and order picking techniques save space, personnel costs and energy, for example because driving distances are shorter. But the solutions offer more advantages. Working conditions are also more ergonomic for the remaining manual work, and heating and good lighting can be concentrated in those places where employees work.

Many modern, mechanized solutions do not require tall buildings; the required height varies from 3 to 12 meters. But even better use can be made of the available square and cubic meters. Until now, there has been little or no such need, as the costs for warehouse land and space in the Netherlands are low. The initial investment in a spacious single-layer warehouse on a large site is simply lower than that in a multi-layer building on a smaller footprint. However, when the available space becomes much more limited, there will be a need to build more and more multi-layer warehouses. To be able to create additional warehouse space and capacity, we will have to go up.

What multi-layer solutions do require is a different way of planning and control. Whereas in traditional warehouses a lot of extra space and capacities are 'reserved' for temporary peaks and promotions, mechanical solutions work better if they can be controlled more systematically. By using historical data from the order management system, picking locations can, for example, be replenished earlier and proactively in a 16-hour or 24-hour process. This results in better utilization of the equipment and more stable and balanced way logistics process.
To make this possible, more coordination is needed between logistics employees and commercial employees. Thorough preparation and good planning are a must. And that requires different competencies and skills.

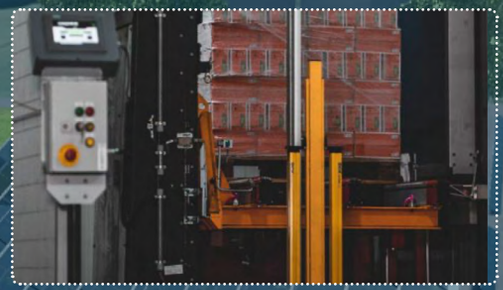


Multi-layered warehouse

Stacking logistical functions on top of each other

It is now clear that the use of space for logistics operations is under pressure and must be limited. It is also clear that available space for logistics in the Netherlands has simply been poorly used. Available heights are insufficiently used, and various logistics functions take place separately from each other. For example, goods are too often transported from warehouses to carriers, to be unloaded, sorted by route and then loaded again. In other words, insufficient use is made of the accumulation of functions.

Stacking logistical functions



Pallet lift

Spiral conveyors over 30 metres, Apollo

Experiences of other densely populated regions

In other densely populated regions with a lot of distribution, such as Istanbul and Singapore, it has long been unthinkable, let alone feasible, to build single-layer warehouses. Warehouses with two, three or four concrete floors, each with a clear height of 6 to 12 metres, are the rule rather than the exception. By consciously assigning the functions of the warehouse to these different levels, and combining functions, a very compact and extremely efficient logistics process is created. And also, less space is required, and goods are delivered at the customers with less energy and CO_2 production.

Multi-Layer Operations

Modern, multi-layer warehouses often have a combination of both groupage and warehouse functions. Some layers are used for storage and order processing, while another layer is rented by one or more carriers - for groupage of shipments and distribution to customers, or for sorting B2C shipments by parcel services. On the second floor, for example, the picking, consolidation, and packaging of the orders takes place, after which the same orders are transported to the ground (first) floor via spiral conveyors and pallet lifts, where they are sorted by the carriers. This prevents transport by truck between buildings.
The upper floors are used for bulk storage and value-added services. Large shipments are delivered and stored from the ground floor with continuous pallet lifts. The continuous lifts work in such a way that pallets that go back are transported via the same lifts, making use of gravity and saving energy.

In other multi-layered centers, storage, processing, and packaging are spread across multiple levels. Each of the levels requires pallets from a warehouse environment and delivers pallets back to be stored and shipped. Automatic pallet cranes with a height of 40 meters, or pallet shuttles in combination with pallet lifts, take care of the entry, storage and retrieval of the pallets to and from all levels in the facility.

Cold stores underground

In cold stores, the need for smart and compact logistics is even greater. After all, cooling the building and keeping it at a low temperature requires a lot of energy.
By stacking here as well and building the refrigerated and/or freezer compartment (partially) underground (with other logistics functions above it), the energy bill can be significantly reduced. The temperature of the soil is lower and constant, and also has an insulating effect. In addition, there is no sun shining on the walls or roof, so the warehouse does not heat up either.

