



# The logistics of e-commerce: improving returns on delivery

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## Intro |

- E-commerce has not only disrupted the retail space but also its very enabler - the logistic backbone.
- To offset an ever increasing logistics bill, warehouses have to become automated and - as so often with real estate – their location is key. Warehouse automation providers and prime warehouse real estate owners stand to benefit as e-commerce grows further.
- As the supply chain has become a lot more complex, the logistics system needs to reintroduce transparency and connectivity through sensors, lasers, and (RFID) tags. Next to producers of automatic data capture devices (ADCs), this benefits software companies offering supply chain management tools.
- At risk are incumbent last-mile delivery companies which face increased competition from start-ups and crowd-sourcing solutions; intermediaries such as freight forwarders and those slow in adopting to new technologies.



**Logistics is the silent enabler of e-commerce** | E-commerce has not only changed consumers' shopping experience, but also the logistics supply chain, which is the secret enabler of e-commerce's growth story. Logistic flows have become more diverse and less efficient, especially so for the last-mile delivery. Together with a high level of volatility in order volumes and returns of goods, a lot of strain is put on the current supply chain. E-commerce penetration rates are today around 10%, but have room to go much higher as evidenced by penetration levels of above 50% in early mover categories such as books or penetration levels of above 20% in geographies such as China. However, we think the current supply chain cannot handle further e-commerce growth, but would risk getting clogged - thereby limiting its own potential. The supply chain therefore needs to become more efficient, both in terms of design and automation of logistic flows.

**Limited investment attractiveness in last-mile logistics companies due to fierce competition** | As penetration increases further, especially last-mile delivery will become ever more challenging. Inner-city congestions, high capital requirements, limited economies of scale and pricing power limit the attractiveness from an investment perspective of logistics companies as well as state postal offices. Entrance of start-up companies and crowd-sourced last-mile solutions that make clever use of new technologies and unused capacity elsewhere in the system, will make last-mile delivery ever more competitive.

**Other investment opportunities abound** | Taking a broader look at the eco-system of e-commerce logistics however, we can uncover more attractive investment areas to benefit from e-commerce growth. Generally, we favor companies that come up with solutions to make the logistics of e-commerce more efficient again; i.e. make the difficult task of challenged logistics companies easier. There are many routes to more efficient supply chains and we will need all of them: real estate owners can offer the right warehouse locations to make fast online delivery possible; warehouse automation brings scalability to the supply chain and more efficient usage of costly space; connectivity solutions such as tags and sensors bring visibility to the supply chain and thereby the opportunity for optimization of e.g. routing and planning. Last but not least, there is a lot of innovation activity going on to make last-mile delivery autonomous: the logistics industry will be the first to employ self-driving technology on a larger scale. The first examples of this will be platooning or self-driving fork lifts in a warehouse.

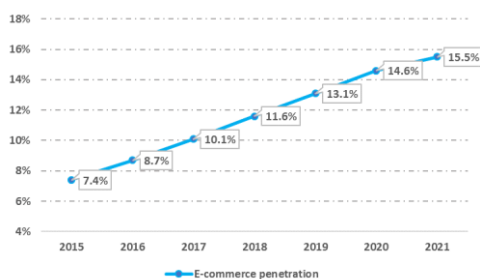
We think that without investment in all these efficiency-enhancing solutions, the supply chain will soon reach its limits and prevent e-commerce from growing further. Warehouse real estate owners, warehouse automation companies, connectivity solutions such as automatic data capture devices (ADC), as well as software developers of supply chain management tools will therefore see increased demand for their services and offer attractive investment areas.

E-commerce  
penetration:  
this is just  
the  
beginning

The e-commerce  
consumption feast is far  
from over. Despite the  
massive success story  
we think there is still  
much more to come.

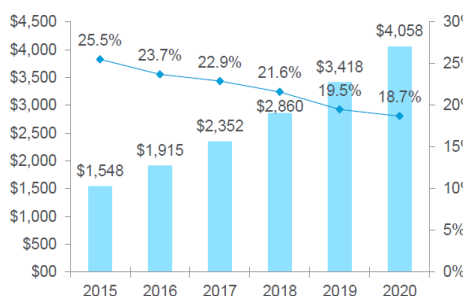
**An online consumer feast** | E-commerce gets consumers cheering. The whole global assortment at your fingertips – and that from the comfort of your own living room. Brought to your doorstep and if you're not home, they'll try again. Or otherwise, if you prefer, they'll deliver it to your work or you can pick it up at a store near you. Not really sure? Just order a few colors and sizes, and if none of them lives up to your expectations, you can return them all for free. With such a consumer proposition, no surprise e-commerce has been on a massive growth trajectory over the last years.

**Figure 1** | E-commerce share of total global retail sales



Source: Statista

**Figure 2** | Growth expectations for global e-commerce in USD

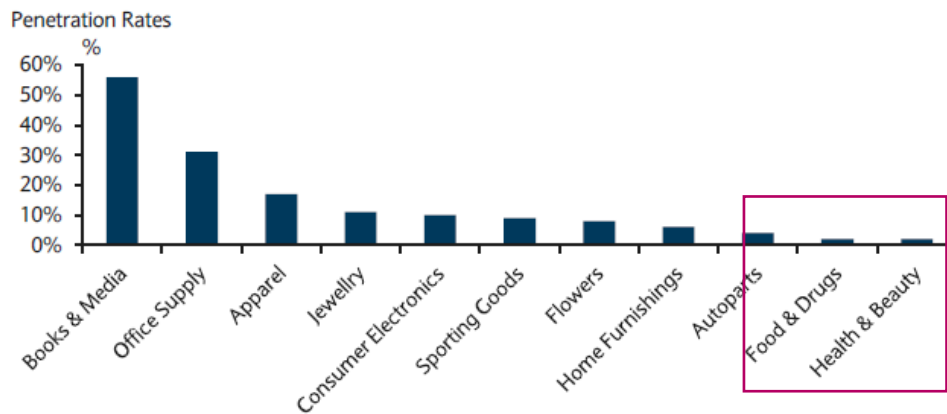


Source: Citi Research

Thanks to all those promises, new giants like Amazon, Alibaba, JD.com and the likes have risen to the top of the most valuable companies. At the same time, traditional brick & mortar retailers and shopping malls alike are struggling to stay out of bankruptcy. Over the course of the last decade, e-commerce has become mainstream territory.

**This is just the beginning – expect increased e-commerce penetration** | E-commerce amounts to 10% of total retail sales globally. Yet we don't think we are anywhere close to maturity. According to Statista, e-commerce is expected to grow by around 19% per year until 2021 to become 15.5% of overall commerce. We think there is room to go even higher than that; for example in China, e-commerce penetration is already at 22% today. Trust in online shopping has increased, both in terms of payment security and quality of product. This will help more categories to be converted. In fact, today's lowest penetration categories are quite some big shot categories where the major players will fight out their next battle online - especially in healthcare and food.

