The Last Mile
Lukas Neckermann and Tim Smedley
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FOREWORD:

The Arval Mobility Observatory (AMO) is an independent Think Tank which aims at providing detailed, accurate, and neutral information to various audiences, in order to build greater understanding for a emerging, new mobility paradigm. The Arval Mobility Observatory follows on the previous Corporate Vehicle Observatory (CVO), founded in 2002 by BNP Paribas and its subsidiary Arval, who is specialized in the full service leasing of fleets.

Mobility solutions, alternative energies, safety, social changes and technological developments are just some of the key trends that the Arval Mobility Observatory observes and analyses at local, national and international levels.

After collaborating in 2017 on “Corporate Mobility Breakthrough 2020”, and on “Smart Cities, Smart Mobility” in 2018, the Arval Mobility Observatory and Neckermann Strategic Advisors continue their journey together with this new insight, “The Last Mile”. In this release, Lukas Neckermann evaluates the different smart mobility options to improve first and last mile journeys and demonstrate how important and challenging this topic is.

We hope this publication will give you the key to understanding what is driving the need for last mile solutions, the challenges faced in our city centres, the evolution of our way of living and consuming, and how these impact the delivery organisation.

Yaël Bennathan, Head of Arval Mobility Observatory
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CHAPTER 1: The first and last mile: why is it relevant, now?

The ‘last mile’ challenge is as simple as it is complicated. How do you move people, services, and goods along the last mile of their urban journey, without clogging up city centres?

Whether it’s a journey of 100 kilometers or 1,000 kilometers, the extra-urban journey passes relatively easily on highways, air, rail or sea. But the inner-city route, often called the first- and last mile, is taking place in an environment where new mobility solutions are becoming increasingly important. Considering that in the EU, “urban mobility accounts for 40% of all CO₂ emissions of road transport and up to 70% of other pollutants from transport,” there is an urgent need to find sustainable mobility solutions for goods and people transport in our cities.¹

The parallel rise of the automobile and urbanisation over the last century means that available space in cities is shrinking. The last mile is simply congested, and some city centres are choosing to become inaccessible to fossil-fuel-powered vehicles.

Across the EU, congestion costs nearly €100 bn, or around 1% of the EU’s GDP, annually ², and this trend does not show any sign of improvement; of the top 15 cities in the annual INRIX Global Traffic Scorecard, 9 experienced worsening congestion. Paris and Rome rank among the worst, with over 160 hours lost to congestion – equivalent to one full working month!

Addressing congestion, urban air quality and CO₂ emissions, also means addressing the efficiency of the last-mile. With this in mind, urban planners see a new paradigm emerging for urban transport. As an Arup report describes:

“Getting around in cities can often be inefficient and slow. Today’s dominant transport modes have also led to additional challenges, such as air pollution, greenhouse gas emissions, and noise pollution. They can also be price prohibitive, exacerbating social inequalities.” ³
Similarly, say Arcadis,

“The last mile is always the least efficient part, comprising up to 28% of the total cost of moving goods, and consuming much time and effort from the individual on the move, as public transport doesn’t take us fully to the doorstep, parking space is hard to find, and having a car or bicycle is not always an option. And it may be getting worse, as city populations keep growing.”

The last mile problem can also create what Deloitte calls “transit deserts” – areas with transit-dependent populations that lack adequate public transport services. In the United States, over half of all passenger-car trips taken are under eight kilometres (in the UK, it’s under five kilometres), some journeys are clearly more suited to other transport modes than the internal combustion engine vehicle itself. Across the western world, we have built roads to lead (literally, in many cases) to our doorsteps. And yet, when full of cars, we often
can’t step onto them to get where we need to go by foot.

Alternatives to the passenger-car abound, in some cities. In a study, the University of Leeds argues that solutions to the last mile problem include:

“...cycling (if routes are safe and parking is readily available at the interchange, otherwise bike share schemes offer greater flexibility and efficiency), walking (if routes are relatively direct and through areas that are not adjacent to fast-moving traffic or along dark alleys, for example) and feeder bus services which operate with short headways ... in the context of provision of safe, efficient and convenient access choices to public transport and a subsequent reduction in vehicle miles travelled and greenhouse gas emissions.”

This list could further include vehicle- and bike-sharing services, transportation and navigation apps, electric vehicles or taxi platforms. And with the coming of 5G data, self-driving vehicles and drones may change available modes of mobility even more. On the demand side, consumers are embracing the Mobility-as-a-Service (MaaS) model. Users would rather spend their travel time on other activities like reading or working remotely in public transport, than sitting behind the steering wheel in traffic.

According to McKinsey,

“Micromobility could encompass all passenger trips of less than 8 kilometers (5 miles), which account for as much as 50 to 60 percent of today’s total passenger kilometers traveled in China, the European Union, and the United States.”

Such ‘micromobility’ solutions are the emerging story of this decade – although as we will see in Chapter 2, they are not without challenges.

Changes in consumer behaviour can also be seen in the way we eat and shop. Online, door-to-door deliveries are now adding vehicles numbers to the streets, from the likes of Uber Eats and Deliveroo. Globally, online food ordering went from a €163bn industry in 2018 to €188 bn in 2019 (+16% year-on-year) and is expected to reach €276 bn by 2023. In China, this market already accounts for €37 bn in 2019. The EU market amounts to €15.3 bn in 2019 and is expecting to grow 50% by 2023.
The demand to ease last mile congestion isn’t simply consumer-driven, however. City and national governments are increasingly facing up to the economic and health care costs of urban gridlock. In a 2019 report, the UK Government Office for Science, suggests that car ownership and urban sprawl have, “made town centres hard to access for those walking or cycling and exacerbated the challenge of providing public transport that is frequent, accessible, comprehensive and affordable.” Lack of mobility is a social equity issue, the report continued: “This probably affected women, children and the elderly the most, as they were more reliant on public transport. As a result of inadequate or costly transport facilities, a significant proportion of these groups have suffered from diminished access to employment and services.”

Then there are the health costs associated with the burning of carbon-rich fuel in urban centres. According to the latest estimate from the World Health Organisation (WHO), approximately 4.2 million people die from outdoor air pollution annually, far greater than the number from HIV/AIDS, tuberculosis and vehicle accidents combined. Nine out of ten people around the globe are believed to be breathing air containing high levels of pollutants. As the transport industry accounts for 25% of the global carbon emissions, and these are mostly centred around urban areas, it’s essential to tackle the last mile challenge.
The short-term city-centre strategy to counter emissions from urban transport is to ban fossil fuel cars. Madrid has already banned petrol vehicles from its city centre and its council plans to pedestrianize much of the city’s central area within five years, with major streets redesigned for walking. Paris aims to ban internal-combustion engine vehicles by 2030. The city of Hamburg is also aiming high, aspiring to make 40% of the city car-free by 2034 by making it easier for residents not to drive.

London’s Ultra Low Emissions Zone (ULEZ), implemented in 2019, saw a significant drop in NO₂ by 36%, plus 13,500 fewer vehicles being driven into the zone daily, just in the first six months. Currently operating in a small section of the city centre, it is due to expand to encapsulate most of London in 2021.