Via vertical transport, the goods are transported from the (partially) underground refrigerated or frozen warehouse to the loading dock and loaded directly into the refrigerated compartment of the truck. At the same level, if necessary, the non-refrigerated (ambient) goods can also be added to the consignment.

The concept is energy-saving, requires less floor space and also offers logistical advantages. The extra investments for the construction will pay for themselves. However, this approach requires long-term planning and planning management.

Multi-level material handling systems

Stacking can also be done more often than expected in existing buildings. After all, many modern material handling systems, such as AMRs and sorting installations, are compact and require little overhead height. A clear height of 3meters is often sufficient. By using multiple mezzanine floors, multiple storage and work areas can be realized on top of each other.

This is already happening on a small scale, but at the moment it is often not built higher than 3 or 4 floors. However, there is no reason not to stack up to five or even eight floors on top of each other. The development of vertical transport solutions does not stand still. With continuous lifts, spiral conveyors with built-in sorting units, 'traditional lifts' for the vertical transport of AMRs, or automatic pallet conveyors with automated pallet lifts, any height can be bridged without any problems.

Cross Dock operation

Digitization and planning

An efficient Warehouse of the Future, with minimal space requirements and lower CO_2 emissions, requires a different way of planning and managing supply chains. For example, more use will have to be made of cross-docking, in which goods from different building floors are grouped on one layer. Two examples:

Decentralized storage, central control

One of the major advantages of centralized warehouse operations is that a large assortment is offered from a single inventory location. In addition to increased efficiency, availability also increases. In addition, centralization offers economies of scale.
However, a disadvantage is that goods have to be transported over longer distances. This takes time, energy and leads to more CO_2 emissions. Thanks to far-reaching digitization, a high availability of a wide range of products can also be achieved in other ways. Fast and medium movers are then stored decentrally, closer to the consumer. Slow movers are added later in the process.

The transport of the fast and medium movers from production to the decentralised warehouses can then take place condensed, according to an optimized planning and with full trucks - or via waterways, without much direct time pressure.

Inventories are then centrally managed and allocated to customer orders from a central point, but physical storage and processing takes place decentrally - and closer to the buyers. Average transport distances are thus reduced.
Digitalization also offers consumers the choice of accepting partial deliveries or opting for longer delivery times with less CO_2 impact.

Extending lead times and improving reliability

Digitalization and a different way of planning can reduce the enormous time pressure that many logistics operations suffer from. As a result of this time pressure, and especially in E-commerce warehouses, many employees have to work in the evening or at night and there is hardly any room for optimization.
If consumers accept an additional 1-day delivery time, 80% of the work can be carried out during the day, at a normal pace and with less CO_2 emissions. This is because carriers have more opportunities to group shipments and plan better and more efficient routes. This is also better for the employees, and leads to a better use of resources, lower CO_2 emissions and less energy consumption.

Right now, there are warehouses, especially in the B2C sector, where work is only carried out at the end of the afternoon, in the evening and at the beginning of the night - in order to be able to deliver all shipments to the customer within 24 hours of order receipt. However, those same orders are often waiting for days before they are used which is a pure waste of resources, unnecessary burden on many employees and unnecessary CO_2 production.
This waste can be prevented by informing the customer about this when ordering the goods, and by imposing a CO_2 tax. Research shows that many consumers accept a longer delivery time if there is less CO_2 tax in return and they benefit from increased delivery reliability.

From 2030, consumers will have to pay CO_2 tax. This is a good reason to further reduce CO_2 production in the logistics chain. Another way to limit CO_2 production is to tax same-day and next-day deliveries - and not taxing deliveries with a lead time of 48 hours. This saves a lot of unnecessary transport, stress and pressure on the distribution employees. But this takes courage.

Organization is decisive for success

Of course, managing supply chains differently and managing more compact and sustainable warehouse operations does not happen by itself. The management of the logistics processes must change, and more attention will have to be paid to making better use of available cubic metres. Supply Chain Links must also be removed from logistics chains and at least equal production must be achieved with less CO_2 production.
Process optimization, supply chain planning, mechanization and robotization have an impact on daily practice. And choices made to make better use of both square and cubic metres have consequences for all stakeholders in the supply chain - within the organisation, but also with suppliers. And even in education. This also requires different competencies from logistics specialists and logistics managers.

