

# White paper

WESTERNACHER KNOWLEDGE SERIES | WHITE PAPER

# The trend towards **warehouse automation.**

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2017<sup>+</sup>



## EXECUTIVE SUMMARY

# Emerging Challenges. How to tackle them.

*Automation has gained increasing traction over the last few years as a way of unlocking productivity in warehouses. A recent study by PRG shows that over 10% of warehouses in the U.S. were using sophisticated automation technologies in 2016: a trend that is likely to accelerate in the next five years. In this research, we examine in detail the various proponents driving this automation trend, the different forms of automation, and the ways managers can prepare for this phenomenon.*

**A**n important contribution of this research is to identify the core reasons for automation: the rising costs resulting from operational challenges caused by higher consumer expectations from the e-commerce trend. As U.S. e-commerce sales continue to grow at over 15% annually, suppliers feel the pressure to satisfy e-commerce customers by delivering a varieties of goods in smaller sizes at a faster pace. This translates into complex operational challenges that are costly to tackle, especially when labor and land costs continue to rise.

After studying different automation technologies, we categorized automation using a 2-dimensional framework (decision-making automation and goods-movement automation). Within the framework, we identified 4 levels of warehouse automation (Low, system, mechanized, and sophisticated). Each type of automation utilizes a mixture of different technologies, and requires a different level of capital expenditure.

## ESTIMATED COST AND PAYBACK PERIOD FOR DIFFERENT LEVELS OF AUTOMATION<sup>1</sup>

	TECHNOLOGIES	EST. COST IN USD	EST. PAYBACK PERIOD
<b>System Automation</b>	WMS with RF Device, Pick-to-light, or Voice-picking	0.5 – 2M	0.5 – 2 years
<b>Mechanized Automation</b>	+ Conveyors, AS/RS	5 – 15M	2 – 4 years
<b>Sophisticated Automation</b>	+ Sorter, AGV, Robotic picking, Palletizer, etc	>50M	> 5 years

In addition, this whitepaper offers insight on how to pick the level of automation depending on your operational challenges and budget constraints, as well as how to plan for your potential automation initiatives by considering scalability issues and organization changes ahead of time.

<sup>1</sup> Cost and payback period varies depending on different industries

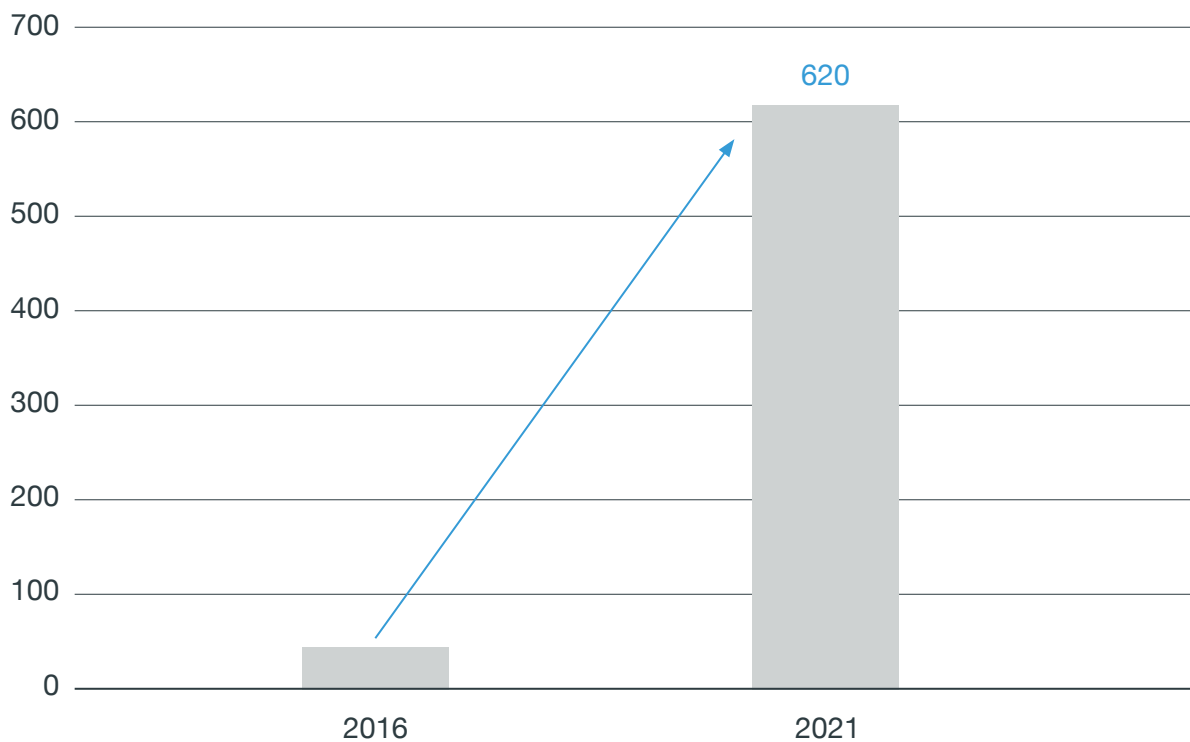
## INTRODUCTION

# The rise of the automated warehouse. **An accelerating trend.**

Imagine shuttles driving through racks, retrieving products and putting them on conveyor belts, while autonomous vehicles roam the warehouse with pallets of bulk products. Could this be the warehouse of the 22nd century? No, it's the modern warehouse of today.

As of 2016, more than 10% of warehouses in U.S. were using automated warehousing equipment that enables a goods-to-man picking approach<sup>2</sup>. The trend will only accelerate over the next five years, with research predicting the number of robots in warehouses growing 15 times by the end of 2021 to 620,000<sup>3</sup>.

