Focus

Roland Berger

From atomization to massification |
Urban logistics must make a U-turn to achieve a sustainable future

Roland Berger

The Roland Berger
Center for Smart Mobility

From atomization to massification / *Urban logistics must make a U-turn to achieve a sustainable future*

Urban logistics – how we transport goods to cities and deliver them to businesses or private customers – is facing a number of fundamental challenges. Customer expectations regarding speed and flexibility are growing fast, cities are becoming ever more congested, emissions are increasing, regulation is tightening, while infrastructure is by and large failing to keep pace with demand. Solutions are needed as a matter of urgency.

We believe that urban logistics must make a radical U-turn, away from the current process of atomization and towards massification. Some initial attempts to transform the sector are already underway, such as the use of purpose-built vehicles and the establishment of urban consolidation centers, but these are isolated efforts at the moment. In this study we present three possible future scenarios in which massification plays a more central role, facilitating the better filling up of vehicles and mutualization of volumes. In the first, retail giants take the lead in efforts to massify. In the second, governments play the main part. In the third, the ecosystem itself is the chief driver of change.

Stakeholders from city authorities, logistics operators and consumers to infrastructure providers and vehicle manufacturers should work shoulder to shoulder to ensure massification. The tasks range from preempting environmental issues by investing in new fleets and optimized delivery schemes to proactively voicing new solutions to regulators. Different players have different roles to play – but only joint action can ensure that urban logistics achieves the U-turn needed for a sustainable future.

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Cover photo frantic00/iStock

1 / Keeping up with demand

THE CHALLENGE OF MODERN URBAN LOGISTICS

Urban logistics – how we transport goods to cities and deliver them to businesses or other end customers – is a key enabler of convenience. Today's logistics industry is more important than ever before. We increasingly expect the items that we order to arrive at our doorsteps on time, often in a matter of hours if not minutes, and at an affordable price.

Established logistics operators and startups have found various ways to satisfy our growing demand for convenience – despite monumental challenges such as the COVID-19 pandemic and the resulting expansion of e-commerce, including the delivery of prepared food and groceries. But the rapid growth of flows of goods, combined with greater demands with regard to convenience, is rapidly increasing the complexity of the urban logistics backbone. It is now no longer clear that urban logistics can continue to keep up the pace.

The shift towards individualization of logistics services continues to present challenges for providers, making it difficult for them to maintain utilization and fill rates. Greater complexity of delivery modes, driven by the expectation of faster, more flexible delivery times (including early-morning, late-night and weekend deliveries) works against any cost efficiencies. Attempts to improve efficiency by better adapting delivery vehicles to urban logistics constraints and efficiency obligations are hindered by underlying consumer requirements that make it difficult to reduce delivery costs per goods item. The result? Increasing revenues per package combined with decreasing operating margins. → A

The expansion of e-commerce – currently representing around 20 percent of global retail sales – and increasing customer demands with regard to convenience are not expected to slow in any way in the coming years, driven by the growing penetration of online shopping and the race for speed of delivery. With the trend towards urbanization and denser cities, more consumers need to be served within the same area with the same infrastructure. Yet that infrastructure is not itself expanding, putting greater stress both on cities and on the economics of logistics.

THE PROBLEM OF ATOMIZATION

The fundamental issue that needs to be resolved is that items are currently delivered in an "atomized" rather than a "massified" manner. Atomization – in other words, a fragmented approach – is driven by factors such as customer expectations concerning delivery speed and strong seasonal volatility of demand.