Process optimization

Process optimization can be implemented gradually and in different ways, ranging from optimizing an existing layout, with small (process) improvements, to completely redesigning the available space with existing techniques, or by digitizing, mechanizing and robotizing.
As a result of the ageing population and the shortage on the labour market, motivated and skilled personnel remain scarce. Given the numerous advantages that mechanized operations offer - in a limited area and with relatively few FTEs - it can be assumed that in the Warehouse of the Future, the automation of information flows and the mechanization or robotization of warehouse processes will take off.
In the field of digitization, the necessary steps have already been taken in recent decades, such as the use of EDI to share Point of Sale (POS) data, Advanced Shipping Notice (ASN), or stock information from stores and distribution centers within the chain. However, this is not yet commonplace for everyone.

Involving employees in change

Engagement generally increases acceptance of change. It is therefore crucial to engage with employees at an early stage and to involve them in the design of their 'own' workplace where possible. Creating mock-ups of future workstations - and testing them together with employees for functionality, ergonomics, safety and layout - can remove a lot of resistance, preserving valuable knowledge for the organization.
This is also what future warehouse workers expect from their employer: more influence over their own working environment and processes. Investing in people is therefore essential. And that investment pays for itself through higher involvement and motivation, and through improved logistics processes.

For process optimization, but also for the design of the warehouse, it is recommended to make employee participation a structural part of the design process. This prevents unnecessary design errors, for example when it comes to ergonomic aspects such as sufficient daylight or limiting noise exposure.
Practical improvements are also immediately taken into account. During the design process, the focus is often on the primary, operational process and there is a risk that insufficient account is taken of derived processes, such as the walking distance from the workplace to toilets or to the canteen. If half of the coffee break is lost on walking back and forth to the canteen, resistance arises. A few extra coffee corners can offer a solution. These kinds of small adjustments often come from the floor and can have a hugely positive effect on productivity, safety, energy consumption and employee satisfaction.

In short, it is advisable to look at the extent to which responsibilities for process optimisation and setting up the workplace can be placed with the employees. A certain degree of independence and responsibility for one's own department results in acceptance and sincere involvement. If you manage to achieve this, you create a 'bottom-up continuous improvement' process in which employees often think about process optimisations on their own. If that feedback is then taken seriously by the employer and proposed improvements, where possible and useful, are actually implemented, employees will feel valued and turnover, and absenteeism will decrease.

Analytical Logistics Support

Managing and optimising logistics flows already demands a lot from an organisation from an efficiency and service point of view. If that operation is spread over several floors, it also requires more planning. If the processes and logistics flows are to be continuously optimized with a view to CO_2 reduction, additional analysis, planning, control and coordination are required. This cannot be left to the operational departments alone. As a result, the importance of an analytical Logistics Support department increases. Logistics specialists, who look at and optimize processes in an analytical way, are then needed to optimally manage the various logistics flows. These logistics support departments are necessary at various levels, especially for multi-layered warehouses to function optimally. Management will no longer take place on the basis of overview and operational control, but on the basis of planning.