NUMBER OF WAREHOUSING ROBOTIC UNITS (IN THOUSANDS)



With all the hype around warehouse automation, many managers start to ask why is automation trending now? What are the types of automation out there? Is automation a good fit for my warehouses in the near future, and if so, what's the ROI, and how do I prepare for it?

<sup>2</sup> PRG, An Evaluation of Warehouse Operations & Trends, 2016

<sup>3</sup> Tractica, Warehousing and Logistics Robots: Global Market Analysis and Forecasts, 2017

## DRIVING FACTORS

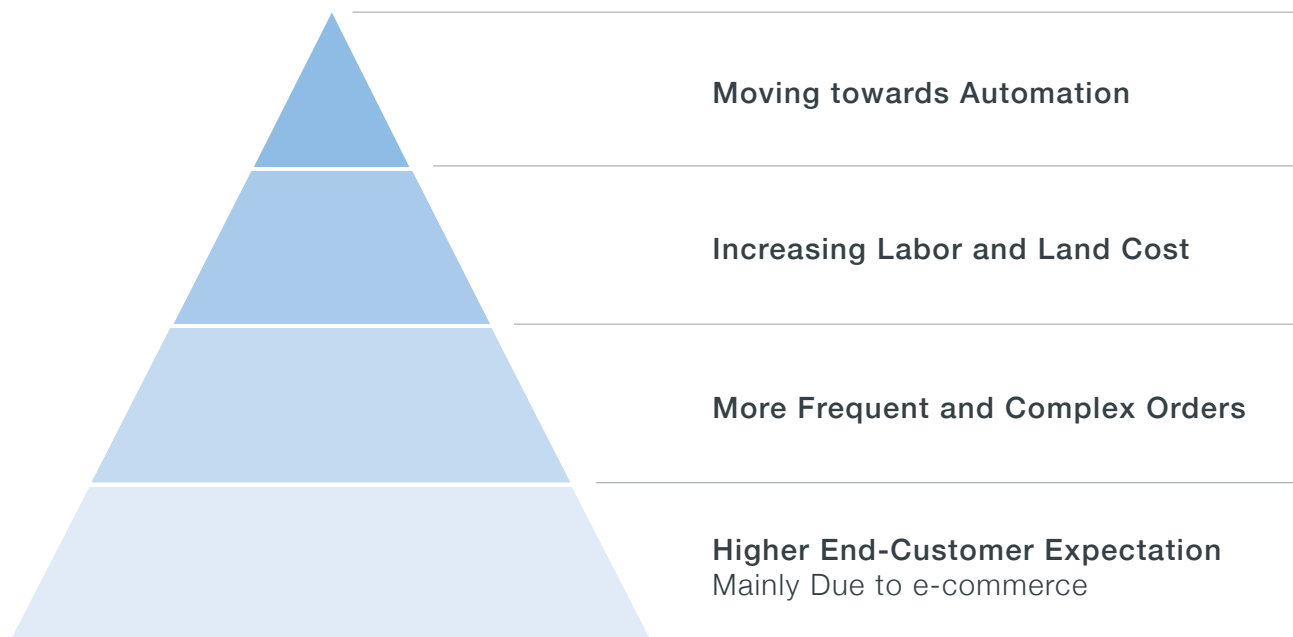
# Warehouse Automation: not a recent invention. **Why is it trending now?**

Warehouse Automation is not a recent invention. The first AGV was invented back in 1953 and the first AS/RS was installed in the 1960s. So, besides some technical equipment improvements, what caused this current wave of interest in warehouse automation?

The diagram below demonstrates the three layers of drivers behind the growing automation trend. In short, the trend is driven by rising costs resulting from operational challenges caused by higher consumer expectations.

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## DRIVERS BEHIND TREND TOWARDS AUTOMATION



The trend is driven by rising costs resulting from operational challenges caused by higher consumer expectations.

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DRIVING FACTORS

# Why is automation trending?

## 1. Increasing labor and land cost

When business expands, warehouses can either hire more labor or add more space. However, as U.S. labor and land become more expensive and their marginal contribution to productivity decreases, automation becomes appealing.