Figure 3 | Penetration rates are still low for big shot categories (US)

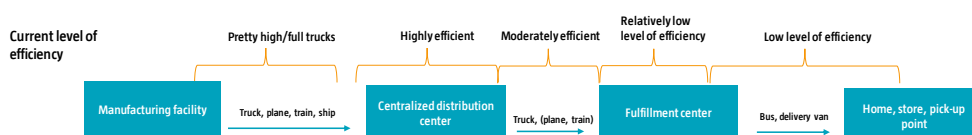


Source: Barclays, Euromonitor

**Omnichannel will be the norm** | Over time, the distinction between on- and offline will become increasingly meaningless. It will all be one integrated, seamless shopping experience. This is called omni-channel. Consumers want to be able to shop online but return goods to the store, or vice versa have the opportunity to touch and feel a product in the store but the luxury of skipping the carrying and dragging of heavy goods home. For retailers, the challenge is to integrate the various touchpoints all the way from the consumer interface through to the logistic backbone.

**The efficiency of today's logistic flows varies widely – and so does the cost split-up** | We will structure the remainder of this paper in line with the flow of goods in the logistics supply chain. Below is a highly simplified visualization of a logistic set-up for e-commerce: goods are transported from a manufacturing facility to a centralized distribution center (DC) in what is called line haul. This mode of transportation is generally still pretty efficient. From the DC, goods then continue further to so-called fulfillment centers (FC), which are closer to demand centers and therefore generally smaller and less efficient. This set-up is known as a 'hub and spoke' model. From the fulfillment center, goods are then finally transported to consumer's front doors, pick-up points or stores. This is generally done by small delivery vans and is often much less efficient.

Figure 4 | Diagram logistic flows E-commerce



Source: Robeco



Clearly, as goods travel further to the right in the chart above, efficiency decreases – which is also reflected in the cost split per step as a percentage of total logistics costs. The very last mile is estimated to account for nearly half of total logistics costs (AT Kearney).

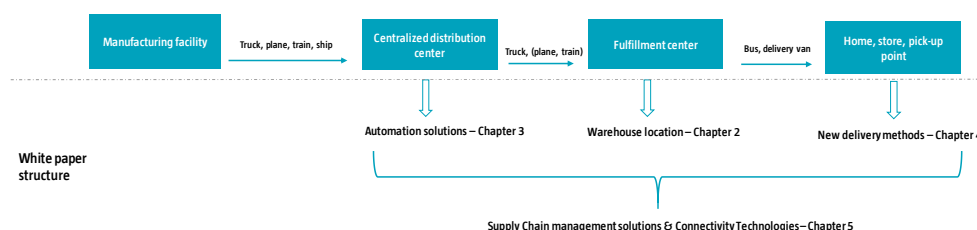
Figure 5 | Split up of total logistics costs

Total Logistics cost	Distribution center	Line haul transportation	Fulfillment center	Inventory carrying cost	Last mile
100%	6%	16%	23%	15%	40%

Source: Robeco

Given that the last big chunk of the overall cost structure is incremental to e-commerce, overall logistics costs are pushed upwards. The industry therefore moves to find cost offsets along the various steps of the flow chain; from new delivery forms that are being invented, to warehouses automation and optimization of their locations and the overall flow of goods through the logistic chain.

Figure 6 | Chapter outline



Source: Robeco

We have structured this white paper as follows: Chapter 1 will first provide more color on the challenges the logistics system faces. Chapter 2 will revolve around the importance of especially fulfillment center locations, and chapter 3 will discuss automation solutions in especially distribution centers. Chapter 4 will illustrate activity around start-up or crowd-sourcing solutions for last-mile delivery and, last but not least, Chapter 5 will focus on the interconnectivity between all individual steps, facilitated by sensors, tags, and supply chain management systems. In each part we will point out investment areas, which are summarized below.

Solution	Sector
Warehouse location	Real Estate (REITs)
Warehouse automation	Vision Technology Warehouse automation
Autonomous driving	Connectors and semi-conductors
Connecting the whole supply chain	Automatic Data Capture Devices Supply change management software

Challenges  
of the last  
mile

The supply chain is aching – logistics have become infinitely more complex. Transportation of individual pieces, returns and an unlimited shelf have all introduced inefficiencies. The biggest struggle of all, however, is the last mile – the delivery to consumers' front door.

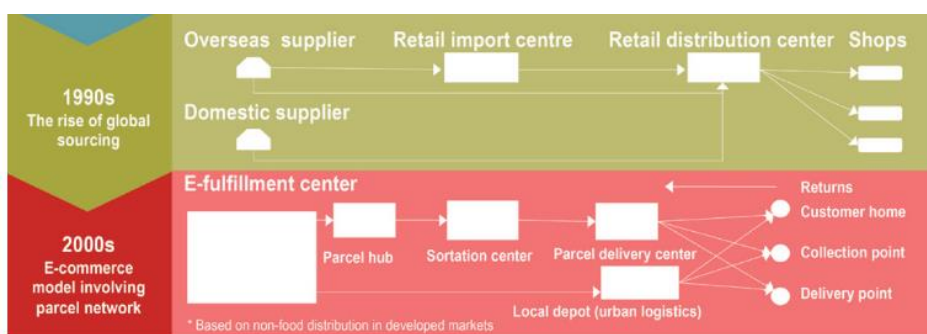
**The supply chain struggles to facilitate the massive e-commerce growth** | The supply chain is aching under the e-commerce explosion. While Amazon is on all newspapers' front pages, various logistics companies are the ones that have to enable all that growth – and this is not an easy task. Supply chain complexity has increased significantly with the advent of e-commerce, due to:

- the many additional miles delivery trucks have to drive
- a stock keeping unit (SKU) proliferation as consumers basically get access to an unlimited shelf
- significantly more cross-border trades increasing the distance covered
- inefficient packing as parcels are basically 'batch-size-one' transportation versus much more efficient pallet shipping
- shorter and shorter delivery times being expected by consumers
- Inner-city traffic congestions getting worse and worse

To add insult to injury, consumers have become accustomed to get delivery for free, as retailers in the early days were willingly absorbing transportation cost in their fight for online market share, or living up to their motto of 'customer first'.

**Move towards a decentralized world introduces inefficiencies and duplications** | Figure 7 compares the logistic set-up of a traditional brick & mortar supply chain with an online logistics system. With the end points becoming a seemingly infinite number of homes and pickup points rather than a limited number of retail shops, there are a lot more capillary routes that trucks have to drive – and back considering the large number of returns of around 30%!

Figure 7 | E-commerce supply chain is significantly more complex

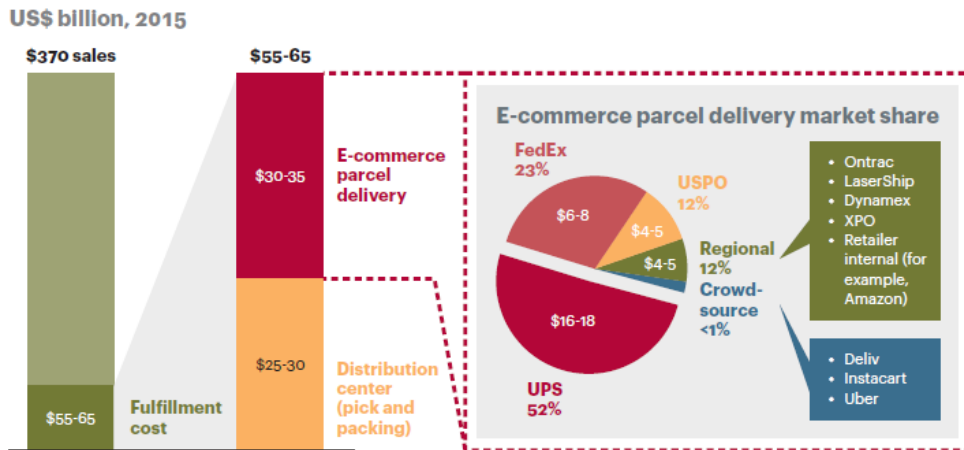


Source: Jones Lang LaSalle

**Last mile is the biggest struggle of all** | Fulfillment costs make up on average 17% of your overall e-commerce shopping bill according to a study by AT Kearney in 2015. About half of that fulfillment cost is what is incremental to online; the so-called last mile or that drive to your doorstep. In the US, the United Postal Service (UPS) delivers about half of those routes while United States Postal Office (USPO) and FedEx deliver another 35%.