Education and training

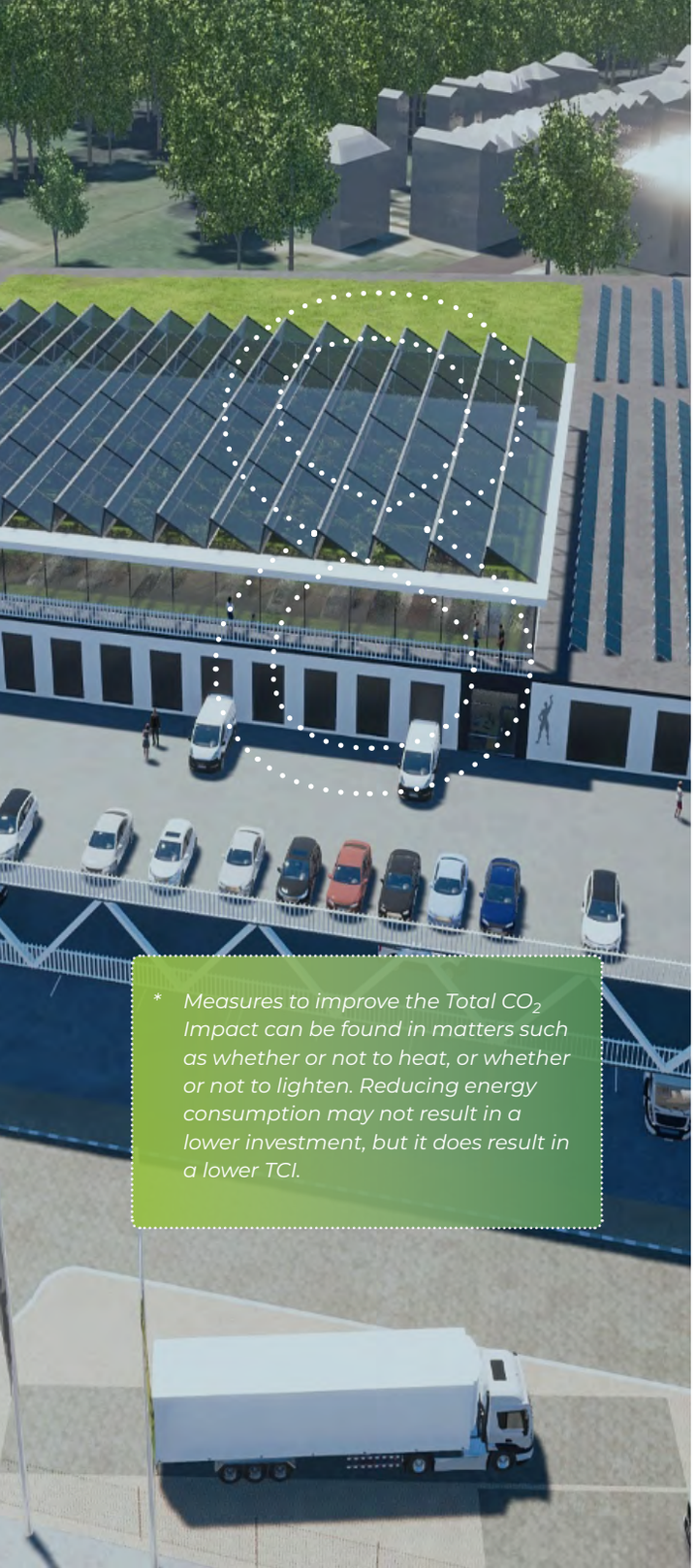
In order to realize the Warehouse of the Future and to be able to manage it optimally, different demands are placed on logistics employees, specialists and managers. Among other things, more attention needs to be paid to:

- knowledge of sustainable logistics and supply chain concepts;
- knowledge of mechanization and robotization, including the control of such systems;
- knowledge of digitization and planning of supply chain processes;
- knowledge about optimising supply chain processes;
- knowledge about space use, energy consumption and CO_2 reduction and
- Knowledge about activating the logistics organization to optimize processes.

Future logistics staff, specialists and managers will need to be trained to give direction to these topics and to ensure that a process of Continuous Improvement is initiated. Not only from a cost point of view, but also in terms of space utilization, energy consumption and CO_2 reduction.

Digitalization, improvement of planning processes, mechanization and robotization are certainly not the only answer to the challenges facing the logistics sector when it comes to making optimal use of the available space. Without a doubt, however, they are all indispensable components in the logistics landscape- now and in the future.

The components help - at least in part - to overcome the shortage of motivated and skilled warehouse staff but on the other hand, the need for well-trained ICT specialists, service technicians and control room operators is only growing. More attention should therefore be paid to these aspects in logistics training.



Organizational aspects

Deciding to mechanize or robotize remains a strategic choice. However, the question of how the chosen system will be optimally used after completion of the project is too often not asked or asked too late. The entire process, from the choice to mechanize to the optimization of a stable operation, can be roughly divided into three phases:

1. **Design & Build: focus on Total Cost of Ownership (TCO) but increasingly also on Total CO_2 Impact (TCI*);**
2. **Implement & Stabilize: focus on 'quality and readiness' and**
3. **Operate & Maintain: focus on cost effectiveness, life cycle management and continuous improvement.**

This white paper focuses on phase 3: the impact of mechanization on the organization, daily operations and the trade-offs that have to be made once the decision has been made to mechanize.