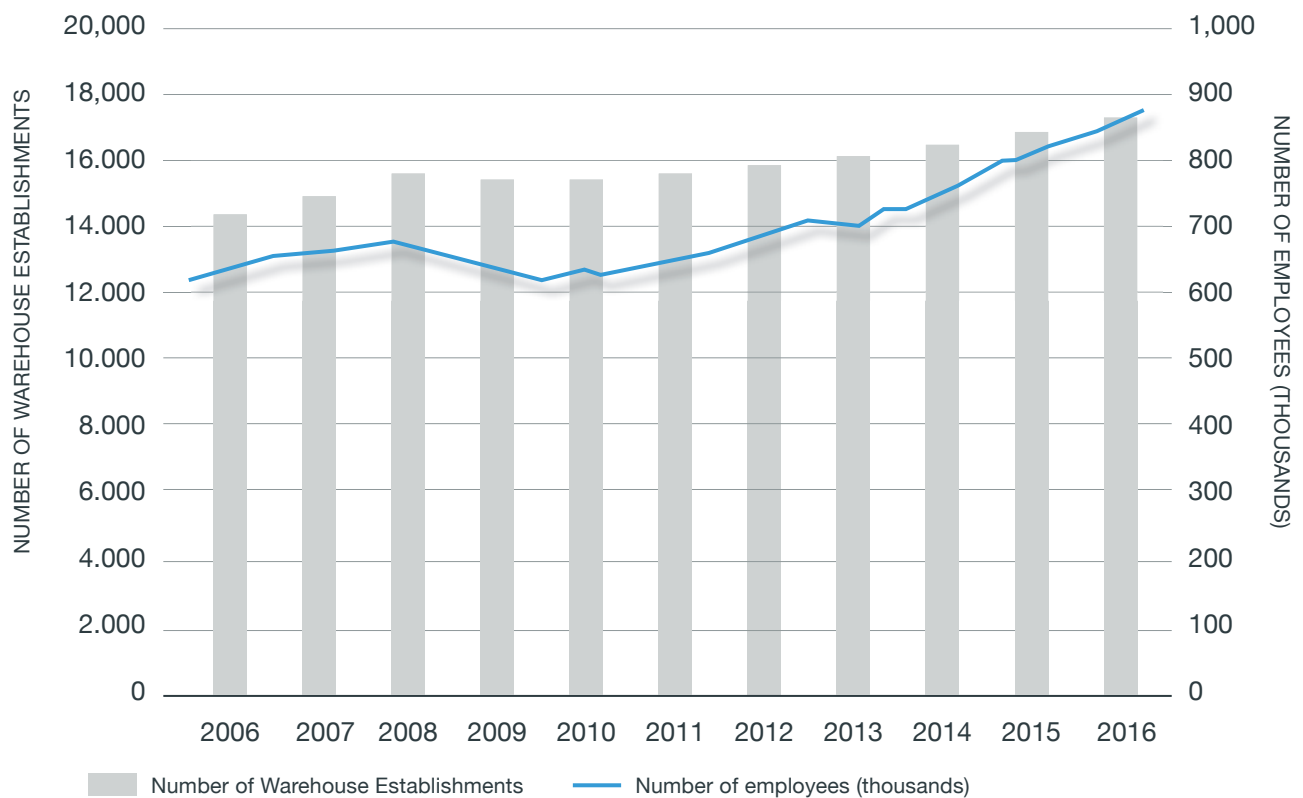
Today, the single largest expense for warehouse operation is labor. To keep up with fulfillment requirements, warehouses are hiring more and more personnel. Per US Bureau of

Labor Statistics, total employment in the warehouse and logistics grew 6% last year. The strong demand for labor along with tighter hiring standards pushes wages higher too. Since 2006, the average hourly earnings of all employees had risen by 16%<sup>4</sup>.

To make it worse, the increasing process complexity requires workers to have higher qualification, and made it harder for warehouses to find people with the right skill set. In 2016, a staggering 41% of warehouse managers reported an “inability to attract and retain quality hourly workforce” as one of their top concerns<sup>5</sup>.

A typical warehouse with 100 employees costs more than \$3.5 million in labor expenses per year (an average production and nonsupervisory employee earns \$15.81 per hour at an average of 42.9 hours per week as of 2016). This is not considering health insurance, seasonal labor spikes and overtime adjustments.

NUMBER OF WAREHOUSING ROBOTIC UNITS (IN THOUSANDS)



Source: U.S. Bureau of Labor Statistics

<sup>4</sup> U.S. Bureau of Labor Statistics, Warehouse & Logistics Data

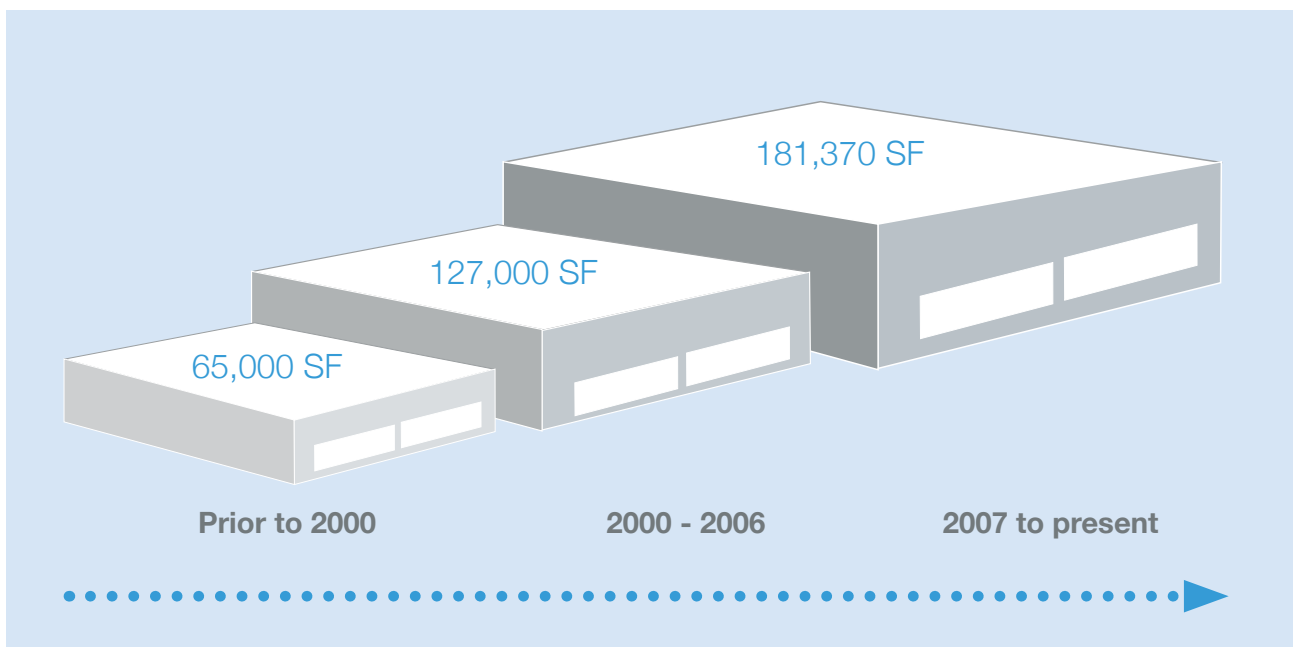
<sup>5</sup> U.S. Ibid

No wonder many warehouses are looking towards automation: Compared to labor, automated solutions do not require health insurance, lunch breaks, or paid time off. In addition, they can operate 24/7 with minimal maintenance.