UPS repeatedly struggled to keep up with e-commerce growth. The annus horribilis was 2013, when the company failed to deliver parcels on time in a spike during the Christmas period. Painful in terms of both reputation and profitability: it had to top up its operations with expensive last-minute resources. In the meantime, things have improved only partially. As a result, the company decided in early 2017 to ramp up capital expenditures to USD 4 billion to increase capacity and invest in automation. Nevertheless, on-time rates during the Christmas period were again only 90% (source: ShipMatrix).

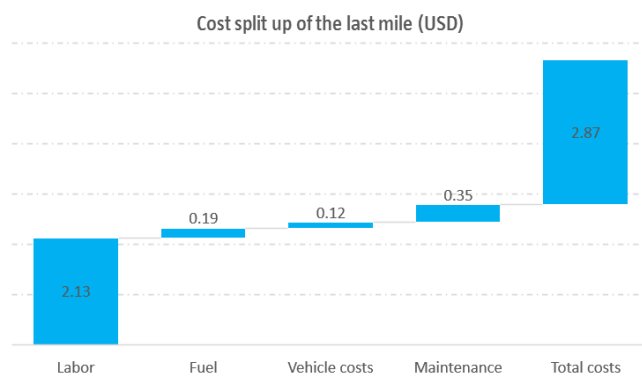
Figure 8 | What it costs to bring your package to your doorstep



Source: AT Kearney

**Little hope for better last-mile economics** | If we further examine the cost structure of that biggest cost bucket, the last mile, we find that variable costs - labor and fuel - make up its biggest portion, implying there are limited economies of scale to be achieved as e-commerce grows further.

Figure 9 | Average cost to deliver a package to your front door is just below three dollars



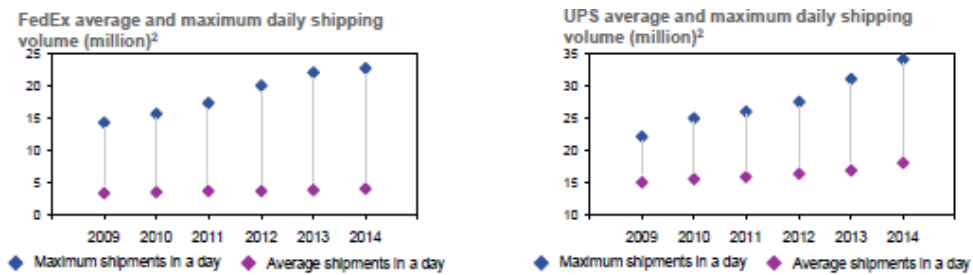
Source: Bernstein

Effectively, economies of scale can be reached only at the level of that little delivery bus that maybe stocks 100 packages. We'd argue that there is even an element of diseconomies of scale as we are seeing significant wage pressure right now due to a shortage of drivers, and congested cities will lead to more and more traffic jams and delays.

**Logistics systems need to be flexible and able to scale up quickly** | There is more. Volatility in order volume has increased substantially as a result of 'special days'; Black Friday, Cyber Monday, Singles Day and Christmas shopping all deliver massive shopping peaks. Operators therefore need to build quite some flex into their

logistics system, implying they need to either be able to scale up quickly or have ample spare capacity all year round.

Figure 10 | Volume spikes on special days get bigger



Source: Accenture

**Conclusion – increased decentralization & complexity** | E-commerce has made logistics infinitely more complex. Especially the last mile is very expensive and has inherently few economies of scale. Consumers have become used to receiving shipping for free. For logistics companies this implies high capital spending requirements combined with limited opportunities for price increases.

## E-commerce by the numbers – Did you know?

A typical good delivered has been touched 21 times by a human until it reaches your doorstep.

Last-mile delivery in dense urban areas costs USD 2.50 to USD 5 per stop, but in rural areas costs this can run up to USD 20-30 per stop.

FedEx owns 647 airplanes.

Labor, vehicle and fuel spend on last-mile delivery amounts to USD 220bn annually in the US.

The number of SKUs at Amazon is estimated to be 400m as of January 2017.

In India 1.2m parcels are delivered per day, in China 27m and in the US 17m.

Today Alibaba has 4 million square meters of warehouse space. This is up 130% from 2016.

US Postal services is said to handle 40% of Amazon's packages and receives only USD 2 per package.

2017's Singles Day, China's major shopping event, had sales of USD 25bn – in an estimated 1.5bn parcels on one day.

For every additional USD 1bn in online sales, retailers have to add 1m sqft in warehouse space.

Alibaba's logistics arm Cainiao intends to invest USD 15bn over the next few years. FedEx and UPS are estimated to increase investments by USD 10bn as well.

Warehouse  
real estate:  
urban  
logistics

The right industrial real estate can reduce last-mile cost and improve service levels. At the same time it enables fast delivery. Warehouse rental costs are only a small portion of the overall logistics bill, which is why warehouse owners are often able to enjoy substantial rent increases.

**The right warehouse location shortens the expensive last mile** | Owners of industrial real estate – i.e. warehouses - in prime locations are enjoying the best market conditions in decades: e-commerce is three times as warehouse-intensive as traditional brick and mortar trade. On the one hand, retail stores are replaced with warehouses, and on the other hand inventory ratios also rise as retailers are duplicating their our inventories to get them closer to the consumer and shorten delivery times. Operations also become inherently less space-efficient as retailers are shipping individual items rather than pallets.

A warehouse location as close to consumption centers as possible shortens the expensive last mile and accordingly controls a big portion of the overall cost structure. While total warehouse costs – including labor and interior installations – can run up to 30% of total logistics costs, rental costs for the warehouse generally amount to only about 5% of the overall logistics bill. This implies that tenants are generally willing to accept quite some rent inflation before economics push them out to B-locations. This benefits the owners of warehouses, often industrial REITS (Real Estate Investment Trusts), who rent out their real estate to logistics operators.