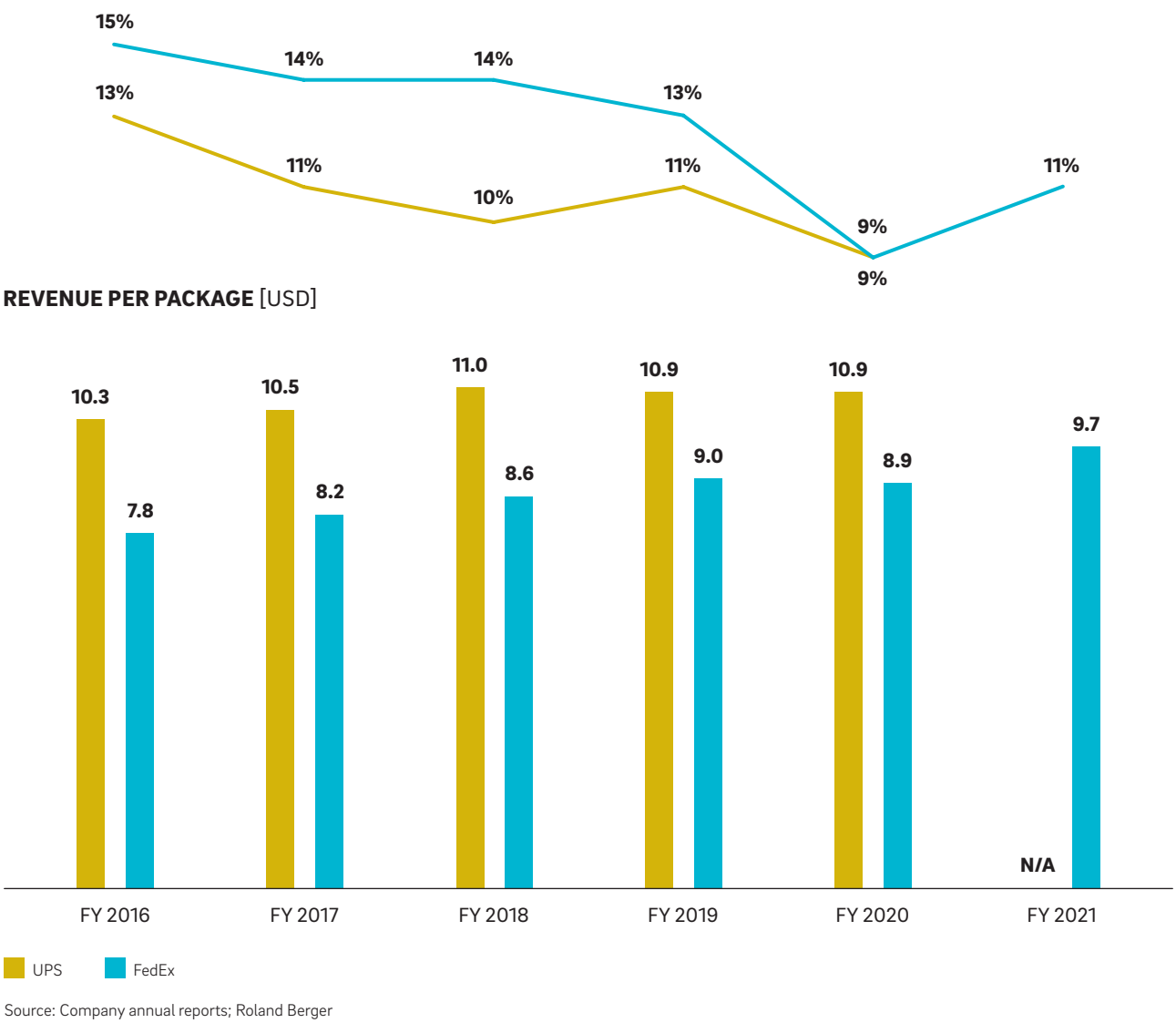
Expectations with regard to **delivery speed** are increasing, with around 56 percent of online consumers aged 18-34 years now expecting same-day delivery of items.[1] Moreover, as same-day delivery services become more widely available, e-commerce sales and deliveries are growing in volume, putting logistics service levels under even greater stress. To take an example, Amazon – a frontrunner in delivery speed – started offering free, two-hour delivery in limited locations with Prime Now in 2014; it has now integrated this service into its main app and offers it to all Prime customers.[2] The company achieves this level of service thanks to its ability to analyze and predict direct customer demands on local or city level, coupled with its use of urban fulfillment centers.

Similarly, leading players in China are achieving faster delivery speeds by enhancing their network planning, with decreased coverage and increased delivery times for each service station. In top-tier cities, service stations now offer up to three deliveries a day. Providers are also adopting self-owned or shared third-party relay points or lockers to improve delivery efficiency, with around 50 to 60 percent of parcels delivered indirectly to customers' homes in 2020, according to a leading express company in China.