Besides rising labor costs, the cost of warehousing space is rising too. In fact, warehouses now are nearly three times as large

as 15 years ago. The average size of warehouse in 2000 was about 65,000 sqft, whereas now it is over 181,370 sqft<sup>6</sup>. The increase in size helps warehouses to cope with higher volumes and a growing number of SKUs. However, rising costs and long travelling distances in large warehouses are making size expansion less effective in addressing operational challenges.

### GROWTH IN WAREHOUSING SPACE



Source: Cushman & Wakefiled

As warehouses demand more space, this naturally pushes up price. In fact, between 2011 and 2015, warehouse renting rates were up by a whopping 28%<sup>7</sup>. This trend is likely to continue as US Industrial Space vacancy rate falls to 5.3% in Q1 2017, the lowest since 2000<sup>8</sup>.

<sup>7</sup> Supply Chain Brief, 4 Biggest Numbers in Warehousing, 2016

<sup>8</sup> SCDigest, <http://www.scdigest.com/newsviews/17-06-12-1.php>, 2017



## DRIVING FACTORS

# Why is automation trending?

## 2. More frequent and complex orders

So why do warehouses need more labor and space? Because warehouses need to handle more frequent shipments and more complex deliveries. Since end-customers now expect faster delivery, companies are likely to skip intermediary bulk buyers (e.g. distributors) and instead ship directly to end customers. This poses a drastic change for warehouse operations since end-customer orders are smaller in size and contain multiple SKUs per order. Even if a warehouse is not shipping directly to customers, there is indirect cross-industry pressure for a warehouse to ship more frequently with smaller orders.

The increased warehouse order frequency and complexity are hard for traditional warehouses and DCs to handle. “With all the goods that are being shipped direct to consumers, a lot more individual packages have to be sorted and shipped.” As one of the warehouse managers said, “Whenever you run into a situation where single-item goods—not cases—have to be handled by a DC, the only way to do that efficiently is by using sorters and conveyors.”<sup>9</sup>

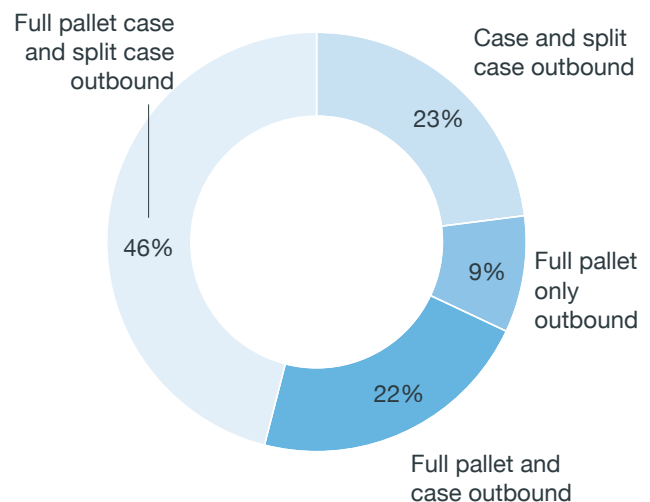
A decade ago, DCs could still just ship pallets in and pallets out, but now they must handle cases and partial cases with increasing complexity. As one warehouse logistics expert puts it: “What used to be pallet orders are now cases, and what was a case order is now a piece pick.” With increasing throughput requirements, warehouses are now stepping up technology

investments to manage the increased volume and complexity.

According to the 2016 Warehouse Operations Survey, only 9% of DCs now handle only full pallets during outbound. Most DCs (46%) now handle a mixture of pallets, cases and split cases. While it still could be time-efficient to deliver pallet orders using traditional labor, it might not be so for cases and split cases<sup>10</sup>. Therefore, many warehouses are turning to case conveyors and robotic picking arms for help. In general, many warehouses found that optimizing piece & case picking gave them the highest ROI.

The increase in complexity also puts pressure on order accuracy. As there are more orders with higher complexity, the chance of a human error increases and the cost of return management shoots up. Again, this pressures warehouse managers to look for automated solutions that are less prone to error such as pick-to-light systems.

### IN WHAT UNIT LOAD QUANTITIES ARE PRODUCTS SHIPPED OUTBOUND?



<sup>9</sup> Logistics Management, Conveyors and Sortation Keep up the Pace, 2017