While a privately-owned vehicle is typically parked some 95% of its time, occupying 10 square meters on expensive real-estate (i.e. €14,000 per square meter for residential properties in Paris⁶), switching to new mobility modes of transport such as micromobility may completely reshape urban design and real estate principles.

Architecture firm Farrells and engineering company WSP found in 2016 that with a larger area for scooters, bikes, pedestrians cannibalizing automotive infrastructure, the “design of on-street parking would create 15-20% additional land at ground level”.¹³ Last-mile solutions would also redesign in-building parking and property access. Charging point, drop-off area, dockless “parking” spaces and reconversion of former car parks are opportunities that designers in both urban and suburban areas are embracing to deliver mobility-aligned properties in the coming years.
The internal combustion engine (ICE) has literally driven our lives and economies to this point in our development. We owe it a great debt, but it appears to have reached the end of the road, at least in many cities. New last mile solutions allow us to look beyond the private vehicle and ICE commercial vehicles. The direction of travel for transport policy seems clear: greener, cleaner, safer and multi-modal.
Freight with problems

The transport desires of urban residents and city authorities is only one side of the last mile coin, however. The other side is freight transport. The same internet, app-based revolution that is revolutionising transport has also revolutionised our shopping habits.

Globally, freight CO₂ emissions from multi-modal commercial transports (including air-sea-land) represent 30% of all transport-related CO₂ emissions from fuel combustion. These in turn represent 7% of the global CO₂ emissions across industries.¹⁴

Studies forecast urban traffic freight to increase in the coming years due to this continuous increasing pressure from customers. Europe’s last mile delivery market accounted for €625 mn in 2018 and is expected to grow at a CAGR of 16.1% over the forecast period 2019–2027, rising to €2.3 bn by 2027.¹⁶ This expansion is driven by a strong e-commerce market growth of 16.6% CAGR between 2020 and 2023.¹⁷

Grocery delivery is one of the main factors accelerating the increase of the e-commerce market size. In its Last-Mile Delivery Challenge Report, Capgemini found that “40% of consumers use grocery delivery weekly and this number is expected to climb to 55% by 2021.”¹⁸ Although the global emission efficiency from individual light vehicles has dramatically improved over the last two decades, the total emissions from last mile delivery have never been as important as today.
Few companies understand these challenges more acutely than Deutsche Post DHL Group, who commissioned a report that describes how consumer trends have had a significant impact on transport operators:

“Urban consumers now have a wider array of products from which to choose, making impulse purchases with fast deliveries in mind — not only do they want products a certain way, they also want them at a certain time. When shopping online, rather than adapting their daily schedule to receive their purchase delivery, consumers are seeking a seamless experience where deliveries adapt to their schedule.”

For many consumers, the footprint of the parcels themselves is as significant as the vehicles they are carried in. As part of a reflection on urban delivery, sustainable packaging needs to be included. Nielsen showed in 2018 that the percentage of respondents in EU who are extremely or very concerned about packaging waste is as high as the one for air pollution (63%). There are many examples of sustainable packaging limiting waste such as biodegradable Sealed Air Peanuts, corn-starch packaging and of course recycled cardboard or plastic materials.
Customers are increasingly asking for goods to be delivered more quickly, with same-day or next-day delivery becoming the “norm”, rather than the exception. 55% of the customers would increase their loyalty to a specific company if a 2-hour delivery option is available and the share goes up to 61% for a “same-day delivery” feature. Paradoxically, increasing traffic congestion in turn threatens the reliability of such deliveries: around 13-14% of home deliveries ‘fail’. With an increasing number of retailers offering customers free home delivery, there is rising demand within peak periods: “Overall, consumers’ demands for faster, more frequent and more precisely timed deliveries – all at ever lower costs – will have environmental and economic consequences. Emerging technologies may be needed to meet these demands.”

According to Capgemini, around 40% of consumers frequently use delivery services (i.e. ordering once a week or more), a number that increased rapidly during the coronacrisis. As delivery becomes increasingly popular, the cost of providing last mile services accounts for 41% of overall supply chain costs, more than double any other category of spend, such as parcelling or warehousing: “as online grocery delivery volumes increase, so will the costs for last mile
services, thereby increasing the proportion of supply chain costs going toward last mile delivery.”

These challenges can be countered by leveraging innovative technologies and new business models, say Arup:

“The transport of people and goods, materials and by-products is an ongoing activity in every prosperous city, and demand for transportation is only expected to increase. Vehicle automation is also predicted to impact urban mobility systems. However, the outcome of this transformation is entirely dependent on how these new digital solutions are applied. Today’s urban mobility system is highly car-dependent, but solutions for people and goods can be diversified to include mass-transit, ridesharing, load-pooling, and low-impact vehicles – all of which can offer a broad range of benefits.”

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3 Key Questions with:

Jan Peters,
Strategic Projects Manager at Wunder Mobility: a user app and vehicle sharing company.

1. **In your experience what is driving the need for new last mile solutions: city congestion, resident/consumer demand, or increased freight delivery?**

   It’s a mix of all three. Congestion definitely drives the need for new, last mile mobility solutions. We’ve reached a point of no return, and cities are only going to expand in size in the years to come. Innovative ideas are needed now more than ever if we hope to cut down on gridlock and frustratingly long commute times in urban areas. Of course, there’s also an intricate connection between congestion and user demand: the more congestion has an adverse effect on city life, the more demand for last mile solutions goes up.

2. **How can data be better used to make last mile less reliant on a single mode (ie. private cars)?**

   Data is already powering the mobility revolution behind the scenes. Analytics tools like the latest addition to the Wunder platform, Wunder City, aggregate data for cities to analyze and visualize in a simple, efficient way and then base their decisions on. The number of micromobility operators active in cities increases at a dramatic pace every year, so it’s of critical importance for cities to have an overview
of which operators are entering the area and how their services are actually being used by commuters and riders. It’s through data that cities can recognize patterns over time and adjust their policies and plans accordingly. It also levels the playing field between private and public operators – collaboration between all sectors is key, and that includes the sharing of data.

3. **What can be learned from recent micro-mobility city case studies, with e-scooters for example banned for safety concerns?**

Every type of technology or vehicle will have its adoption phase. In the early 1900s, cars were also shunned as being extraordinarily dangerous. A few short years later, cities, communities and countries were designed around them. The industry is still very young - e-scooters have been street-legal in Germany for less than a year. Also, the next generation of e-scooters is almost here: swappable batteries will allow for 24/7 servicing and enable rebalancing in smaller hubs more frequently. Low speed zones are already being implemented to ensure safety in urban areas. There are lots of methods that can be tested out until we find a solution that’s workable for everyone. At the end of the day, we all have the same goal: increasing the availability and accessibility of sustainable mobility services. It’s up to the riders to decide which solutions most effectively serve their needs.
CHAPTER 2: The what

We’ve seen that finding new solutions for the first- and last-mile are important to addressing the issues of congestion, urban air quality and emissions. But what can be done about it, and which of the emerging solutions appear the most promising?