[1] https://www.invespcro.com/blog/same-day-delivery/
[2] https://www.cnbc.com/2021/05/21/amazon-is-shutting-down-its-prime-now-fast-delivery-app.html

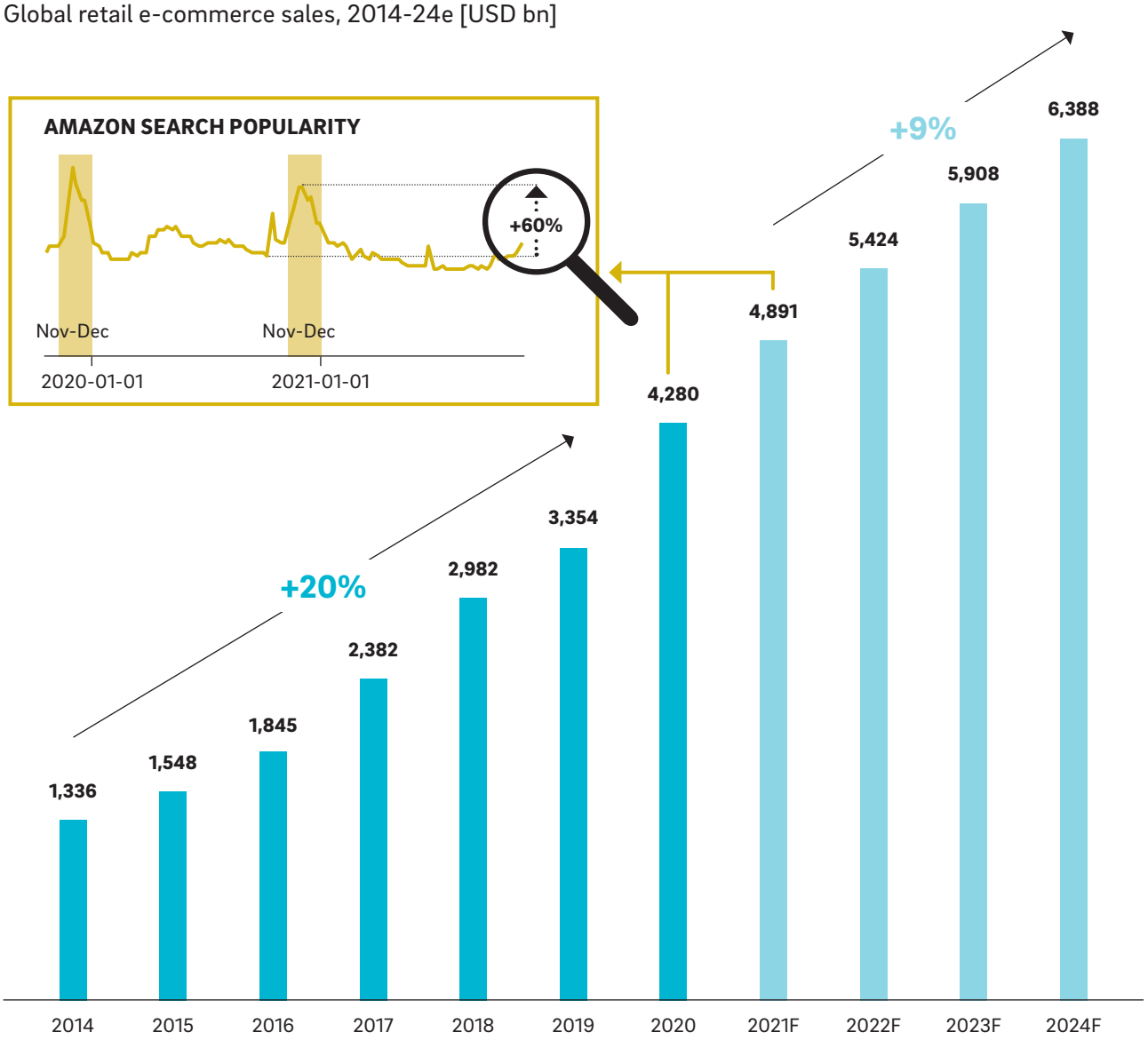
A: Margins are shrinking

Financial development of selected US logistics operators



Source: Company annual reports; Roland Berger

B: E-commerce is growing – but demand is volatile
Global retail e-commerce sales, 2014-24e [USD bn]