<sup>10</sup> PRG, An Evaluation of Warehouse Operations & Trends, 2016

## DRIVING FACTORS

# Why is automation trending?

## 3. Higher customer expectation largely due to e-commerce

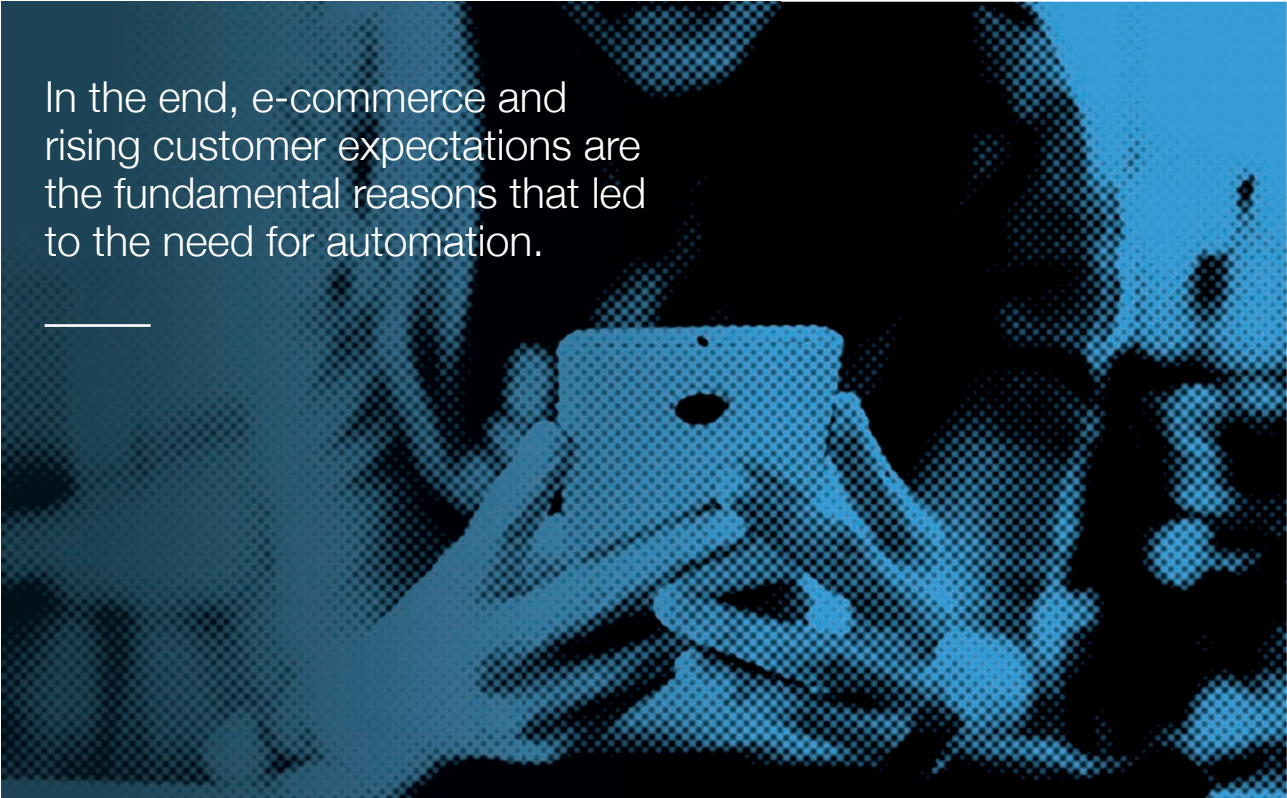
The underlying cause for increasing complexity is consumer demand for faster deliveries in the age of e-commerce.

Last year, e-commerce sales grew an estimated 15.8%, representing 8.2% of total retail sales<sup>11</sup>. The e-commerce phenomenon influenced customer expectations on order fulfillment.

When e-commerce began, delivery costs were standard. But as the customer got used to it, they started demanding free two-day delivery as the standard (also known as the “Amazon Effect”). This means retailers, distributors, or even manufacturers must respond with higher frequency picks with smaller pick sizes, especially during fourth-quarter peaks in retail.

Not only do customers expect faster delivery, they also expect more variety and customization. This means warehouses need to manage more SKUs. Just in 2015, the average number of SKUs in warehouses increased by 18% in U.S. Next year, 38% of companies plan to handle even more SKUs based on PRG’s Research<sup>12</sup>.

“A lot of companies have been caught off guard by the growth in e-commerce,” says Ian Hobkirk from a Supply Chain advisory group<sup>13</sup>. In the end, e-commerce and rising customer expectations are the fundamental reasons that led to the need for automation.



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<sup>11</sup> United States Census Bureau, 2016

<sup>12</sup> PRG, An Evaluation of Warehouse Operations & Trends, 2016

<sup>13</sup> Modern Material Handling, 7 Warehouse E-commerce Best Practices for 2017, 2017