As cities grow, the way we build and manage urban infrastructure has never been more critical to global economic and social development. Cities already account for 60–80% of energy consumption and 75% of carbon emissions worldwide. Demographic, economic, and environmental changes are amplified – and in some cases driven – by the rapid changes in the technological fabric of the modern city.

People are flooding to cities for jobs, money and culture, and in turn mayors are pushing for more control over the money they generate and the citizens they represent. The EU’s Covenant of Mayors sees signatories pledge to reduce CO2 emissions at least 40% by 2030. So, what should such cities spend their money to solve the last mile problem?

**Electrification of personal cars**

Internationally, CO2 reduction and regulations are driving electrification. In the UK, sales of battery electric, plug-in hybrid, and hybrid-electric vehicles increased to 7.2% of all new vehicle sales in the year to November 2019 (SMMT, 2019), with all forms of hybrid vehicles approaching 15% in the month of November. Similar growth can be seen in France (3.4% of new passenger cars were plug-in as of October 2019), Germany (4.2% as of October 2019).

This growth is, in part, driven by falling costs for batteries, increasing number of models available on the market and tax incentives in certain countries. Between 2010 and 2018, the average cost of a lithium-ion battery, which many electric vehicles use, fell from US$1,000/kWh to US$176/kWh (BNEF, 2019).
Electrification of commercial vehicles (trucks and vans)

In November 2019, Volvo Trucks announced the start of sales of its Volvo FL and Volvo FE electric trucks in selected markets within Europe, specifically to meet “the increasing demand for sustainable transport solutions in city environments”. In the absence of exhaust emissions and with reduced noise levels, electric trucks offer huge potential in urban areas. “Global urbanization requires urban logistics and truck transport with zero emissions and less noise with increasing urgency,” said Volvo. The lower noise levels also make it possible to carry out deliveries and refuse collection in early mornings, late evenings or even at night, helping to improve transport logistics and reduce congestion. The Swedish company is not the only European manufacturer to develop electric trucks. There is a wide range of producers from the largest and traditional such as Daimler, Renault Trucks, DAF or MAN to the newest, well-funded start-ups such as Volta, Einride and Arrival.

The significant increase in choices among electric vehicles is being matched by concerted growth in demand. Sixteen of the UK’s largest van fleet operators have joined the “Clean Van Commitment”, which will see nearly 2,400 zero emission vans join their fleets by 2020. By 2028, their fleets will be completely zero emission in cities.
In many Asian cities, three-wheeler rickshaws are an important last mile transport and delivery mode. IKEA’s recent entrance into the Indian market for example announced at least 20% of its delivery vehicle fleet will be electric rickshaws, charged in-store and run on solar power.

Electrification isn’t only for on-road transport, however. Even rail operators are being encouraged to move from diesel to electric rolling stock.

**E-scooters**

Major global mobility companies, such as Lyft, are investing in scootersharing and bikesharing. End-users can continue with the same app and ease of use as with ridehailing, but just opt for a different – cleaner, more nimble – mode of transport.

Dockless e-scooters and e-bicycles such as those available from Voi, Tier or Lime are enabled by a mobile phone app and can be picked up or left anywhere, providing a quick way to travel over short distances. Where the necessary segregated cycle lane infrastructure is in place, such as The Netherlands, e-scooters have integrated into the transport system just as well as bicycles.
Deloitte notes that some challenges remain around the business model of these providers:

“The industry is clearly in its infancy and is, unsurprisingly, experiencing growing pains. While the economics of the e-scooter business, in particular, appear attractive given the vehicles’ relatively low cost and potential return on investments, a host of business-model challenges remain. Vandalism and theft are persistent issues. Retrieving, charging, and balancing the fleet each night can be a costly and labor-intensive exercise. Some providers are opting to simply flood the market with vehicles rather than bear the full cost associated...”

“(Scooter) ridesharing is widely unsustainable,” argued The Verge’s Andrew Hawkins, predicting that they may not be around for much longer if they do not improve their profitability. But the first shared e-scooters only popped up in September 2017, when Bird appeared in California. While the learning curve may be steep for e-scooter operators, users clearly like them. Bird hit 10 million scooter rides within just 12 months. Sorting out the parking and distribution of them is surely not beyond the collective minds of city authorities and private providers.

They are also very efficient users of energy. According to Arcadis, one kilowatt-hour of energy can move a gasoline-powered car 1.2 kilometres, an electric vehicle 6.5 kilometres, but an electric scooter 133 kilometres. Deloitte believe that e-scooters have the potential to, “better connect people with public transit, reduce reliance on private cars, and make the most of existing space by ‘right-sizing’ the vehicle, all while reducing greenhouse gas emissions.”

**E-bikes**

Electric bicycles, or e-bikes, are the largest-selling electric vehicle in the world. E-bikes now look almost identical to regular bicycles, except they have an in-built battery and motor which assists the riders as they pedal, adding extra wattage to each pedal stroke. They largely remove the challenge of cycling up hills, making them a more attractive option for many than traditional bikes. Indeed, e-bikes captured a 23.5% share of all bicycles sold in Germany in 2018, with growth rates over 6% across other European countries. As with e-scooters, dockless e-bike sharing schemes are also proliferating, from the likes of Bird, Lime and Lyft. The Confederation of the European Bicycle Industry (CONEBI) MD, Manuel Marsilio, revealed that the current EU market of 2.5 units sold in 2018 could triple by 2025, to 7 million e-bikes.
There is increasing interest from last mile delivery companies and inner-city businesses, too. Add a load-bearing basket or crate to a (reinforced bike), and you get a cargo bike. Arguably, given they are the workhorses of bicycling world, adding more horsepower to cargo bikes makes even more sense.

Pedal & Post deliver Yodel parcels in Oxford, UK, using e-assist cargo trikes for the last mile. The Royal Mail Group’s international parcel business also uses e-cargo bikes in Italy. UPS and Deutsche Post each use cargo-bicycles in Germany, and of course, Deliveroo drivers across Europe and Asia use e-assist bicycles to deliver food swiftly across cities.

Cargobikes have also proven to be popular among urban services companies. French energy and infrastructure company VINCI in February 2020 launched a small fleet of cargo-bikes for use across their facilities management division in Antwerp.

A study performed by Transport for London in 2018 illustrated considerable economic advantages of these bi- and tri-bikes when compared to traditional diesel vans in an urban environment. Of particular note was their efficiency and flexibility; a cargobike takes less space on the streets and can easily escape congestion.
1. **How can micromobility providers and public transit providers best work together?**

   By definition, mobility is a concept that moves away from car-centric labels such as “public transit”. Thus, active transport commuting options such as walking and cycling are, under this new perspective, included under the definition of mobility. In this way, the only option left for the cities of the future is to embrace mobility, a more dynamic way of understanding the city where its inhabitants no longer have to be born into the way they move (by car, if you have the money, versus public transit if you don’t) but where they have the choice to move in various ways according to parameters like price- and time-sensitivity.