Source: Statista; eMarketer; Google Trends

This shift to ever-faster delivery poses a major threat to logistics players' profitability and competitiveness. Customers' need for speed works against network efficiency and leads to a massive increase in complexity, both in terms of the sheer mass of data on customer behavior required and the necessary vehicles and warehousing capacities. Current hub-and-spoke organizations are not fit for same-day delivery: Even DHL, which has a 45 percent share of the market in Germany, has decided not to offer same-day delivery services. For this to be possible, deliveries would need to be integrated into regular planned routes – via smart routing, for example. Logistics operators have to meet certain requirements depending on their agreed service level. This always involves trade-offs in terms of how they design their network. Initially, scale was of paramount importance; over the years, flexibility and precision have gained precedence – a road that ultimately leads to on-demand services.

A second factor driving atomization is **volatility of demand.** Global e-commerce sales have boomed over the last decade and penetration has been further boosted by the COVID-19 pandemic since 2020. The total market is set to grow by around nine percent annually over the coming years. The number of customers, product categories and shippers is also increasing. But shopping patterns are complex and demand is highly volatile. Black Friday and the Christmas period exemplify this extreme seasonality: The popularity of searches on the Amazon website increases by 50 to 100 percent during November and December compared to the rest of year. → B

Logistics companies already make huge efforts in the area of demand planning in order to cater for these fluctuations. They have models in place that allow them to add variable capacity through temporary labor, temporary warehousing and the like. However, strong demand volatility makes it difficult for them to maintain high, stable utilization rates of assets such as vehicles, warehouses and other infrastructure.

Strong demand volatility makes it very challenging to maintain stable utilization rates.

The challenges are not limited to business-to-consumer (B2C) markets, either. The business-to-business (B2B) sector is also showing increasing atomization. Demand is changing significantly here, as the number of marketplaces grows and business customers increasingly expect the same speed and level of service as they receive in their private dealings with companies. Eezee, for example – Singapore's largest B2B marketplace for industrial and business supplies – promises delivery in one to three days.

The rapid growth of the B2B e-commerce market could mean that even more atomization is to come in urban logistics. The current penetration of B2B e-commerce in the United States is just 14 percent, leaving considerable room for future expansion. Likewise, the global merchandise value from B2B e-commerce is forecast to grow by around 17 percent a year through 2025. Although unit volumes are typically larger in B2B than B2C, growth in B2B e-commerce will bring further volatility of delivery demand compared to traditional offline sales. Of course, it remains to be seen whether e-commerce in B2B will become as atomized as in B2C, but its impact on the complexity of logistics is already evident.

[3] https://www.statista.com/statistics/273104/us-b2b-e-commerce-share/
[4] https://www.statista.com/study/44442/statista-report-b2b-e-commerce/

2 / First steps

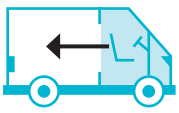
ISOLATED ATTEMPTS TO SOLVE THE PUZZLE

Clearly, action is needed to turn urban logistics around and ensure a sustainable, efficient future. "Various efforts to change the sector are already underway, as we discuss below. However, these are currently isolated attempts driven by different stakeholders, rather than a concerted effort to transform the entire ecosystem.

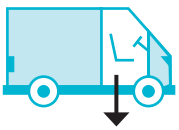
From a technology perspective, a number of solutions exist for improving efficiency and reducing emissions. This is an important issue, but one that lies somewhat outside the main focus of this study, so we will only give a few examples here. Some logistics players are beginning to adopt purpose-built vehicles (PBVs) for deliveries. These special vehicles enable productivity gains as the vehicle design is optimized for delivery workers: Fewer steps are needed to collect the parcel, time spent searching for the parcel is minimized, ergonomics are enhanced and so on. PBVs currently available on the market also feature optimized electric powertrains that cut emissions while still enabling high delivery performance. Studies show that shifting to electric trucks reduces full-lifecycle emissions by around 50 percent – although additional measures would be needed to achieve net-zero emissions, as vehicle production still relies on fossil fuels. → C