## TYPES OF AUTOMATION

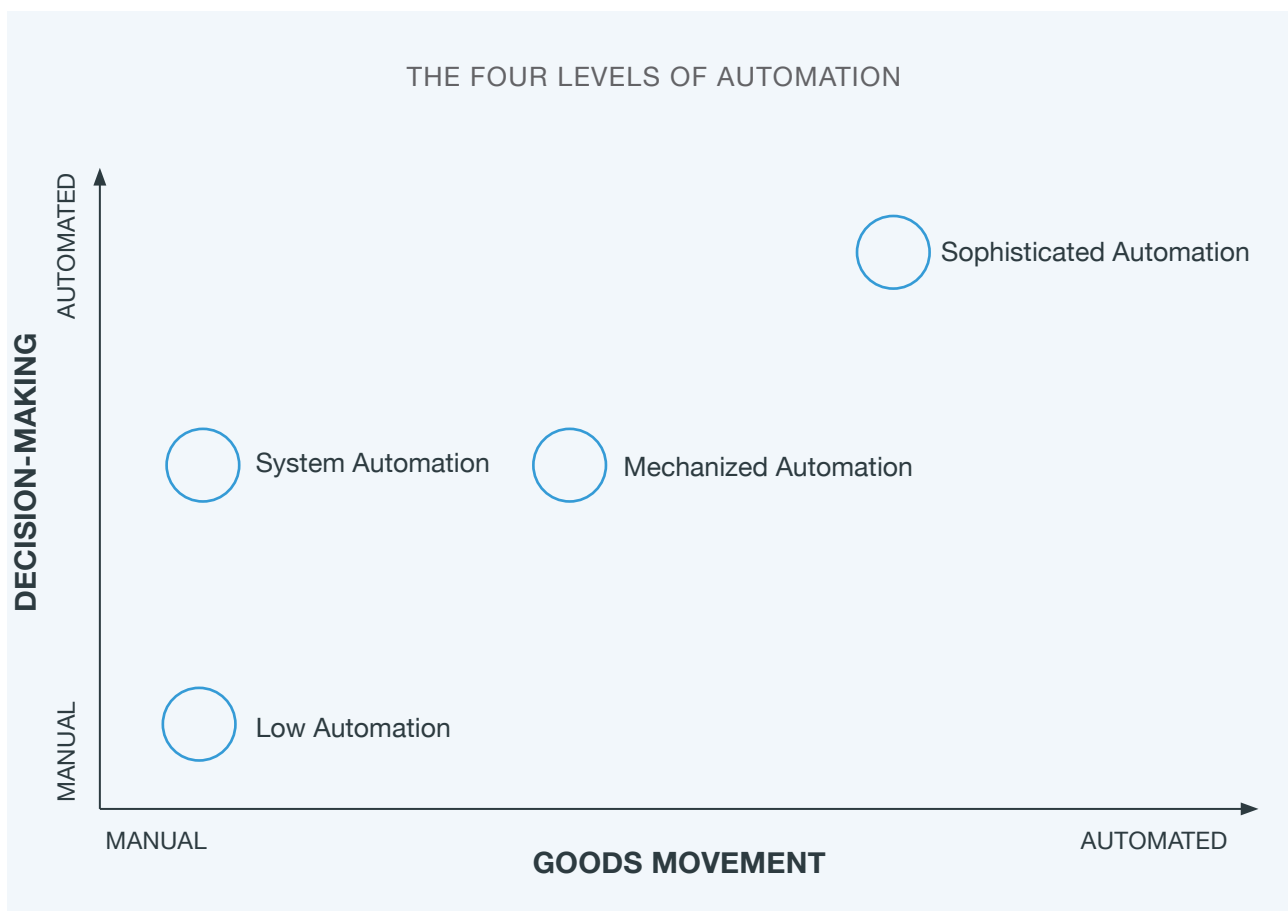
# What is automation in a warehouse?

## Understanding the various types of automation

So, how can you ride the trend towards automation and develop your warehousing strategy? To answer that question, one needs to understand the various types of automation and the type of technologies being used.

There are two things that can be automated in warehouses: the decision-making process and the goods-movement process. The first refers to how a warehouse makes better decisions on

where to store, how to pick and how to optimize resources automatically. The second refers to how the various movements from Point A to Point B in the warehouse can be executed by machinery. Together, they form the brain and body of a warehouse. Warehouse automation is therefore not a static term, but a spectrum of decision-making and goods-movement automation.



## TYPES OF AUTOMATION

# What is automation in a warehouse?

## The four levels of automation

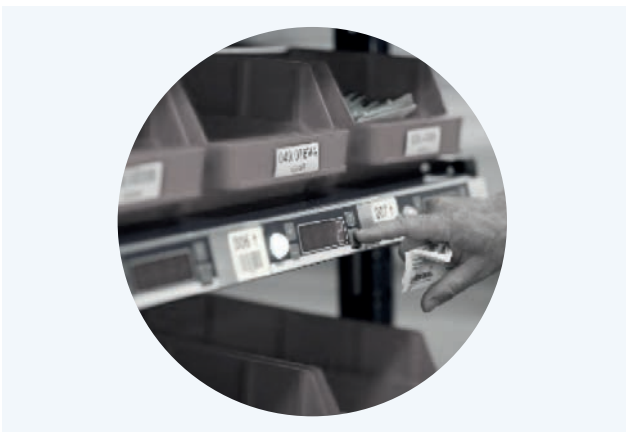
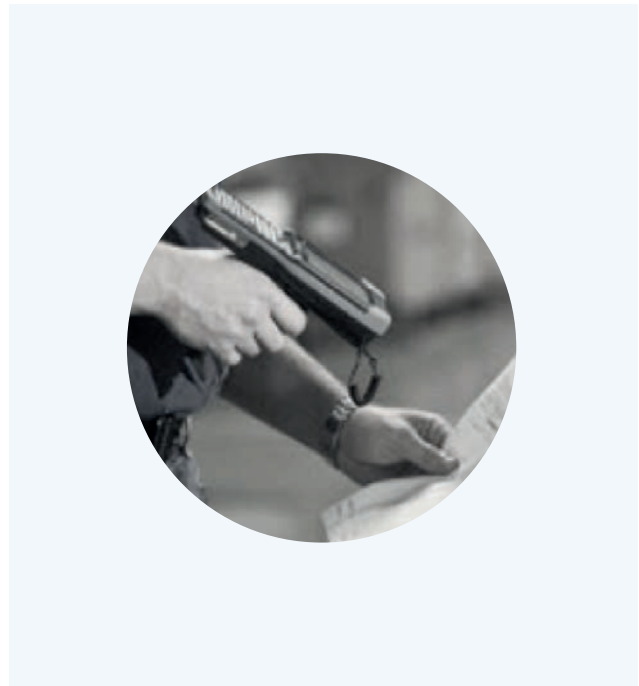


### 1. Low Automation

On the lower left corner are warehouses with low automation. These are usually warehouses with rudimentary inventory recording systems which mainly operate using printed papers. Decisions such as “where to put away products” and “where should I replenish this bin from” can be hinted by the system, but precise decisions are made by workers on the floor. Workers need to travel long distances to putaway and pick goods from shelves.