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**Table: Vehicle Load Capacity and Costs**

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<th>Cargo Bike</th>
<th>Cargo Trike</th>
<th>Van</th>
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*EAPC refers to Electrically Assisted Pedal Cycle*

*Leasing price per year based on contract hire for 3 years at 10,000 miles per year*

*Calculated based on cycles and cans covering the same distance per day (30 miles); diesel fuel for vans (53 miles per gallon), electricity cost for EAPC cargo cycles, based on one charge per day*

*Average figure per van, calculated using the median annual cost of penalty charges reported in the FTA PCN Survey 2012 divided by the average fleet size of fleets registered under the Fleet Operator Recognition Scheme (FORS), reported in Van Travel trends in Great Britain, RAC Foundation 2014.*
2. How critical is single-platform MaaS and mixed-modal transport to last mile mobility?

Single-platform MaaS was a concept that received a lot of attention when it emerged in 2015-2016, but it is now fading away as the market consolidates around the new mobility paradigm. Some ridehailing companies still believe in the “umbrella app” approach, but it seems less likely that this will be the norm as the mobility space becomes more complex. It looks more like there will be networks of mobility services that will connect with each other, some having more predominant apps than others, but without ‘one app to rule them all’.

3. With the age of autonomous vehicles dawning, do we need to geo-fence or even close off urban centres to vehicles, before they get filled up with delivery bots and Uber-like AVs?

AVs do not seem to pose a threat to city centres in the near future. Evidence shows that the hype created by certain tech companies in late 2018 has not met the expected results in 2019. In that case, it seems like we won’t be able to see self-driving technology reach level 3 in the next few years. However, yes, we need to close off urban centres. The common denominator across cities: pedestrianisation. The less space for private cars, the more new mobility services bloom and create new business models. But not because of AVs, but because of car ownership. We live in cities built around and for cars, but now the paradigm is changing. Rather than thinking about AVs, we should consider how the new mobility paradigm essentially moves away from car ownership as a sign of social promotion.
Ridehailing

Last mile commuter travel has already been transformed by ridehailing apps such as FreeNow, Uber, and Didi. Since their emergence over the last decade, these platforms have experienced extraordinary growth; Uber is available in over 150 cities across Europe, and 500 more worldwide. This simple idea has seen global ride-hailing services market globally amount to €170 bn in 2019, and expected to grow to €295 bn by 2023.30

The rise of these services may become tempered in the coming years, however. In the words of Goldman Sachs:

“When Uber initially launched in the US in 2010 it was a taxi competitor and in its early days Uber’s differentiation centred around its cost and convenience relative to calling for a cab. Today, prices are on the rise, and we believe this has been a primary factor in the company’s slowing Rides growth... the rapid adoption we’ve seen in the category to date and subsequent deceleration, in our view, reflects an industry coming off a “sugar rush” of cheap rides and driver subsidies fuelled by venture capital.”31

As they are challenged in certain cities, ridehailing companies are looking to new business models, such as freight. Uber Freight first launched in April 2017 in Texas. To June 2019, Uber Freight has seen more than half a million downloads of across the US and launched a European version in The Netherlands to address what it sees as a €370bn market. With transparent pricing, fast payments, and the ability for carriers and drivers to book a load with just a few taps of a button, the technology has been adopted quickly. In August 2018, Uber announced that it would make Uber Freight a separate unit and more than double its investment into the business. Today, the corona crisis has accelerated the goods delivery market including food, grocery and medical supplies. From February to March 2020, Uber Eats orders increased by 59% across Europe.32

Drones

Drones could decrease labour costs and disrupt the parcel delivery model for small, same-day packages. Online retailers and delivery companies such as Amazon are already filing patents for unmanned aerial vehicles (drones), reducing the demand for local transport. In March 2020, UPS signed a partnership with the German Wingcopter to develop urban autonomous delivery drones to face an exploding demand started with the surge in home-deliveries due to the COVID19 crisis. Some regular drone delivery routes already
exist, such as blood and plasma flown by drones to clinics in the rural western part of Rwanda run by Zipline, where poor road conditions often delay time-critical delivery of medical supplies for hours or even days. The company operates over 100 drones in Africa.  

Amazon’s first drone delivery trials began delivering to customers in rural England in December 2016. Jeff Wilke, Amazon Worldwide Consumer CEO, wrote, “Can we deliver packages to customers even faster? We think the answer is yes, and one way we’re pursuing that goal is by pioneering autonomous drone technology.” In June 2019, the latest Prime Air drone design was unveiled, capable of flying up to 24 Km, delivering packages under five pounds to customers in less than 30 minutes, and operating safely in gusty wind conditions. “We expect to scale Prime Air both quickly and efficiently, delivering packages via drone to customers within months,” wrote Wilke.

The UPS subsidiary, UPS Flight Forward, was granted US certification to operate a “drone airline” in 2019, initially as a delivery network for hospital campuses around the US. Previous regulations would not allow drone operators fly beyond a human pilot’s visual line of sight. The UPS trials open the doors for other operators to apply for the same.

Figure 10: Zipline
Many other companies are hoping that drones will ultimately realise many childhood flying car fantasies. In 2018, Bristol-based firm Vertical Aerospace successfully tested, for the first time in Britain, an electric flying taxi at an airfield in Gloucestershire, and aims to fly commercial flights by 2022. German aviation firm Volocopter performed test flights in Singapore with a drone taxi capable of flying two passengers for 30 km. Not to be left out, major aeroplane manufacturers are building their own passenger drone projects too. Airbus is building one and two passenger ‘Vahana’ eVTOL (vertical take-off and landing) aircraft, specifically targeting the urban taxi transport market.

Morgan Stanley says that the market for autonomous urban aircraft could rise to €1.4 tn by 2040.\textsuperscript{3,4}

\textbf{Figure 11: UPS}

\textbf{Figure 12: Volocopter}
Delivery bots

Companies such as Amazon, DHL, and UPS have also been experimenting with ground-based delivery robots to deliver parcels. As described by Arcadis, a product can be “loaded onto a fleet of LCVs (light commercial vehicles), continuously touring between cities. From there it will get passed onto another vehicle responsible for sorting and delivery to specified areas within the city, using algorithms to adjust routes real-time to maximise efficiency... Last mile bots can [then] take the product to the end customer, thus further reducing emissions and congestion.”

Such last mile bots may largely be pavement-based robots, rather than road vehicles. For American university campuses that have signed up to Starship Technologies this is already a reality. Fleet of self-driving delivery robots, moving at pedestrian speed and weighing no more than 45 kg, constantly tour the campuses delivering food and groceries. As of August 2019, they had delivered over 6,000 pizzas, 26,500 litres of milk, 8,000 coffees, 9,000 sushi rolls, 15,000 bananas and over 3,700 diapers. Available for download on iOS and Android, users choose from a range of items, then drop a pin where they want their delivery to be sent. They can then watch as the robot makes its journey to them.

Figure 13: Starship
via an interactive map. Once the robot arrives, they receive an alert, and can then meet and unlock it through the app. Delivery fees vary by locations but are typically $1.99 or less.38

In the UK, a partnership with retailer Coop in Milton Keynes allows customers to have their goods be delivered for an additional cost of £1. We can expect a similar price level when the company will go live in EU after its series of ongoing trials.