C: Going electric
Advantages of purpose-built vehicles

BENEFITS OF WALK-IN VAN DESIGN

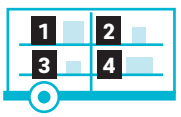


Walk-in design
Driver can access the storage room without having to exit the vehicle first



Side door
Driver can walk out on the right-hand side of the vehicle, which reduces the risk of accidents

Wide aisle
Driver can easily move around inside the spacious storage room



Shelf structure
Parcels are sorted onto numbered shelves to minimize searching time

EFFICIENCY IMPACT

Time savings
30-45 secs per stop

Productivity gain
10-20 more stops per route

Fleet optimization
10-15% fewer vehicles

Source: Roland Berger

One way to reduce atomization and increase massification would be for PBVs to evolve into **"containers on wheels"** – vehicles designed to transport small modularized containers filled with parcels would facilitate mutualization of volumes, as players could more easily interconnect their transport schemes and combine capacities. This would involve shippers filling containers that are then transported to logistics hubs, service points or even homes, where they are emptied and parcels separated into last-mile flows. This approach would deliver cost benefits similar to those achieved in freight container shipping, as the handling time for multiple parcels is consolidated in a single container. Shippers could then pay a "per container" price, with containers shipped once only, filled with as many parcels as possible. Flexible and potentially autonomous PBVs would run empty less often, over time increasing the number of users that put their containers onto them – delivering parcels to Street A and picking up recyclables from Street B and so on.

The reason that various players in the ecosystem are trying to solve the puzzle in isolation is partly because **different stakeholders face different challenges.** For example, logistics operators are asking how they can avoid losing access to cities as urban regulation tightens, how they can provide a 24/7 logistics flow and how they can offer faster delivery without losing network efficiency. Infrastructure providers, by contrast, are concerned with how they can benefit from – or at least limit the impact of – new regulations such as urban tolls, low-emission zones and bans on conventional combustion engines. Vehicle manufacturers (OEMs), for their part, are focused on what kind of vehicles are needed, how many, and whether drastic changes will take place impacting demand or the customer landscape. And city authorities must comply with legal frameworks covering CO_2 emission levels, store opening hours, labor laws and so on, while at the same time ensuring that the expansion of (often uncoordinated) delivery services does not have an excessively adverse effect on traffic levels and residents' personal mobility. The difficulty is that many of these challenges are contradictory: The key instrument available to cities is introducing more regulation, while logistics providers and infrastructure operators strive for less regulation. A collaborative approach, crucially involving politicians and the public sector, is needed in order to achieve the right balance in terms of the impact on the various stakeholders.

As different players have very different priorities, joint efforts have been limited so far.

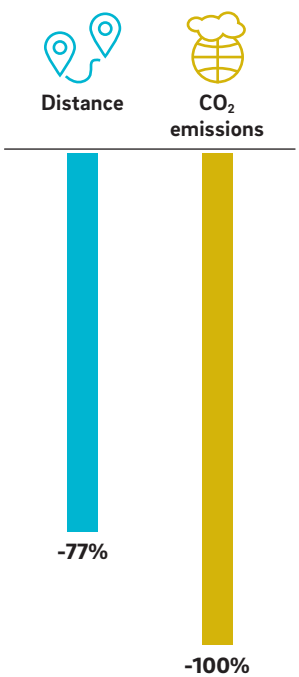
With different players having different priorities and options for action, it is not surprising that joint efforts have been limited so far. However, it is well understood by the sector that collaboration is needed in areas such as exchanging data and bundling cargo flows. Examples of joint approaches do exist, such as the urban consolidation centers (UCCs) launched by European logistics operators and cities working together over the last decade. The concept of bundling larger shipments to UCCs and then making deliveries with lighter vehicles starting closer to the delivery point has been shown to effectively reduce mileage and emissions. Logistics parks, which are often a source of congestion and noise, can also be relocated to suburbs and their original site redeveloped as commercial real estate, for example.