Commissioning and start-up of new systems

The focus of the project team is primarily on the delivery of phases 1 and 2. Too often, insufficient attention is paid to the interests of the future user(s) and the improvements resulting from small optimizations of sub-processes and the addressing of imperfections in the system. Think especially of processes that occur frequently and/or require a lot of capacity and handling. There is often a lot of easily achievable improvement potential here.

Once the project has been completed and mechanization or robotization has been implemented, it is up to the operation to achieve the financial and operational objectives from the business case (phase 3). This is a continuous process, in which the right balance between costs, performance and risks must be constantly sought - in order to ultimately achieve optimal utilization of the available capacity.

Choices to keep the Capex low can lead to a high(er) Opex and often a higher CO_2 impact (energy consumption, wear parts, manual process steps and additional actions) in the later years. This may be a deliberate choice, but it is good to realize that with the future tax on CO_2, lower CO_2 production will become increasingly important.

The impact of mechanization on the operational organisation should also be considered in the design process. The switch from a manual to a mechanized process means that functions are eliminated and that new functions are added, or functions change. Think, for example, of the repackaging of goods from outer boxes to standardised storage crates, or the introduction of roll containers. A well-known example of a changed function is the order picking from manual pick lists to a goods-to-person pick-to-light system.

Changed management and required competencies

However, the most important changes take place in the control and control function of a mechanized warehouse. Depending on the degree of mechanization, such a mechanized warehouse shows strong similarities with factories from the process industry - with new positions such as control room operators, maintenance and process engineers, troubleshooters and a spare parts coordinator.

For middle management in the workplace, a switch to mechanization also has consequences for the way of working. More technical trained operators are required, and it is essential to recruit those technicians before the technical installation is being installed. The technicians should be in place in time. When they can support during the installation but especially during testing, they are trained directly 'on the job'.
However, this also applies to warehouse employees in the operational process, because they too are increasingly confronted with digitization and mechanization. If they leave the company - because of a slightly higher hourly wage elsewhere, an unpleasant working atmosphere, or for whatever reason - the organization has to invest again and again in training of new employees.

It shows once again how important it is to think about the future organizational blueprint and its impact on employees in the design phase, across the board. It is therefore advisable to set up a separate workflow in the design of the project structure. They are not concerned with the technical side of the project, but rather with the organizational aspects. For example, attention is paid to the impact of mechanization on people and organisation at an early stage and throughout the entire duration of the project.

Management can then also enter into dialogue with employees and their representatives, such as the trade unions and the Works Council. This 'New Operations' workflow also includes topics such as communication and change management.
Although it is often the main focus of attention, the changes in operational functions, both in terms of content and implementation, are often less drastic than expected. The difference lies more in the conditions in which the functions are performed and the interaction with the new system. This is generally where the restlessness and resistance among employees lies. Frequently asked questions are: 'What will my new workplace look like?', 'Do I still have a say in my own workplace, or will I become part of the machine?' and 'Will there still be room for social contacts with my colleagues?'.
If the management and project team pay too little attention to these concerns, and the communication is only about the progress of the project and the benefits of mechanization or robotization, this can entail risks:

- employees drop out or resist the changes;
- absenteeism due to illness increases, or
- the new system is not accepted, with negative consequences for the implementation and later the operation.

Service and maintenance

When choosing to mechanize, it will also be necessary to consider the type of service concept that best suits both the chosen material handling equipment (MHE) and your own organisation. For the purchase of a few tens of meters of conveyors and a few miniload aisles, the consideration will be different than when large-scale mechanization is carried out. In the first case, an in-house technical service for corrective maintenance in combination with a service contract with the MHE supplier may be sufficient to solve the more complex faults and carry out preventive maintenance. For large-scale projects, such as has been increasingly seen in food retail in recent years, an On-Site Residence Team from the MHE supplier is now used in almost all cases. These teams often consist of 50 or more specialists from different technical disciplines, who are responsible for both corrective and preventive maintenance in a 2- or 3-shift operation.