### 2. System Automation

Moving up, are warehouses that use system-directed work to automate decision-making. Here, a Warehouse Management System (WMS) is used to make decisions on where to put away/pick items and manage processes such as deconsolidation, VAS (Value Added Services) and quality inspection. It also optimizes decisions on when to perform the tasks, and who should perform the tasks. System Automation usually involves using Mobile RF (Radio Frequency) Technologies or Voice-directed Technologies to confirm and send stock information to the WMS in real time. In general, most companies observe around a 25% gain in overall productivity, a 10-20% improvement in space utilization, and a 15-30% reduction in safety stock when moving from a paper-based system to this level of automation<sup>14</sup>.



Having a WMS also enables warehouses to leverage other picking technologies such as Pick-by-light. In a Pick-by-light station, rows of lights above bins show workers what bins to pick from and how many items to pick, thus making the picking process faster and more accurate during multi-order picking. According to Statistics published by the Material Handling Institute, pick-to-light systems can improve pick rate by 30-50%<sup>15</sup>. In addition, they reduce picking error rate by 67% compared to a paper and pen system<sup>16</sup>.

<sup>14</sup> Hokey Min, The Essentials of Supply Chain Management, 2015

<sup>15</sup> MHI, <http://www.mhi.org/ofs/solutions-guide/pick-to-light>

<sup>16</sup> Georgia Institute of Technology, A Comparison of Order Picking Methods Augmented with Weight Checking Error Detection, 2016

### 3. Mechanized Automation

Then come the warehouses where not only the logic is automated, but good-movements are automated as well. Instead of having workers walk around lengthy aisles looking for picks (person-to-goods model), automated systems are put in place so the goods are transported to the worker (goods-to-person model). There are mainly two technologies deployed in a mechanized automation.

#### Conveyors

Conveyors transport goods from point A to point B. They are akin to blood vessels in an automated warehouse. Using conveyors reduces travel distances and improves pick rates dramatically. While an order picker can do 60 to 80 picks an hour, using conveyors can result in a pick rate of 300 picks per hour<sup>17</sup>.

Usually a conveyor system consists of 1) belts, rollers, or chains that move goods horizontally, 2) lifts that transfer goods vertically, 3) transfer units that change direction of the the goods travel, 4) handling unit storage (pallet magazines and tray loader). These conveyor systems are not bound by floor. For example, there are conveyors that transfer goods by moving along a fixed rail overhead (called monorails).



#### AS/RS: Automated Storage and Retrieval System

AS/RS stores and retrieves bins in high racks using automated rack feeders or shuttles. The types of AS/RS vary by the size of the material it stores (pallets, trays, cartons), the mechanism (crane, lift & shuttle) and depth (single deep, double deep). However, in the end, all types of AS/RS simultaneously solve two of the biggest problems warehouses face: space utilization and handling accessibility. AS/RS increases space utilization by reducing aisle width and expanding storage space vertically. It also makes handling accessible since the storage and retrieval process will be fully automated.

AS/RS is usually connected to picking stations using conveyors where workers execute their picking orders and view/manage workflow on a WMS.

<sup>17</sup> SSI SCHAEFER, <http://www.ssi-schaefer-asia.com/blogsg/automation/from-man-to-goods-to-goods-to-man/>, 2014

## 4. Sophisticated Automation

Finally, at the top right corner are warehouses using highly automated equipment to eliminate manual movements and streamline order-picking processes. This level of automation requires systems to handle complex decision-making logic. In addition to an extensive use of pallet and case conveyors, below are some other common technologies used in these types of warehouses.

### Automatic Sorters

Automatic Sorters further automate the multi-step picking process by identifying, transporting and grouping cases into orders they belong to. Depending on the size and packaging of the goods, different types of sorters can be deployed. For example, some sorters control the flow of goods by using pop-up wheels, while others may use tilting trays or sectional conveyors.



### AGV: Automated Guided Vehicle

These are the spotlight robots that move bulk goods through autonomous navigation. They are equipped with visual recognition capabilities and smart algorithms that helps them to transport goods to workers and take themselves to recharge stations when their battery is low. AGVs have been around for decades, but now are getting more traction due to recent technology improvements and the major trends mentioned in this whitepaper. Kiva (now Amazon Robotics), KNAPP Open Shuttle and Hikvision's Qianmo Robots<sup>18</sup> are examples of this technology.

### Robotic Picking System

Another type of system that handles even smaller item picks is called Robotic Picking Systems. These robots scan and identify items in containers, then pick them into corresponding totes and packages. They require a high level of precision and are the frontiers of warehouse automation. Some examples of Robotic Picking systems are SSI SHAFER's Robo-pick and Swisslog's Automated Item Pick Robots.



<sup>18</sup> Quartz, <https://qz.com/961022/a-chinese-warehouse-reportedly-cut-its-labor-costs-in-half-with-a-fleet-of-tiny-robots/>, 2017





### **Automatic Palletizer**

After picking, packages need to be packed on pallets so they can be easily shipped to customers. An automatic palletizer utilizes cartonization algorithms to build the perfect pallet, which will then be shrink-wrapped and shipped out.

Warehouse automation is not a static term, but a spectrum of decision-making and goods-movement automation.

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## IMPLICATIONS FOR YOUR WAREHOUSES

# E-commerce will continue to push higher customer demands. **What does this mean for your warehouses?**

## 1. Decide the Right Level of Automation

It is inevitable that e-commerce will continue to push higher customer demand on speed, variety and quality of product delivery. The growing operational challenges for warehouses to respond faster and more accurately are

becoming more imminent. To cope with these challenges in a period of rising labor and land costs, managers are looking to improve efficiency through automation.