Delivery bots could increase online shopping yet further, replacing even the walk to the local store (as appears to be the case in Starship’s US college campuses). But if they are proven to replace large on-road delivery vehicles, they could also reduce road congestion and emissions. Across Europe, there are still countless issues to resolve, however, including the legal use of pavements (sidewalks), pedestrian safety, vandalism and theft.

**Autonomous vehicles (AV)**

Initially, self-driving vehicles are likely to be shuttles – not cars – rolled out in ‘geofenced’ (virtually or software enclosed) areas, before being used in uncontrolled public spaces. Autonomous shuttles have, for example, been piloted on a low-density bus route in Switzerland, as well as in other locations.

“Autonomy could make buses – or new, demand-responsive transport services – more commercially viable in rural regions, where it is often expensive to provide public transport. Driver costs currently make up a large proportion of the total cost of such services: 40% is spent on drivers, part of the 61% spent on labour in general… Buses equipped with connectivity and automation capabilities are predicted to make up 79% of global sales in 2025.”37 Volvo, Scania and Daimler have all announced plans in development for autonomous buses.

Autonomous robotaxis – ridehailing, but without drivers – could be the most significant consideration for town planners, however. Waymo launched a self-driving taxi service in a geofenced area of Arizona, USA, in 2018 and transported 6,299 passengers in its first month. In China, Baidu and Didi are both expected to offer their robotaxis to paying customers in 2020. On the shuttle side, Navya and Easymile are running pilots around the world.
As the cost of using such services falls because the companies no longer need to pay drivers, why would people continue to queue for traditional public transport? AVs could be too good. Separate studies from the University of Adelaide, OECD, the World Economic Forum and the Boston Consulting Group, have all predicted that driverless vehicles will likely worsen traffic congestion in the coming decades. As ownership is replaced by autonomous ride-hailing it might result in fewer vehicles on the road, but those vehicles that are left constantly ply the streets 24 hours a day. Traffic zoning, geo-fencing, and improved and subsidised public transport, will balance the benefits of autonomous robotaxis against the needs of a city to manage congestion.

An additional challenge remains: human acceptance. A 2019 Neckermann Strategic Advisors study on human adoption and ownership of autonomous vehicles, “Being Driven”, showed that moving towards a fully shared autonomous mobility might be harder than expected. Not only are consumers not yet willing to share a driverless vehicle instead of owning a car, but also, their perception against the technology remains quite negative.

How comfortable are you with vehicles operating at L4 or L5 right now?

Irrespective of autonomous passenger vehicles, autonomous roaming fleets will play a key role in last mile logistics. Amazon has invested over $1bn in autonomous technology, including by acquiring the startup, Aurora. Ford, Walmart, and delivery service Postmates are collaborating to design a service for delivering groceries and goods to Walmart customers using autonomous vehicles by 2021, specifically to reduce the costs of last mile delivery.38

Figure 14: Neckermann Strategic Advisors / 7th Sense study 2019. n=3,000 in UK
In Europe, the Deutsche Post is testing its new semi-autonomous delivery service called PostBOT. The robot designed by the French company Effidence can carry up to 150 kg and can follow the mail carrier in all sort of weather conditions.

![Figure 15: Deutsche Post](image)

The COVID-19 crisis has accelerated the test and development of autonomous deliveries within the last mile around the world. In China, JD.com supplied hospitals with automated small pods while Meituan Dianping delivered groceries for the disabled and people at risk with autonomous robots. In Europe, a massive order by UPS for 10,000 e-vans from Arrival is launching the race to urban autonomous delivery vans. The pandemic has positively impacted this nascent market to a point that the latest studies suggest a market value in 2021 of €10.2 bn where Europe would account for 30% of it (US, 40%).

Replacing drivers with sensors could potentially increase profit margins by up to 14%, according to Capgemini. A director of udellv, an autonomous delivery startup, suggests, “When you take the driver out of the car, the delivery cost goes down by about 50% to 60%.” Autonomous vehicle owners could also, in theory, send their own vehicle to pick-up their orders.
3 Key Questions with:

Damien Declercq,
Founder and CEO of Spring Mobility GmbH: Accelerating the adoption of self-driving vehicle fleets

1. How will autonomous vehicles work with and compliment other last mile modes such as cycling, micromobility, and public transport?

It is a very dynamic environment out there. Potentially micromobility could be autonomous. Potentially public transport is micromobility. What I see now is that we can expect different levels of integrations depending on the location. Local leadership will have a big role to play in shaping how this will roll out. I believe it is about vision and leadership. As for electric mobility, some are showing the way, while others are following.

2. What types of businesses or business solutions will most likely utilise AV, and for what purpose, within their last mile solutions (such as delivery)?

A number of use cases have been identified and addressed through pilot operations so far. In order to gain traction and scale, convenience and customer acceptance will have to improve. Eventually any business that moves people and goods through motorized vehicles can leverage autonomous vehicles. Then other fields related to surveillance of people, goods and infrastructure for example can benefit from the technology.

3. For urban residents, how should AV be accessed fairly and equitably? In other words, should geo-fencing restrict access in some areas, to ensure people still use public and active transport?

It is a matter of defining the vision of the urban environment you want to promote and then pro-actively influence the deployment of the technologies through local leadership. If the vision is liveable environments to make life more enjoyable, then restrictions are likely required.
Active transport: Walking and cycling

The least ‘techy’ option of all may yet prove to be the most important for last mile: old-fashioned walking and cycling. 43% of the Dutch and 30% of Danes cycle daily. Differences between regions are striking: up to 50% of the Copenhagen residents who bike to school or work whereas only 0.6% of the US working population cycles to work.\textsuperscript{40}

In the 1970s, Copenhagen, too, was as car-dominated as the US. The difference in recent decades has been the willingness to invest in cycle lanes and pedestrianisation – a fact not lost on city planners across southern Europe and the UK. London and Bristol have recently begun building dedicated cycling infrastructure, and have seen an overall growth in trips and distances over the last 10–15 years as a result.\textsuperscript{41} Paris mayor Anne Hidalgo pledges to add bicycle lanes to every street by 2024. Mayor Hidalgo also happens to be a Co-President within the Global Covenant of Mayors for Climate & Energy – a consortium of over 9,000 cities “working towards a resilient and low-emission society”.\textsuperscript{42}

The ‘Copenhagen-isation’ of cities is catching on, including bicycle highways, because the benefits are obvious: a healthier, safer, cleaner air, society. Research published in the British Medical Journal shows significant health benefits of walking or cycling to work: cycle commuters scored significantly better for heart disease (46% less likely to develop it; 52% less likely to die from it), and cancer (45% lower development risk; 40% lower death risk), while those who walked to work had a 27% lower risk of heart disease, and a 36% lower risk of dying from it.\textsuperscript{43}

It also transforms the efficiency of moving people over the last mile. According to research by Delft University of Technology, a 3.5-metre-wide road lane can transport only 2,000 people an hour in cars, compared to 14,000 cyclists or 19,000 pedestrians. If you factor in the removal of car parking spaces freeing-up more road space, then the benefits are even greater.