Figure 11 | Typical logistics cost structure split-up

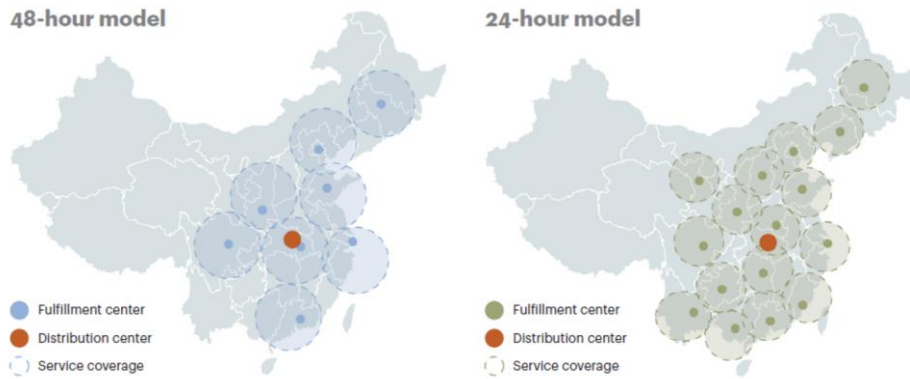


Source: Prologis

**Warehouses close to consumption centers are indispensable for 24h-delivery models** | A well-positioned warehouse footprint is not only crucial from a cost equation perspective but also very important for service levels; in fact it is often the only way to live up to delivery promises. Warehouses need to be especially close to consumption centers, and are generally much smaller and frequently referred to as fulfillment centers. When retailer move from a 48-hour to a 24-hour delivery model, their footprint in fulfillment centers can double. This means higher demand for all warehouse owners, but especially for those with real estate close to consumption centers.



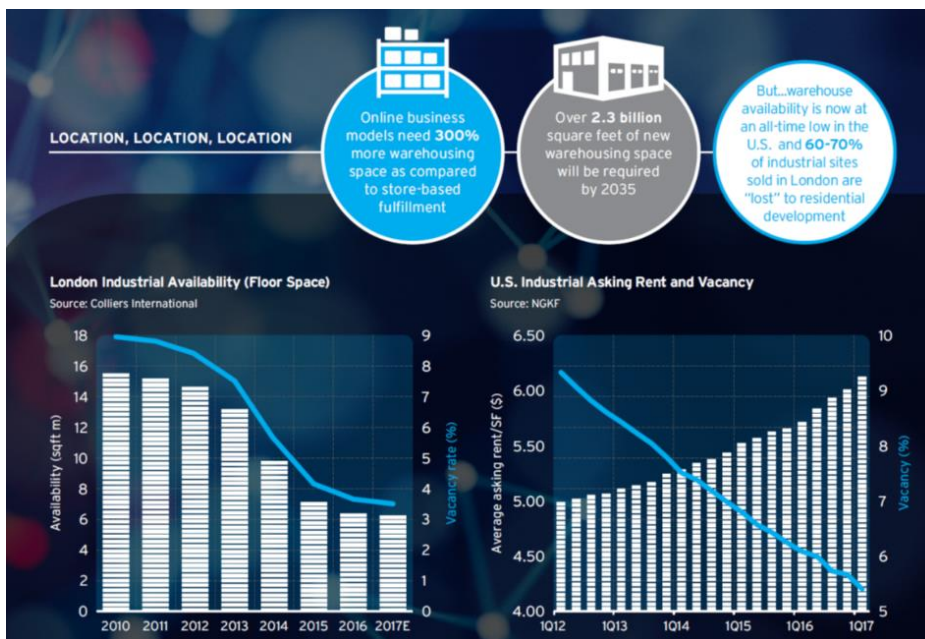
Figure 12 | Footprint change required to deliver faster, example of China



Source: A.T. Kearney

All this demand comes at a time when industrial real estate is a scarce asset. The economic value of land is lower when classified as industrial rather than for residential or commercial use. In addition, from a municipality's point of view, industrial use of land is less attractive from an employment and especially traffic perspective. Clearly, city councils and land owners alike prefer other uses, so land designation has long been converted away from industrial to other types of real estate.

Figure 13 | Industrial real estate is scarce: in London industrial sqft halved



Source: Citibank

This makes it really difficult to add (prime) warehouse space – environmental, economic and livability considerations all favor other land uses. This effectively limits additional supply, benefiting owners of today’s industrial real estate as they enjoy significant rent increases.

**Multi-story and multi-purpose developments the new ‘big thing’** | The right warehouse location has to fulfill even more requirements; there need to be a lot of docking stations for trucks to deliver and collect goods without wasting time waiting in line; enough room for parking spots for employees – and all that close enough to a catchment area so the operator can actually find enough employees. Importantly, the location needs to be connected to major transportation ways such as ports, airports or highways. Once this ‘mission impossible’ has been accomplished, operators and developers alike want to make the most of the site: this has led to a very recent development of multi-story warehouses – even if so far limited only to the highest priced land bases. This can provide further support for earnings opportunities of industrial real estate owners.

Figure 14 | Multi story warehouse



Source: Prologis

Figure 15 | Major industrial real estate owners

Industrial Warehouse Owners	Main areas of operations
Prologis	US, Europe
Segro	UK
Goodman	Australia
Duke Realty Corp	US
STAG Industrial	US
Rexford Industrial Realty	US

Source: Robeco

**Conclusion and investment opportunities – favorable environment for industrial warehouse owners** | We see owners of prime industrial real estate assets as major beneficiaries of e-commerce growth. Prime real estate is a scarce asset with little room for additional supply, so REITS with a stock of attractive industrial land bases will enjoy a nice rental uplift in their portfolios. It is crucial here to be selective though, and focus on those with the best assets as only they will be able to help operators live up to delivery promises.

Warehouse automation: vision technology | Warehouse automation is crucial for e-commerce success. While many different automation technologies will improve warehouse operations, one specific technology will bring about the inflection point: as robots learn to see through vision technology, they get ready to enter the warehouse.

## Did you know? Facts & figures on warehouse automation

DHL estimates self-driving technologies could cut operating costs by as much as 40% and alleviate the driver shortage in the US.

Logistics automation investment in China has grown by 45% from 2007 to 2015.

Only 10% of Amazon's warehouses use KIVA robots.

IBM estimates the logistics industry could save USD 300bn annually through the use of blockchain in supply chains. This is because trade-related documents and administration amount to a full 20% of overall transportation costs.

Delta, JD's claw-like robot, is capable of picking up 2,500 to 3,000 products per hour, and can only handle objects that weigh between 50 grams and 3 kilograms. The company's larger 6-axis robot, which can handle 100 to 160 kilogram items, takes 10 to 12 seconds to move one item (techinasia.com)

Venture capital raised USD 2.7bn in logistics over the last 3 years versus USD 0.4bn over the three years before that.

The industry has classified warehouse automation into four levels: level 1 solutions can cost only USD 500k while level 4 fully automated solutions can easily cost more than USD 25m.