However, the choice of such a service team from the MHE supplier does not mean that the company's own responsibility for the functioning of the warehouse lapses. There are still aspects that need to be taken into account.
Of course, the design of the warehouse must take into account additional workstations, space(s) for the storage of spare parts and a workshop with basic facilities, such as shower facilities. In addition, a 'directing function' will have to be set up within the own organisation. This person or department is directly responsible for the correct compliance with the service contract and, in that role, is also the primary point of contact and sparring partner for the service team of the MHE supplier. This role is often forgotten or underestimated, but is crucial for, among other things, monitoring the execution of (preventive) maintenance, monitoring service and maintenance costs, and regularly discussing system performance based on the contractually agreed KPIs. Another important task of the management function is to set up a Continuous Improvement program together with the MHE supplier and the day-to-day operations.

It is also important to ensure from the outset that there are no two camps. So, no 'us' versus 'them'. Investing in mechanization means that as a company you enter into a long-term relationship with an MHE supplier. In that partnership, a collaboration will have to be found that works for both parties and is successful. The timely and correct delivery of the goods to the store or consumer must be a common goal. Just like making the system more efficient, ergonomic and sustainable through Continuous Improvement.

Planning, organization and control

Implementing a mechanized system also has a direct impact on the control of a warehouse. A planning department is still needed; to make a daily or weekly schedule. But the control of a mechanized warehouse also requires real-time monitoring, analysis and adjustment. In that sense, as noted earlier, it is very similar to operating a factory in the process industry. There, the system, the process progress and possible malfunctions are monitored from a control room. Employees who work in such a control room must have a number of important competencies that may not have been present or insufficiently present before:

- **Analytical skills:**
  Process information is provided through dashboards. Interpreting this information correctly, drawing the right conclusions from it and then acting accordingly requires - in addition to a thorough knowledge of the process - strong analytical skills. This also applies to information from applications, such as SCADA, in which malfunctions in the system are visualized.
- **Stress resistance:**
  Being able to handle this amount of information, in combination with the normal time pressure that every warehouse has to deal with, requires a high degree of stress resistance.
- **Communicative skills:**
  The control room is the beating heart of any mechanized warehouse. Communication, both internal and external, largely runs through this control room. Internal communication, for example, involves coordination with the management on the floor, or with the service team. External communication can include communication with the purchasing department, suppliers or the helpdesk of the MHE supplier.

Sometimes people from your own organization can be trained and grow into such a position. But recruiting people with this knowledge and skills from other sectors, such as the process industry or greenhouse industry, can also be worth considering. After all, both industries are characterised by a high degree of automation and high energy consumption. Energy savings and process optimisation have been central here for some time.

Leadership

The impact of mechanization on management - especially middle management - is underestimated, or even completely overlooked, in many projects. But there are also consequences for the way of leadership.
Whereas in a manual warehouse the focus is mainly on the deployment of people and hours, after mechanization the interdependence and dependence of departments and processes must also be taken into account. If, for example, all employees in a repack department take a break at the same time, this can mean that another department comes to a complete standstill later in the picking process. Practice shows that aligning these seemingly logical consequences often takes a lot of time and can even be a serious delaying factor in the implementation of mechanization.

Moreover, management in a mechanized warehouse is often remote management. Departments that are functionally related to each other can be physically separated from each other. As a result, a manager does not always have a direct view of the process. In addition, in many cases the workplaces are integrated into the system in such a way that the direct view of employees decreases. The manager will have to take this into account and adjust the way of communicating and leading.

Finally, there is another challenge that is much less visible, but can certainly lead to problems if not paid attention to in time: In a manual warehouse, the team leader calls the shots in the department. He or she deploys the people, monitors progress and makes adjustments where necessary. In a mechanized warehouse, some of those tasks are in the control room. This can lead to irritations, tensions and even arguments within the team. All the more reason to consider the Organizational and social component and of a new way of working caused by a different (automated) system from day 1.

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Warehouse of the Future

This is part 1 of our white paper series: Warehouse of the Future

- Optimal use of square and cubic metres (Part 1)
- Efficient use of land and space (Part 2)
- Business park and logistics ecosystems of the future (Part 3)

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