According to a joint paper by Arup and the Ellen MacArthur Foundation, in addition to supporting Copenhagen’s 2025 carbon neutrality target, bicycling also generates a net profit for society through increased productivity and health (€ 228 million in 2009):

“To further increase bicycling rates, the city has implemented a range of initiatives, including an electric city-bicycling scheme, dedicated cargo-bicycle parking, bicycling highways, and green bicycling routes creating...
shortcuts across the city. The regional trains also support the increased bicycle use by allowing users to bring bicycles on, free-of-charge, in specifically adapted carriages making first- and last mile transport more convenient for longer distance commuters.”

As well as improving access and infrastructure, cities can also provide city bike hire for residents and tourists. One of the first such schemes in Europe – the Velib, in Paris – launched in 2007 with some 7,000 bikes and grew to over 18,000 bikes in 2016. Now most major cities have their own version, such as Barcelona’s Bicing, London’s Santander Cycles, and Washington’s SmartBike DC. Dockless bikes also began appearing in 2013, from private companies such as Ofo. Similarly, Cargobike hire schemes are also increasingly available in European cities.
Public Transport

Public transport – or mass-transit – such as metro, rail, bus, and bus rapid transit (BRT), has the benefits of being high capacity and cost-efficient. In terms of the efficient movement of people in dense urban environments, the importance of efficient public transport cannot be overestimated.

Access to jobs, education, health services and other facilities is increased by public transport provision, say UN Habitat: “These are central to social inclusion for the disadvantaged. Furthermore, public transportation also supports community cohesion.”

A paper from The Royal Academy of Engineering recommends, “pricing the roads to discourage private vehicle use in favour of less congesting modes is best combined with measures that bolster the supply of public transport, such as light rail or an efficient bus network, in order to improve their attractiveness as a viable alternative to car travel.”

Mobility as a Service (MaaS)

Given all the last mile options available and outlined in this chapter, how can cities begin to stitch them all together into one cohesive system? One option is Mobility as a Service (MaaS) – essentially putting all the options, both public and private, onto a single transport app with a single payment model.

The idea came from Helsinki, where the Whim app allows residents to jump from public bus or train to private taxi, bikesharing or carsharing, all with ‘one tap’ payment. The central premise is to make journeys quicker, more efficient, and less reliant on a single mode of transport – especially the private car. Central to the concept are mobility subscriptions, which replicate the feeling of monthly leasing payments, and thereby make multi-mode transportation simple and predictable.

Instead of switching between apps to secure a ride during rush hour, a mobility-as-a-service app allows single-app, single-payment transitions between various modes of transport. Some of the world’s largest tech companies — including Didi, Uber, and Google — are similarly placing bets on this type of aggregation service.
In Berlin, Jelbi allows for bus, train, scooter, bike, car and hailed transportation from a single app. EMMA (TaM) in Montpellier, France, also offers users a single system to access bicycle sharing, car sharing, urban public transport, and even parking. And MaaS apps can have the effect of making alternatives to the automobile attractive: a report by the Netherlands Institute for Transport Policy Analysis finds that UbiGo in Sweden saw car use of users drop 44%.

A question remains whether MaaS will be enabled by single apps such as Whim, Jelbi, or Uber, or will instead be a network of interconnected apps. Key to any system will be its ubiquity. Uber already operates in 150+ European cities (a number that increases to over 190 if we include its food delivery service, Uber Eats). Perhaps as well, these may be coordinated by payment providers, or even travel companies (hotel-booking-site Booking.com, for example, is expanding to include car-rental and ridehailing, and may some day even offer public transport).

What is clear, as the Netherlands Institute report shows, is that all currently successful models of MaaS use public transport as “the backbone”.

**Hub-and-spoke freight models**

While many of the options in this chapter are also available to freight delivery, there remains an obstacle in getting large goods trucks from distribution centres to their end destination, without causing urban gridlock.

Again, DHL offer a glimpse of the future: in 2017 it introduced the ‘City Hub’ in Frankfurt and Utrecht for inner-city deliveries. It uses a customised trailer to carry up to four containers attached to a single delivery vehicle, which replaces two standard delivery vehicles. Once in the city, the four containers are individually loaded onto a DHL Cubicycle – a customised electric cargo bicycle. The Cubicycles complete the Last mile and can be reloaded again for outbound shipments. This enables twice as many deliveries per hour as normal vehicles, and costs DHL less than half the lifetime cost of a delivery van.

Ford says that the growth in online shopping across Europe means the number of parcel deliveries is expected to double in the next 10 years, with most of these deliveries undertaken by vans. Teaming up with Gnewt, a last mile delivery service managed by Ford’s cloud based logistics software MoDe:Link sees parcel delivery designed to optimise multiple modes of transport including pedestrian and bicycle couriers. It uses larger commercial vehicles as ‘warehouses on wheels’, from which last mile services collect and distribute goods. “Our goal
is to keep larger vehicles like delivery vans operating in the high load, less congested environments in which they perform best,” said Tom Thompson, project lead at Ford Mobility. “However, for the last mile of a journey into an urban area, where congestion and lack of parking can be a challenge, it makes sense to offload deliveries to more nimble, efficient and cost effective modes of transport.”

3 Key Questions with:

Richard Dilks,
Chief Executive, CoMoUK: leading the UK’s transition to integrated mobility solutions.

1. **How can private mobility providers work with public and active transport, rather than compete?**

   In principle, it is heavily inter-dependent with public transport, and dovetails nicely with active travel. In practice, the UK still mostly lacks ways of doing this, although we are starting to see the market making integrative moves of its own. In an ideal world, local governments would set a vision for sustainable travel that had the carrots of shared, public and active travel alongside some sticks against inefficient and unwarranted private car use – all within a framework from central governments.
One physical workaround to this in the near term is a mobility hub. Designed and implemented well, these have the power to simplify where supply (bike stands, EV charge points, parking for shared cars and so on) should go and to funnel demand to that supply.

2. Do dockless scooters and bikes have a future?

In the UK we have actually had very few examples of what you might call ‘wild west’ dockless, where an operator just launches shared micro mobility onto streets without authority permission and consultation. What we do have are a number of dockless and docked schemes operating with permission and consultation, plus some which are blending the docked and dockless elements together (as with Edinburgh’s bike share scheme). I think the future will be a blended one, with London looking to move to parking zones. The trick to pull off will be to have said zones in the right places and at sufficient density to make schemes well used, and to be able to recognise that what works in very dense urban cores is not necessarily the same as what works in less dense suburbs.