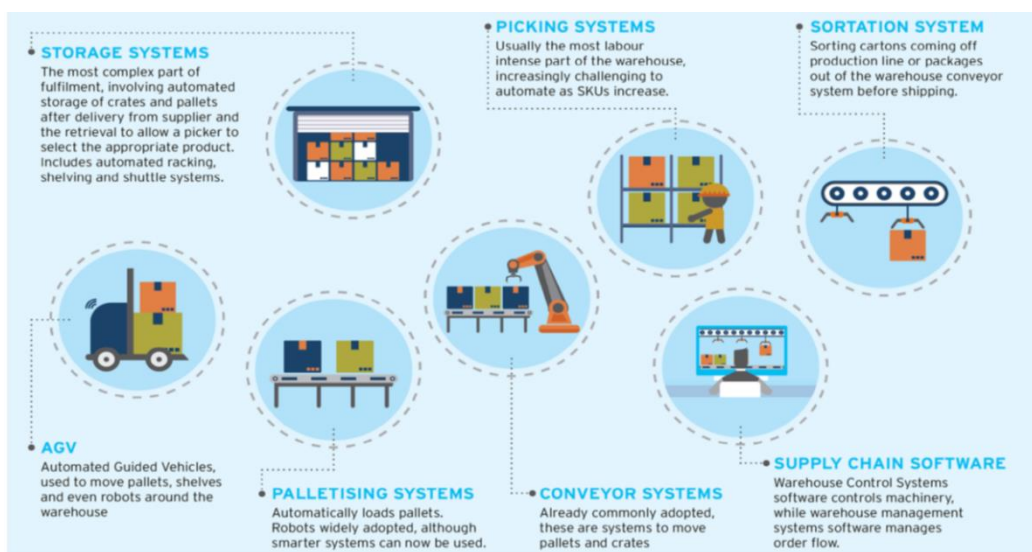
Amazon employed 220,000 people and 45,000 robots in 2016.

Level 1 automation payback periods can be as short as 6 months while fully automated solutions require longer term planning with payback periods of 5 to 10 years.

The winner of the yearly Amazon picking challenge in 2017 was from Australia and was able to pick 250 items in one hour. A human worker can handle 400 items per hour.

**Multitude of functions in a warehouse - with varying potential for automation** | Warehouse automation comes in many forms and can take on various degrees. As wide-ranging as the different functions performed in a warehouse are - think of receiving, checking, counting, sorting and storing, palletizing and picking goods – so can the complexity of automation solutions be.

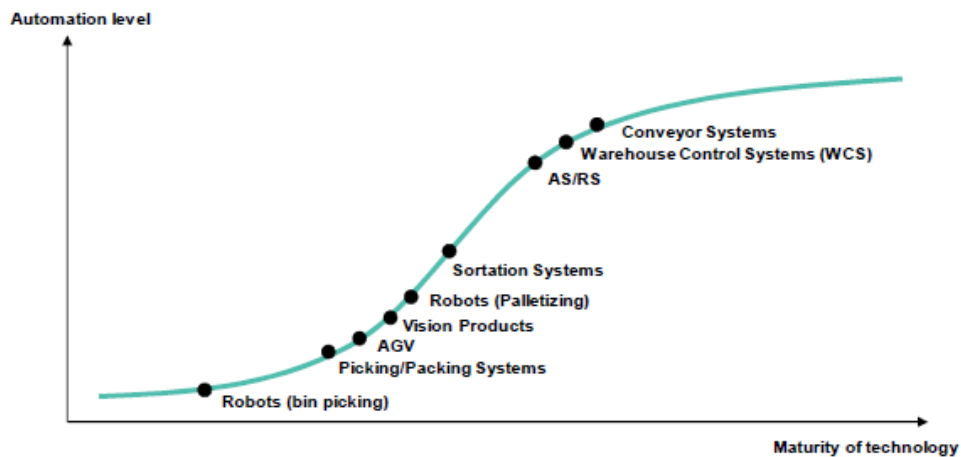
Figure 16 | A wide range of functions to automate in a warehouse



Source: Citi Research

For example, while palletizing, conveyor and sortation systems are relatively commonplace in today's warehouses, automated storage and retrieval systems (AS/RS) and especially picking are a lot more complex. Accordingly, the penetration of different automation solutions varies significantly.

Figure 17 | Adoption level of warehouse automation solutions



Source: Bernstein

**Low degree of automation in the warehouse due to a large number of non-repeatable tasks** | When compared with manufacturing sites, logistics warehouses feature a very low degree of automation. This cannot be explained by a lack of benefit nor demand. To the contrary, there is a significant and growing labor shortage in logistics. However, while factories have a predefined set of tasks that are performed in a repetitive manner and can therefore be automated easily, warehouse functions are generally less standardized. Goods in warehouses come in all shapes and forms, making them tough for robots to handle. For example, when it comes to e-commerce, containers and pallets are still standardized, but parcels and the wide range of SKUs have no standard dimensions. Figure 18 shows the trade-off between the main benefits and disadvantages warehouse operators face nowadays.

According to a study of PostNL, 80% of all warehouses do not have any form of automation, 15% use at least some form of mechanization and only 5% are fully automated.

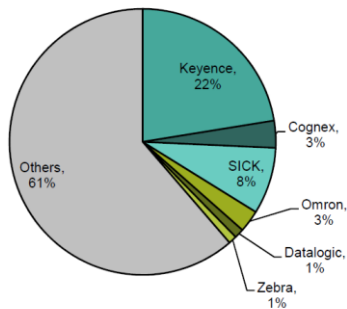
Figure 18 | Benefits and disadvantages of warehouse automation

Benefits	Disadvantages
<ul style="list-style-type: none"> <li>• Reduced warehouse footprints (up to 85%)</li> <li>• Reduced operational costs (up to 65%)</li> <li>• Increased efficiencies (3-4x)</li> <li>• Easier scaling up on peak days</li> <li>• Reduced scrap/error rates</li> <li>• Faster through-put rates</li> <li>• 24/7</li> <li>• Economies of scale</li> <li>• Helps to deal with worker shortage/aging societies</li> </ul>	<ul style="list-style-type: none"> <li>• Standardization can lead to inflexibilities</li> <li>• High initial capex outlays</li> <li>• Payback periods of 5-10 years</li> <li>• Technology not fully developed</li> <li>• Long and complicated planning &amp; design stage (min. 1 year)</li> <li>• Only feasible for larger players</li> <li>• Few off-the-shelf solutions, requires bespoke solutions</li> </ul>

Source: Robeco

**But we are at an inflection point: vision systems will drive automation rates up** | To be able to work in a warehouse environment, robots have to learn something new: the perception and recognition (of the dimensions) of objects. In other words, robots have to learn to see. This so called 'vision technology' includes cameras, laser sensors, Radio-frequency (RF) ID devices and barcode readers. They are found along the whole process chain of a warehouse and make sure that hardware can effectively signal to software, or the Warehouse Control System. We think that vision technology will bring about an inflection point in warehouse automation. The producers of vision systems are therefore among the most interesting investment opportunities related to e-commerce growth.

Figure 19 | Market shares in vision systems, 2015<sup>1</sup>



Source: Bernstein

**Self-learning robots will solve the picking and placing challenge with machine learning** | The order-picking process is the holy grail of warehouse automation as half of all labor time is spent on picking and packing. 90% of the picks in a warehouse are still done by a human hand (Schaeffler) and as figure 17 above shows, the technology is still very immature. This is something which has been termed Moravec’s paradox: it is very easy to teach robots adult skills but incredibly difficult to let them perform tasks a two-year old already masters – such as picking from a cluttered bin with overlapping items. Human hand-eye coordination and fine motor skills are fascinating and incredibly well developed skills after all! Nevertheless, we think solving this challenge is possible at least for our warehouse purposes and will be done through a combination of machine 3D vision and deep learning. Machine vision is a subset of the larger vision technology market and refers to taking and automatically analyzing pictures and patterns. This will allow robots to grab even unknown objects in an unstructured environment – critical in a warehouse with a high number of SKUs.