D: Savings on distances and emissions

Achievements of sample urban consolidation centers

LONDON
[TNT, Gnewt Cargo]

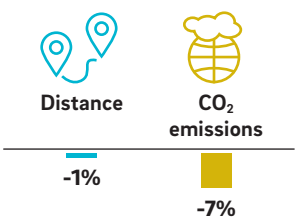
Gnewt Cargo launched a consolidation depot integrating input flows from one supplier and two TNT terminals



- Shift to electric distribution vehicles as large trucks no longer needed

LONDON + 3 COUNCILS
[DHL]

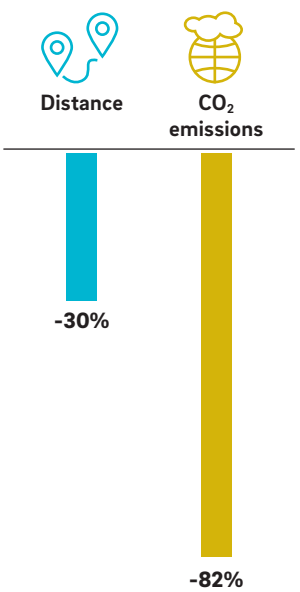
DHL as logistics partner of a center in North London consolidating goods for the public sector (launched 2014)



- Low reductions due to low service demand and lack of warehousing capability (same-day delivery)

PARIS
[The Green Link]

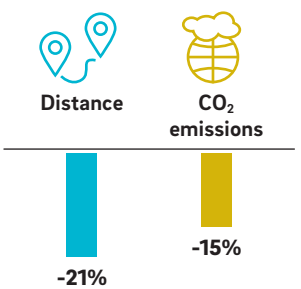
TGL launched three micro-distribution centers in Paris close to urban areas where goods are delivered



- Reductions driven by shorter length of daily roundtrips
- Further reduction of CO_2 emissions as short trips enabled deliveries by bicycle/ tricycle

BRUSSELS
[CityDepot, TRI-VIZOR]

Urban consolidation center launched for Brussels and operated by CityDepot and TRI-VIZOR from 2014



- Reductions driven by carriers consolidating goods into truckloads instead of several small vehicles

Source: Clausen et al. (2016, "Hands-on testing of last mile concepts"; European Commission (Citylab))

Unfortunately, many UCCs to date have shown low or negative return on investment (ROI) and so have been dependent on government funding.[5] A key reason for this is that logistics providers have been reluctant to join forces, share data and scale solutions up, and consequently UCCs have failed to realize their full potential. → D

[5] Sochor and Miller (2021)

A number of **other innovative efforts** are underway around the globe in areas such as new vehicles, infrastructure for hubs and delivery points, and freight technology. In China, for example, the government is considering an underground cargo pipeline model for new cities, such as Xiong'an, close to Beijing. Germany has trialed locating parcel boxes that can be accessed by all delivery companies in front of customers' homes. However, few of these innovations have gained wider traction yet. → E

E: Innovative pilots

New ideas in urban logistics

VEHICLE TECHNOLOGY

Delivery robots [Starship]

- Starship operates an autonomous delivery robot controlled by artificial intelligence
- In use in Milton Keynes with over 2 million deliveries made

PostBot [Deutsche Post]

- Movable robot box that can carry up to six letter trays and follows mail carrier
- Shields cargo against weather conditions and supports mail carrier

INFRASTRUCTURE (hubs/depots)

Urban pop-up parcel hubs by Rytle [Rytle]

- Movable containers dropped off at any possible point within a city
- Mail carrier uses container as local logistics hub for deliveries

Multifunctional parking garage [Fraunhofer, evopark, TÜV Rheinland]

- Parking garages used as temporary city distribution hubs during hours of low occupancy, e.g. at night
- Pilot currently conducted by Fraunhofer, evopark and TÜV Rheinland in Stuttgart

INFRASTRUCTURE (delivery point)

ParcelLock box (Germany) [GLS, Hermes, DPD]

- Parcel box in front of customers' homes
- All delivery companies can access the box and place cargo inside – no need for customer to be at home

Smart lockers [Amazon, DHL]

- Smart lockers in public places that can be opened by a unique code
- Code provided either by text or by applying blockchain technology to enhance security

FREIGHT TECHNOLOGY

Underground cargo pipeline (UK) [Mole]