3. How can business fleets play a part in improving urban air quality and reducing congestion?

A number of car clubs have helped fleets achieve the win–win of reducing cost, carbon and so on while enabling an area to have car club cars in greater numbers or even at all by having the cars available to residents off peak and/or at weekends. If we are at all serious about net zero as a country, looking at how to make fleets the cleanest they can be as well as intensively used as possible where that takes modal share away from less efficient vehicle use and there are not workable other alternatives has to be priority. These are not new ideas but pool and grey fleets offer really substantial opportunities for rationalisation and service provision.
Rethinking the last mile for services

A last category to consider is our service-industry – those companies that repair our buildings, energy systems and elevators, among other things. Each intervention may be subject to the use of heavy, large or fragile spare parts – not always ideal for delivery by any other means than by truck or van. Furthermore, if the availability of a specific component is restricted, and it is inconvenient to travel back and forth between the city centre and the warehouse, an engineer may not able to finalise a service. Indeed, the COVID-19 crisis showed once again how critical it is to supply hospitals and healthcare centres with the right components at the right time.

Still this industry is showing ingenuity and resolve, rethinking the management of components with innovative solutions. Firms such as Bybox and Pelipod offer smart autonomous lockers to service providers, enabling spare parts to be stored in the heart of the city for future interventions. These boxes are placed close to areas where parts are the most likely needed and, thanks to their connectivity, allow an engineer to know the status of the locker in real-time – including its location and content.

In this way, engineers can avoid time-consuming trips to warehouses for minor parts, all while downsizing the vehicles used to conduct services. In other words, both vehicle sizes and distance driven can be reduced.

Similarly, since 2018, the elevator firm Thyssenkrupp has trialled mini-robots to support engineers with elements they need through the day. These autonomous pods ride around a city with the components that a technician needs at a specific location for a dedicated time.

Last but not least, 3D printing is also in the mind of technical firms. Spare parts can be printed closer to the point of application, rather than in factories thousands of kilometres away. These machines could be the ultimate solution to a just-in-time last mile delivery strategy for basic but sometimes hyper-specific spare parts.
CHAPTER 3:
The who & where
(case studies for the first- and last-mile)

This chapter doesn’t attempt a comprehensive overview – many other examples can be found throughout the paper and beyond – but here we offer a few select case studies and ‘ones to watch’. No single solution to the multitude of challenges around the last mile has yet been found – it will likely contain a mix of all the above, and below. We have the ingredients – but the final recipe still needs perfecting.

Companies

Gnewt

Urban logistics specialist, Gnewt, provides all electric delivery services within London’s Ultra Low Emissions Zone (ULEZ). Gnewt stands for ‘Green New Transport’ and boasts largest 100% commercial electric vehicle fleet, delivering zero-emission final mile logistics for retailers and third party logistics companies. With a custom-designed charging infrastructure, using pre-purchased green energy from sustainable sources – a 70-strong fleet is comprised of double payload modified vans, plus e-cargo bikes. With rapid expansion plans for other cities, Gnewt hopes to solve the freight last mile emissions problem, reducing CO₂ emissions by 67% per parcel.

Now a subsidiary business of Menzies Distribution, Gnewt was picked by mega clothing retailer ASOS for last mile delivery, enabling ASOS to reach London based customers throughout the Congestion Charge and Ultra-Low Emissions Zones (ULEZ). Menzies Distribution trunks the parcels from the Barnsley warehouse into Gnewt’s depot in Bow where they are then distributed to ASOS customers across the City of London utilising 40 of Gnewt’s all electric fleet. During a six month period from September 2018 to February 2019, Gnewt delivered 361,032 ASOS parcels emissions-free, covering 210,000 kilometres (130,000 miles).48
UrBike

Belgian start-up, UrBike, is pursuing bicycle deliveries with specially designed trailers – starting in the Brussels Region – with a capacity of 200 kg, as an alternative for vans. UrBike is planning 115,000 bicycle deliveries a year as from 2020. These ambitious plans could create 20 local and sustainable jobs and save 66,000 ton CO₂ emissions.

“Almost one out of ten vehicles in Brussels is a delivery van,” Philippe Lovens of UrBike explained to New Mobility News. “Average speed in the city is 11 km/hour. Especially the last mile to its destination is the flaw in goods transport.” UrBike’s e-cargo bike transports a standard Euro-pallet, which can interact with all other types of transport and delivery hubs. “The company talks of multi-modal and multi-functional micro-hubs in the heart of cities too”, says Fleet Europe. “And as delivery is by bike, it can take place right outside the front door of the shop, being transported in bike lanes and not being subject to any traffic jams or other delays. The advantages are in time (trials show a 30% improvement over any other form of last mile delivery) and environmental friendliness, as there are clearly no emissions at all.”

It is also safer: in over 5,000 km covered in Brussels, which include the Belgian Post Office and supermarket chain Delhaize, it has had no recorded accidents.

UrBike also offers dockless pedal bikes, e-bikes, and e-scooters along with accountable service plans and fleet management.
Amazon

In 2018, Amazon’s share of the US ecommerce market hit 49%. Each month more than 197 million people around the world visit Amazon.com: more than the entire population of Russia. Many people’s image of last mile delivery is Amazon.

While many of Amazon’s deliveries rely on using private vans as delivery contractors (much as Uber does for drivers), Amazon is cleaning up its image, and its emissions. In September 2019, Amazon placed an order for 100,000 electric delivery vans from US electric vehicle manufacturer Rivian – the largest ever single order of electric vehicles. The first vans will be ready by 2021, and all will be in use by 2024. The company believes this will save four million metric tons of carbon annually by 2030.

Amazon founder and CEO Jeff Bezos explained in a press release: “We’re done being in the middle of the herd on this issue – we’ve decided to use our size and scale to make a difference. If a company with as much physical infrastructure as Amazon—which delivers more than 10 billion items a year—can meet the Paris Agreement 10 years early, then any company can.”

A research note reported in Logistics Management, called the Rivian order “a step-function change in Amazon’s last mile fleet” and that Amazon’s stated ambition to convert 100% of its delivery fleet to renewable energy by 2030 “could put pressure on UPS, FedEx, and DHL to respond similarly.”
Amazon has been also been trialling self-driving trucks, developed by Embark, and Scout, an electric sidewalk delivery bot. The company also announced plans to increase its air freight fleet to 70 planes by 2021 to fulfill its Prime delivery promises.

**Grow Mobility**

Sao Paulo-based bike-and-scooter-sharing start-up Yellow merged with Mexico City’s electric scooter-sharing company Grin in January 2019 to form Grow Mobility, Latin America’s largest micromobility company. Grow Mobility operates more than 100,000 e-scooters and 35,000 bicycles across South America, with plans in the works to more than double its fleet by the end of 2020.

Grow Mobility builds upon Yellow and Grin’s strong relationships throughout South America to continue improving transportation in cities throughout the region.

“The demand for these everyday services across Latin America is huge and, by combining strengths and resources, we will be able to move quickly to serve more users,” Grin co-founder and Grow Mobility CEO Sergio Romo stated in a press release. Grow is committed to addressing unmet urban mobility needs across South America, where high population density and insufficient public transportation infrastructure creates unique demand for micromobility services. Grow is also expanding its partnership with Rappi, the largest food and grocery delivery platform in South America, which currently operates in 27 cities across seven countries. Rappi’s 20 million users will be able to unlock scooters, bikes and e-bikes directly through the Grow app.

**Cities**

**Barcelona: Superblocks**

Barcelona, Spain, is reducing emissions by constraining car use while promoting cycling and pedestrian-friendly neighbourhoods.