Figure 20 | Machine vision combined with deep learning will enable bin picking



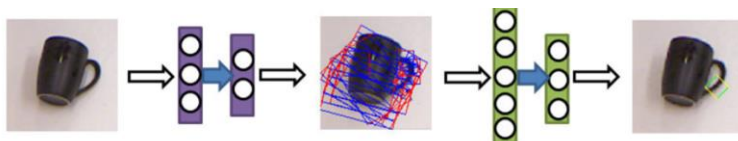
Source: Google & RobotWorkx

Deep learning is a technique useful in situations with a high degree of complexity and ambiguity – just like in a warehouse. Deep learning works through several hierarchical layers and with the help of probabilities it

<sup>1</sup> These company names are mentioned for illustrative purposes only and are not intended to be an investment advice in any way.

forms an 'educated guess' of what an object constitutes. Being able to identify objects is the first step, now the robot needs to determine how to best grasp the object. Here we come back to hand-eye coordination. Equipped with a number of sensors, the robotic arm starts a feedback loop until the best strategy to pick an object is determined.

Figure 21 | Deep learning: the robot determines the right grasping position through trial and error

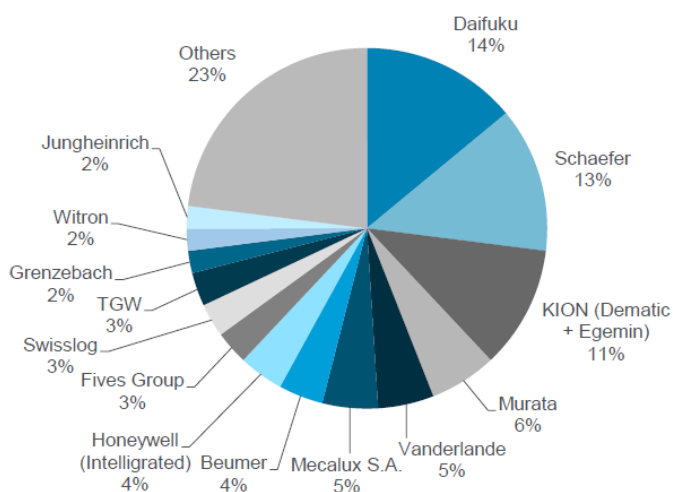


Source: Bernstein

**Vision technology is a great play on warehouse automation** | The vision technology market is a subset of the larger automation market and worth USD 15 billion as of 2017. It is expected to grow at a strong ~15% growth rate over the next five years. From a customer perspective, the initial capital expenditure for vision technology is much lower and the payback period is much shorter than for other more 'invasive' types of automation. This makes adoption hurdles much easier to overcome. Considering the low levels of penetration mentioned above combined with the time-intensive process, we expect a sustained period of growth to come.

**We prefer hybrids of software and hardware/all-in suppliers** | Above and beyond vision technology, warehouse automation in general is an attractive investment area. Automation solutions in a warehouse are very wide-ranging and technological requirements are so advanced that players each have a specialization.

Figure 22 | Warehouse automation market shares<sup>2</sup>



Source: Citibank

<sup>2</sup> These company names are mentioned for illustrative purposes only and are not intended to be an investment advice in any way.



This results in a relatively fragmented industry, but we do expect a lot of consolidation. Automation gone wrong can introduce a lot of inflexibility to a warehouse and disrupt operations, so the planning and design process needs to be executed very carefully. Except for the very large warehouse operators most customers cannot implement an automated warehouse on their own but need support from integrators and process designers. Therefore we would expect all-in solution or full-service providers offering both automation hardware and software to become more commonplace than mere equipment suppliers. To become a real partner for clients, the larger automation players will go on a shopping spree. The first examples of this can be seen in Toyota Industries' (a lift truck manufacturer) acquisition of Bastian Solutions (a system integrator) and Vanderlande (a logistic process automation player) or Cognex (vision technology) buying ViDi Systems in 2017, a vision technology deep learning software producer. KION bought Dematic (a full-fledged automated material handling solution), Retrotech (a system integrator) and Egemin (making AGVs & conveyor systems) – and so we could go on.

**Conclusion and investment opportunities |** One of our favorite ways to benefit from growing e-commerce penetration is in the warehouse automation space. Penetration rates are still low yet demand is high and thanks to vision technology we are at an inflection point. In addition, we expect consolidation activity to accelerate as players battle for size and aim to become full-fledged solution providers or consultants to their customers.

Shake-up and start-up: autonomous delivery

The future of delivery: autonomous delivery & crowd-sourcing solutions. A wide range of options will lead to a patchwork solution, keeping delivery economics in check.

**Patchwork solution** | As the last mile is the biggest cost item, it is the main battleground for incumbents and start-ups alike. There is a growing need to eliminate the above-mentioned diseconomies of scale in the last mile. There won't be a 'one-size-fits-all-solution' though, and we rather think the last mile will become an ever more fragmented mix of many solutions. Start-up companies will bring technologies such as cloud platforms or crowd sharing to the logistics industry to make clever use of free capacity elsewhere. Incumbents will experiment with automatically guided vehicles (AGVs), drones, self-driving robots or even delivery tunnels. While many sound and probably are far out in the future, others - or at least pre-forms of them - will be with us quite soon. We think that it is very likely that in the near future we will have a multitude of innovative solutions that work together in a patchwork, where each is doing what it does best.

**Automating the last mile – the logistics industry is experimenting with self-driving technology** | The logistics industry will probably be one of the first to employ self-driving vehicles on a large scale. There will be many degrees and forms. It will start with platooning for line-haul trucks and self-driving forklifts inside the warehouse or other fenced, internal, controlled and closed environments (think yards, harbors, airports). All these are technologically feasible today and we think they will be a very normal sight just a few years from now.

Figure 23 | A range of applications for self-driving vehicles in logistics

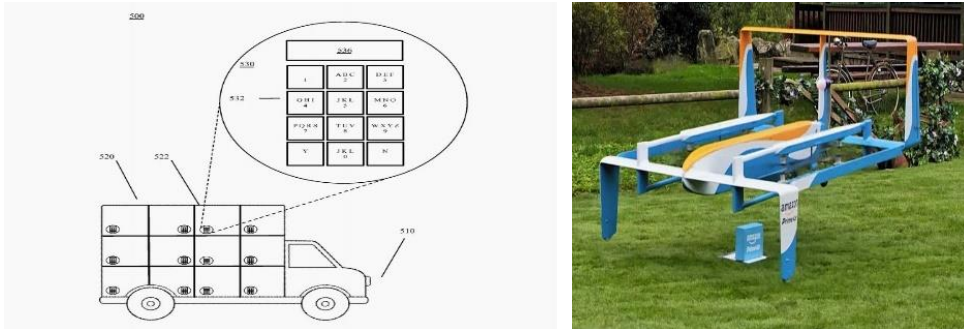


Source: DHL Trend report

The most challenging part to perform autonomously is of course the last-mile delivery on public roads in very dynamic and congested inner-city environments. At the same time, this last mile is very attractive to convert to self-driving technology, considering the high costs involved. Machine-to-person delivery on a large scale may be far out, but machine-to-parcel station handover is realizable even today. In addition, Google is working on self-driving delivery trucks with separate compartments that can be opened with a pin code, while Amazon is putting its bets on drones. JD is employing both already in China.