**So, what does it all mean for your warehouses?**

ESTIMATED COST AND PAYBACK PERIOD FOR DIFFERENT LEVELS OF AUTOMATION<sup>19</sup>

	TECHNOLOGIES	EST. COST IN USD	EST. PAYBACK PERIOD
<b>System Automation</b>	WMS with RF Device, Pick-to-light, or Voice-picking	0.5 – 2M	0.5 – 2 years
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If you are planning to roll out a new warehouse to handle complex omnichannel distribution operations involving high speed piece picking, then upgrading to a sophisticated automation warehouse with AS/RS Shuttles technologies may be the right move. But if you have an existing warehouse with moderate SKU velocity, then

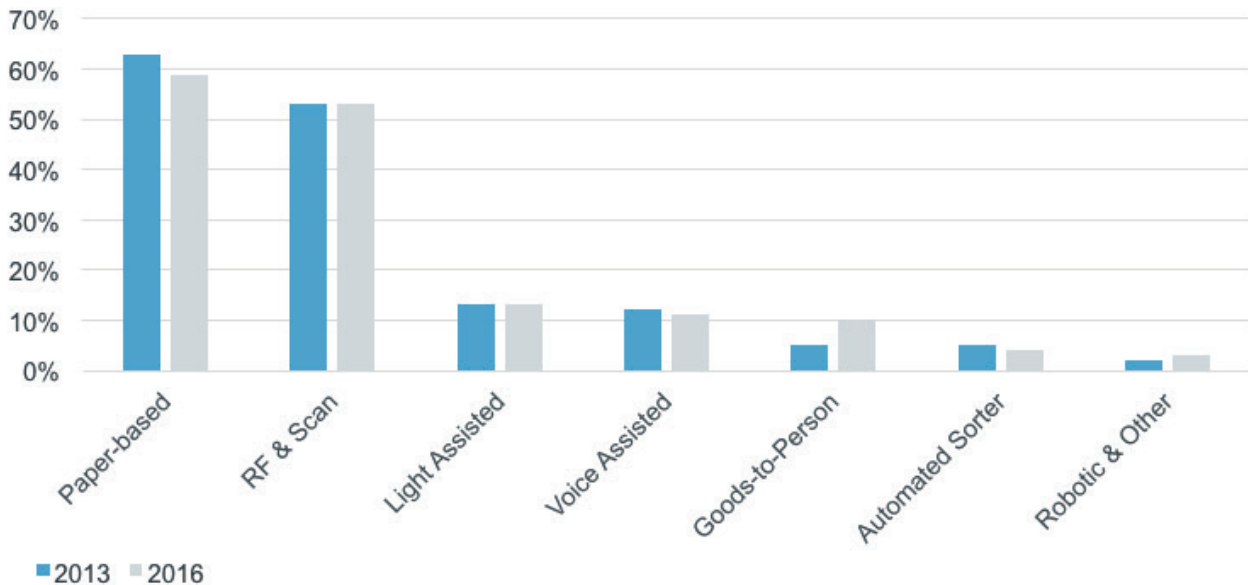
installing or replacing your old WMS for a leading system such as SAP's EWM (Extended Warehouse Management) and utilizing the system's advanced wave picking functionalities with the help of cluster-picking carts is a more viable option.

<sup>19</sup> Quartz, Cost and payback period varies depending on different industries

The chart below shows the type of picking technologies currently used by domestic warehouses. Not all warehouses<sup>20</sup> need a sophisticated AS/RS and robots roaming around,

but if your warehouse is mainly paper-based, it might start to make sense for you to upgrade to a warehouse management system that supports standard RF technology integration.

PICKING TECHNOLOGIES IN USE FROM 2013 TO 2016



## 2. Start small and build a scalable solution

The path to advanced automation sometimes involves going through each level of automation sequentially as the business matures. When making the first upgrade decision, you should think ahead and pick an automation solution that is scalable and can be easily integrated with

future solutions. For example, you may want to find a solution that not only works with standard RF technologies, but also integrates well with the PLCs (Programmable Logic Controllers) that would be deployed to control automation equipment in the future.

## 3. Plan change management & training

Introduction of automation involves organizational changes. One should carefully think through what automation means for different stakeholder, such as warehouse workers, IT Teams, supervisors, inventory controllers and others.

Of all stakeholders, warehouse workers may experience the most challenging changes. To ease their transition and maintain a relationship with unions, warehouse managers need to consider the following steps.

1. Going over union agreements and identifying potential problems ahead of time.
2. Developing an employee training plan and “train the trainers” early.

3. Involving employee representatives when designing processes and user experiences.

4. Collaborating with union and employee representatives when designing incentive pay programs enabled through the functions of warehouse management systems.

5. Communicate benefits to employees from their perspectives, such as a reduction in overtime and simplified processes.

It is not rare that employee morale and retention can increase after technology implementation, especially if incentive pay programs are used.

<sup>20</sup> PRG, An Evaluation of Warehouse Operations & Trends, 2016

## WESTERNACHER'S OFFER

# Take the next steps. Start your transformation journey with Westernacher.

Is your team interested in automation? Westernacher can help. We are a global SAP partner with 35 years of warehouse automation experience and over 250 automation implementations.

If your team is already working with automation equipment suppliers, we can help you plot system strategies and facilitate the system-

to-equipment integration process. We are an automation pioneer and frequently the first in the market to implement sophisticated automation equipment such as Hikvision's AGVs.

Reach out and we will work together to understand how/if your operations can be improved with the introduction of automation and what that process should look like.

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