- Experimental last-mile infrastructure via tubes (near Cambridge, UK)
- Freight pipeline is a freight-only, economical way to transport goods quickly and on time

Blockchain (China) [CFLP, Bitcoin]

- Freight optimization across carriers with blockchain solutions
- CFLP and Shenzen Digital Singularity are working on an industry standard for blockchain in logistics in China

Source: Company websites; Forbes

3 / Scoping the future

THREE SCENARIOS

If stakeholders do not act against increasing atomization, delivery costs are likely to rise in parallel with customer expectations. Eventually, customers will be the ones bearing the additional costs, paying extra for same-day delivery or avoiding these services altogether in order to save money. In Sweden, for example, consumers have been found to be unwilling to pay for home delivery of online food[6] – a trend that could eventually reduce pressure on the urban logistics ecosystem.

Below, we present three massification scenarios. They differ significantly in terms of the power balance they establish within the ecosystem. Ideally, the urban logistics system should be an equilibrium benefiting all stakeholders, in which sound competition exists between logistics players, governing bodies are able to influence the system but not overregulate it and consumer expectations are consistently met.

SCENARIO 1: RETAIL GIANTS PREVAIL

In this scenario, retail giants such as Amazon, JD.com and Alibaba take the lead, investing in new buildings, infrastructure and software, offering even faster and more convenient delivery, also achieving cost efficiencies. For this to happen, the retailers must be prepared to sacrifice short-term profitability to win in the long term – something that has happened in the past and could be further leveraged in the future.

In the endgame for this scenario, resistance to regulation increases and the retail giants are able to dictate logistics policies, forcing cities to accept their way of working. The retail giants themselves follow what their customers want, and other logistics players lose ground. This scenario risks creating inequalities for consumers, with retail giants focusing on more profitable locations, such as urban and suburban areas, and no longer offering nationwide services, leaving consumers in rural areas unserved or forced to put up with poor delivery services.

SCENARIO 2: GOVERNMENTS TAKE THE LEAD

In our second scenario, public bodies – cities, governments, authorities and so on – take control, introducing regulations that enforce massification. Measures might include fees on home or same-day deliveries, subsidies for massified warehouses outside the city or licenses for providing logistics services in cities, leaving only selected logistics providers allowed into specific urban areas. This could lead to regional monopolies in urban logistics, especially in large cities where new districts are under construction. It is also possible that urban logistics operations are limited to just a few hours a day in an effort to reduce traffic and congestion, similar to the low-emission zones already present in many cities.

In this scenario it would be difficult for providers to introduce innovations and new services. By the same token, consumers would lose out in terms of convenience, facing limited delivery options and a small range of logistics providers to choose from, at a price point that could increase due to limited competition.

SCENARIO 3: THE ECOSYSTEM OPTIMIZES ITSELF

In the third scenario, stakeholders in the ecosystem collaborate with massified logistics systems to make convenient deliveries happen at efficient cost levels. In an optimal endgame perspective, this would require the sharing of information (about vehicle locations, fill rates, routes, orders and so on), transportation assets (workforce, vans, trucks, bikes) and infrastructure assets (warehouses, parking spaces, delivery boxes).

Collaboration of this sort would make it possible to bundle deliveries and achieve greater combined utilization of assets. Consumers would benefit from convenient, cheaper deliveries and less urban pollution from congestion and emissions.

[6] https://www.ehandel.se/Ny-undersokning-svenskar-vill-inte-betala-for-hemleverans,14175.html

4 / Shoulder to shoulder

A JOINT PUSH FOR MASSIFICATION

To deliver on customer demands in a sustainable manner, stakeholders need to work shoulder to shoulder to massify urban logistics. That calls for appropriate governance, such as a public body that supports all relevant stakeholders in a specific city or region. This public body should be guided by clear principles – a desire for solutions that prioritize reduced congestion and carbon emissions over financial attractiveness, say.

The solutions in question could be platforms where logistics players massify information and logistics flows to achieve greater efficiency, paying a per parcel fee to participate in the platform, for example. Those platforms could be owned and maintained by the city or the government. Alternatively, logistics operators or retailers could operate competing platforms. The precise setup would differ on a country-by-country basis, depending on the ability of governments to launch platforms.