Platooning is a form of semi-automation in which the lead truck is fully controlled by a human driver, while a number of following trucks break, steer and accelerate automatically. Initially, all trucks still have human drivers inside, so the biggest gains are fuel and reduced accident rates. As the amount spent on fuel in the logistics industry is USD 100bn annually in the US, even a 1% improvement rate makes for attractive savings. Actual savings rates could be much higher though, especially as over time only the first trucks will have a human driver inside.

Figure 24 | Google autonomous delivery truck and Amazon drone



Source: Qz.com

Rather than placing bets on what self-driving technology will become the future – if at all – we would rather side-track and invest in ‘the picks and shovels’ of autonomous technologies. Whatever the solution will be, all have one thing in common: they use an exceptionally large amount of sensors and cameras. ‘Connected cars’ are significantly more semi-conductor intensive – often by multitudes. Producers of connectivity solutions as well as chip producers will therefore see increased demand for their products. For further details, please refer to the white papers ‘Gearing up for self-driving cars’ and ‘Will our future car be self-driving and electric?’<sup>3</sup>.

Figure 25 | The future is now in China: drones and delivery robots already in operation



Source: Sina Tech

**Innovating the last mile – the uberization of logistics** | The last mile is also very fertile ground for innovative crowd-sharing platforms, many revolving around the theme of converting existing spare capacity somewhere in the system into parcel delivery. UberCARGO or UberRUSH, start-up company Nimber which matches commuters to parcels, Walmart’s store employees who deliver groceries on their way home, public buses that transport parcels next to passengers –these are just a few examples. A fascinating amount of clever innovation is going on, and while there is a significant amount of entry (and exit), we think most solutions

<sup>3</sup> <https://www.robeco.com/hk/en/insights/?k=Trends+investing>

will contribute only at the margin. Nevertheless, there is potential for some interesting platforms to develop and in either case their combined effect will matter.

Figure 26 | The Postbus – combining passenger & parcel transport

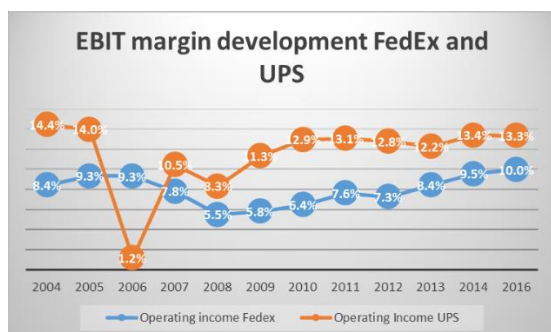


Source: DHL

Larger (incumbent), listed companies might choose to participate via Mergers & Acquisitions but also organically. The largest logistic company, Deutsche Post DHL, recently launched DHL Spaces, a digital warehouse locator, offering flexible warehouse space. Amazon is widely rumored to replicate in logistics what it did with Amazon Web Services (AWS) in data centers and to bring its ‘cloud offering’ to the warehouse and last-mile delivery: smaller online merchants can then rent warehouse and delivery space on a per-use basis from Amazon ‘Seller Flex’.

**Last-mile economics not attractive from a listed equity perspective** | All this amount of innovation and competition has led to quite some pressure on pricing and, consequently, margins of parcel delivery companies. In fact, the United Postal Service (USPS) has reported negative profitability in each of the last five years. While the publicly listed companies fare much better than that, rising e-commerce volumes have so far failed to translate into rising profitability for FedEx and UPS.

Figure 27 | UPS and FedEx EBIT development: no margin uplift from higher volumes



Source: Robeco

While charging extremely low prices for parcel delivery might be a habit of the past, we see only very limited upside room for pricing. Especially thanks to all those crowd-sourcing solutions there are very little barriers to entry and we see the last mile as the main battleground for start-up companies, postal companies, online retailers and large parcel companies alike. There are just too many options and substitutes – which will keep economics low.

Figure 28 | Logistic start-up companies



Source: Accenture

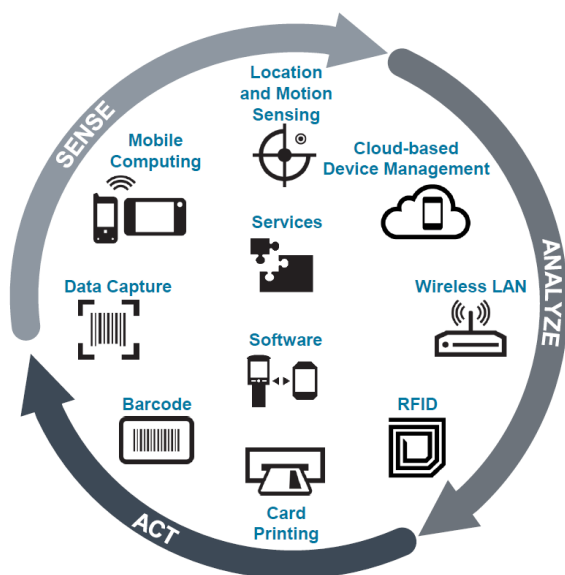
**Conclusion – there is no such thing as free shipping |** In their grab for market share, (online) retailers have captured most of the logistics bill, together with the United Postal Service, which in a way subsidized the growth of Amazon by probably delivering too often too cheaply. While this may be a habit of the past, we still do not see the space as an attractive investment opportunity as there are too many new players entering this major battle ground. There will likely be some very interesting start-up platforms that make use of existing spare capacity elsewhere in the system through crowd-sourcing solutions; however, they are generally found in the unlisted space. In the listed space, we look for the ‘picks and shovels’ of autonomous technology such as sensor and semi-conductor players.

Sensors  
and tags:  
connecting  
the whole  
supply  
chain

Logistics becoming smart: from track & trace to blockchain. We see asset owners benefiting significantly from increased utilization levels, middlemen suffering from higher transparency and software platforms bringing light to a previously opaque industry.

**Logistics of things** | The supply chain is another showcase of how the digital and physical infrastructures of our worlds are converging. The usual buzzwords have arrived in the logistics industry at last; the internet of things (IoT), sharing economy, big data, artificial intelligence, cloud and crowd-sourcing will all contribute to a more efficient logistics system. They will bring end-to-end connectivity and visibility in real time as well as advanced and anticipatory planning tools. All this will again be enabled by connectivity – here called Automated Data Capture devices (ADC). This includes sensors, lasers, connectors, cameras and tags.

Figure 29 | Logistics becoming smart



Source: Zebra

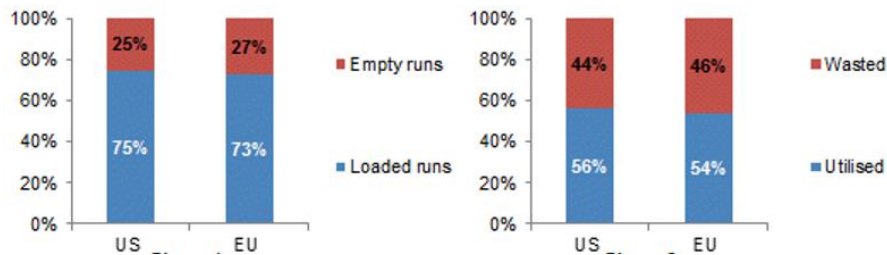
Optimizing and digitizing the USD 4 trillion logistics market can unlock substantial hidden value. We think smart supply chains will not only help to reduce costs and error rates but also improve service levels through faster delivery. Goldman Sachs estimates that big data technologies can save over USD 25 billion in operating costs across the whole logistics system.

UPS was able to reduce total miles driven by 3% through advanced telematics and analytics.

**End-to-end connection of the supply chain generates significant value** | Streamlining operations to reduce costs can deliver significant value; Frost and Sullivan showed that an astonishing one out of four truck miles in both the US and Europe are driven by empty trucks, and trucks that do carry goods are half-loaded. In addition, far too many expensive driver hours are lost, as drivers are waiting in front of warehouses to unload freight.



Figure 30 | Truck load factors – too many ‘dead miles’



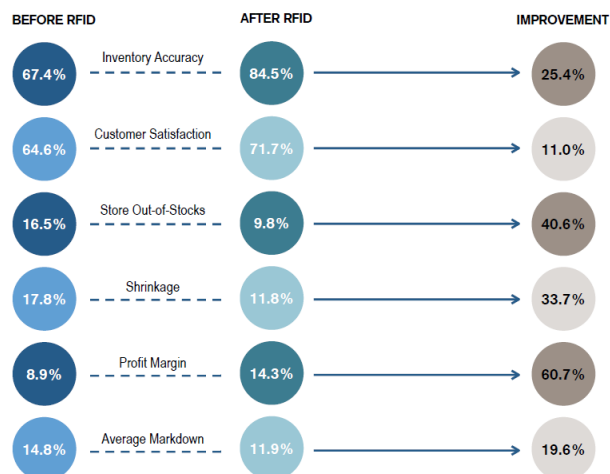
Source: Frost & Sullivan

The transport sector is said to be responsible for 13% of global emissions (PWC). Clearly, reducing empty runs in ships, trucks and cargo planes through optimization technologies will substantially reduce emissions as well.

**Know thyself to save money – track and trace** | An example of cost saving opportunities is supplied by Airbus, which saved nearly 10% of container shipments just by knowing where goods are situated in its supply chain and accordingly running operations more smoothly. Benefits of connectivity are often twofold: IBM shows that avoiding stock outages through self-replenishment of inventory will increase revenues while at the same time reducing working capital through inventory reductions of 10-15%. Lastly, fewer delivery errors and early-detection mechanisms reduce costly faults.

Being able to track and trace products back to its origin is of crucial importance in fresh food, where contaminations can be detected quicker and countermeasures be taken immediately and in a targeted manner rather than through a sweeping overall blow-out. Similarly, for luxury goods, traceability helps to fight counterfeit.

Figure 31 | Examples of savings achieved through connectivity by fashion retailers



Source: Credit Suisse

With so much savings potential, the obvious question to ask is: who is going to reap the benefit? We think it will mainly be the consumer. Surely, there will be logistics or retail companies that can prop up their margins somewhat. However, pricing power has traditionally not been strong in both industries and as we expect competitiveness to intensify, we would expect most of the benefits to be passed on to the consumer.

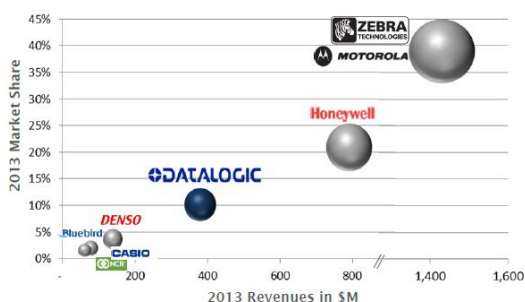
**Sensing to make sense** | Barcodes, RFID tags and lasers alike are generating and collecting vast amounts of data - which are worth nothing unless turned into insights for better decision-making. This is the domain of software companies offering (inter)-enterprise software for supply chain management. With the help of cloud solutions and artificial intelligence, logistics can become just-in-time and efficient.

Figure 32 | Supply Chain Software Providers



Source: BTIG

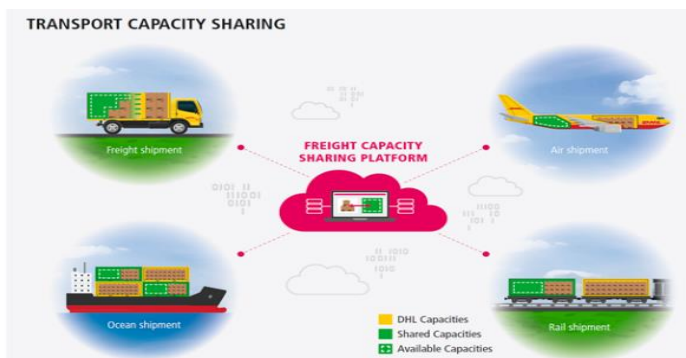
Figure 33 | ADC devices market shares and revenue take (2015)



Source: Datalogic, VDC Research

**Cloud-enabled sharing will optimize utilization rates** | We have seen how much value can be created if the supply chain is vertically connected within a company’s own operations. This value creation will increase exponentially if supply chains are not only linked vertically to suppliers and customers, but also horizontally to competitors and peers. We therefore think the sharing economy will arrive in the logistics sector as sharing capacity with competitors can be mutually beneficial to facilitate real-time matching of loads and empties. As an asset-heavy industry with a high level of seasonality, logistics lends itself perfectly for the sharing economy. An example of this is DHL which uses freight capacity sharing platforms to rent out free capacity in its shipments.

Figure 34 | Transport capacity cloud-enabled sharing



Source: DHL

We see freight forwarders’ business models at risk as the various parts of the supply chain are connected. This is only reinforced through the latest buzzword entering the world of logistics – blockchain.

**Blockchain redistributing value across the supply chain** | Blockchain will significantly benefit asset owners while – just as in many other industries – disintermediating the middlemen. The logistics industry has traditionally been very opaque with too many layers and players. Middlemen who have relationships with all the many parties involved can take a cut of 20-25% - and that even without owning any assets. The asset-heavy players in the industry, however, face thin and very volatile margins. A Return on Invested Capital comparison makes this even more visible; we are talking low single-digit levels versus EBIT (Earnings before Interest and Tax) margins that range up to in the 30s for freight forwarders. This is probably not sustainable. We think new online platforms like UShip and Freightos will bring visibility into the system. In combination with the use of blockchain and other technologies, this will bring margins of freight forwarders down. On the other hand, better matching demand with spare capacity will increase utilization rates for ship, truck or cargo plane owners – boosting their profit margins.

**Conclusion and investment opportunities** | While e-commerce introduced a lot of challenges to logistics, 'Industry 4.0' brings a lot of tools to offset costs in what has historically been a low tech and often very inefficient industry. Connecting the supply chain from one end to the other will significantly benefit suppliers of ADC devices, software companies that offer supply chain, warehouse or transportation management software, asset owners which enjoy better utilization rates and, last but not least, the environment through lower emissions.

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