The joint push for massification requires action by all stakeholders in the urban logistics ecosystem. Below, we examine what each of these players in turn should be doing.

CITIES

Cities (local authorities, government) should create incentives for the pooling of flows of goods outside the city in order to massify and optimize urban logistics flows. One option, mentioned above, is urban consolidation centers. Other potential actions include allowing deliveries only within certain timeframes – between 8 p.m. and 8 a.m., say – as a way to reduce congestion, while mandating the use of quiet, electric delivery vehicles with low CO_2 emissions. Additionally, cities can introduce transporter-agnostic delivery lockers in residential areas to massify home deliveries or create incentives for consumers to be involved in last-mile logistics through concierge models, in which customers themselves sign up to become neighborhood delivery points.

LOGISTICS OPERATORS

Logistics operators should consider sharing facilities, pooling flows in a reduced number of warehouses. They can also optimize flows of goods to cities by optimizing the loads of last-mile vehicles and shipping a larger volume of goods at constant capacity, or optimize their shipping routes by limiting the number of vehicles delivering to different customers in the same area. These actions call for stronger collaboration, with different operators sharing and bundling delivery routes and geographic areas. Other solutions include having a distributed structure of warehouses in cities but consolidating transportation through a single player. Logistics operators can also consolidate dataflows so they can predict consumer demand more accurately.

CONSUMERS

Consumers are a vital part of any solution to the massification challenge. They should be encouraged to become a more active part of the delivery experience, with certain behaviors being incentivized, such as receiving parcels on a specific day or at a specific time. Gamification can be used to support such behaviors, making the delivery experience more fun while helping make logistics processes efficient – for example, consumers can earn points for choosing a greener mode of delivery or one that favors massification, and then convert those points into rebates on the price of their next delivery. Pricing can also be used to steer consumers towards massification. However, experience shows that consumers, not logistics providers, are in the driving seat with regard to demand for speedier, more personalized deliveries.

INFRASTRUCTURE PROVIDERS

Infrastructure providers should promote massification by optimizing space capacities and putting available space on the market, even if only temporarily. Several

startups have already begun doing this, allowing other providers to book their space for a limited amount of time – for example, during the seasonal logistics peak in November and December. Additional actions could include building underground warehouses or converting office space on the first and second floors of buildings into micro-fulfillment centers. Moreover, they could build up their portfolio of assets with a view to creating a network of urban warehouses that logistics operators could then use to serve a territory in optimal fashion, adapting their logistics patterns in line with the size and location of different infrastructure assets.

SHIPPERS

Companies that ship goods, parcels or pallets should accept mutualization when loading vehicles, so as to avoid non-optimized vehicles operating in downtown areas. Pressure should also be put on transportation operators to greenify their fleets and operations, both contractually and through tracking of KPIs (key performance indicators) by both transporters and clients.

OEMs

Vehicle manufacturers should develop purpose-built vehicles (PBVs) specifically designed for urban logistics. These should combine high storage capacity, autonomy, speed and suitability for increasing urban density. Modularized container-on-wheels concepts (see Chapter 2) are a potential next step in the drive for massification.

Outlook

Looking ahead, the massification of urban logistics appears to some extent inevitable, if even only as a result of consolidation among logistics players. Indeed, the tremendous atomization of logistics seen in big cities since the emergence of quick commerce during the COVID-19 pandemic, with groceries delivered as fast as ten to 15 minutes after an order is placed, is already giving way to massification as delivery companies acquire each other. The May 2022 acquisition of French quick commerce company Cajoo by Berlin-based on-demand grocery delivery service Flink is just one of many recent examples.

As logistics providers grow and acquire greater financial and operational resources, we may see them massifying themselves in the most profitable geographic areas – a version of our first scenario, but with logistics providers playing the "giant" role rather than large retailers. Alternatively, having acquired their competitors and now facing limited competition, logistics operators may favor collaboration across the ecosystem, as in our third scenario. The risk, of course, is that they fail to do either and the second scenario happens, in which cities and regulators take the reins, forcing logistics providers to adapt in line with their own vision and priorities.

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