Smaller 100m x 100m residential blocks are effectively clubbed together in quadrangles of six, creating around 400m x 400m ‘superblocks’. These are fringed by peripheral roads open for traffic and public transport, while interior roads are closed to through traffic but open to residents, disabled people, emergency vehicles, bicycles, or entirely given over as new public...
green spaces and playparks. By doing so, this frees up nearly 60% of streets currently used by vehicles and turns them into citizen spaces. In the Gràcia superblock (one of six currently implemented), cycling trips have already increased by 30%, and driving reduced by 26%.

The Superblocks will enable a 21% reduction in private car across the city, plus the addition of 233 km of bike lanes and a simplified ‘orthogonal’ bus network. A report by the Barcelona Institute for Global Health states that Superblocks could prevent 667 premature deaths every year, mainly as a result of decreased air pollution ($\text{NO}_2$), reductions in traffic noise and mitigated heat island effects. It also found that if all 503 potential superblocks are realised across the city, journeys by private vehicle would fall by 230,000 a week, as people switch to public transport, walking or cycling.
The Midlands: Mobility as a service

The UK’s most car-synonymous city, Birmingham, is famed for its ‘spaghetti junction’ road network and is epicentre of the country’s former car industry. To the surprise of some, in 2018 the Helsinki-based technology company MaaS Global chose Birmingham to launch its Whim multimodal transport application, for the first time in UK. Whim’s ‘mobility as a service’ platform offers a single smartphone app to access multiple transport options including bus and urban rail, car hire, taxis and cycle hire Nextbike. Customers have a choice of either pay-per-ride or a monthly subscription.

Transport For West Midlands noted, “New technology and use of transport data will be used to allow residents to travel seamlessly across different modes finding places to park their vehicle before hopping on a bus, train or tram.”

Despite its car-centric reputation, Liveable Cities argues that Birmingham – the UK’s greatest urban conglomeration outside of London – is well-suited to multi-modal last mile transport: “Significantly, 36% of Birmingham’s households do not own a vehicle so they will greatly benefit from lower car dependence within the city... rail use in Birmingham is increasing. Birmingham is also one of the UK’s four ‘Walking Cities’, including a €287k Walking Cities Project focusing on residents in disadvantaged neighbourhoods near the city centre. Birmingham City Council also successfully bid for €19.5m funding to improve cycling facilities within a 20-minute cycling time of Birmingham city centre.

Some kilometers away, the city of Nottingham also stands out for its approach to last mile transportation. Free parking at workplaces attracts traffic commuting and therefore congestion. In 2012, Nottingham introduced a charge specifically for cars commuting in to work. Companies with more than 10 parking spaces must pay a substantial €480 annual levy per space. Since its introduction, this has raised €70 mn, all of which has been put back into public transport, including building a new 32 km tram network. Overall, it has also seen a decline in car kilometres and a rise in the city’s share of public transport to over 40% of all journeys made.

The effect on business is notable as well. The Financial Times reported in October 2019, “Since 2012 the number of businesses has increased by 2,350, almost a quarter. There has been a net increase of 23,400 jobs, or 14 per cent, in the city during the period... vehicle use has dropped 7 per cent.”

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51 The Financial Times, "Since 2012 the number of businesses has increased by 2,350, almost a quarter. There has been a net increase of 23,400 jobs, or 14 per cent, in the city during the period... vehicle use has dropped 7 per cent."
Other benefits of the Workplace Parking Levy are that it creates incentives for employers to re-evaluate and re-use land currently used for parking. It’s also politically easier to introduce than a congestion charge and can provide local authorities with a revenue stream to invest in public and active transport options.52

From 2025, taxis in the city will also need to be ultra-low emission, typically electric. The council is offering drivers €4,100 to convert. The FT reports, “The measures have seen the city’s carbon dioxide emissions fall by a quarter since 2015 and the council hopes Nottingham will become the UK’s first carbon neutral city within nine years.”

**San Francisco: The west-coast pioneers**

San Francisco is arguably the birthplace of modern mobility and micro-mobility, and remains home to many start-ups in the space who went on to global domination, including Lyft, Lime and Uber.

The city also started early with bike share, introducing the Bay Area Bike Share pilot in 2013, and expanded the concept (now ‘Ford GoBike’) in 2017. This started with 700 bikes based at 70 stations throughout the city and has since grown to over 4,500 bikes across 320 stations. In June 2017, San Francisco was one of the first cities to create a comprehensive permit process for dockless bikeshare providers. According to NLC, “This allowed the city to regulate and monitor the deployment of the bikes while also allowing providers to quickly roll them out. In 2018, JUMP bikes became the sole permittee to operate a pilot program that included an initial 250 electric assist bikes as well as potential expansion of up to 250 additional bikes.”53 Dockless electric scooters soon followed in early 2018, but with no such permitting process in place – and a rapid rollout by competing scooter companies including Lime, Bird and Spin flooding the streets – it led to a city-wide ban in June 2018. The scooter companies were invited to apply for permits for a one-year pilot ‘reintroduction’ programme. Interestingly, only two companies were successful: Scoot and Spin. NBC Bay Area reported, “the two winning proposals satisfied the city’s request to solve safety concerns for both pedestrians and riders – offering free helmets and detailed parking instructions, and warning users not to ride on the sidewalks.”54

The long-standing Clipper Card is also the city region’s unified transit payment system. In addition to serving the dozens of public transit options, the Clipper Card allows access bike-share and some parking facilities. In
2019, an upgrade began to enable the future integration of private bike- and scooter-sharing companies, as well as ride-sharing companies, “to deliver a first- and last mile solution to commuters... The single payment account is vital to delivering the streamlined user experience of MaaS – leaders like Los Angeles and San Francisco are helping to lead the way for other ambitious local governments”. This includes the city’s dynamic parking system SFpark: prices are automatically increased or reduced depending on demand, and has decreased the distance travelled by vehicles in the San Francisco area by 30%.

**Singapore: The carrot and stick approach**

Singapore is known as having one of the best transport systems in the world, with customer satisfaction with public transport at 94.5% in 2017. By discouraging private-vehicle ownership through high taxes, significantly ramping up the quality of public transport modes, and maintaining low fares, Singapore achieves a sophisticated transportation system.

In 2013 when just over half (57%) of households were within a 10-minute walk of a train station, it set a target to raise that to 80% by 2030 (figure stands at 64%, as of September 2019, with 100 km of line being added in the next decade). It is also promoting active transportation as the primary mode of transport by linking integrated sheltered walkways to all public transport nodes and creating 700 km of bicycle lanes by 2030. Singapore is also introducing wearables that can be used in place of smart cards: “to promote account-based ticketing, which will use credit/debit cards across the city’s public transport system.” The city has made concerted efforts to keep public transport fares low, with one of the lowest average train fares in the Deloitte City Mobility Index and one of the cheapest monthly travel passes.

The city state’s innovations include the Incentives for Singapore Commuters programme, whereby participants receive personalised travel plans with encouraged times. For each shift they make to off-peak travel, they receive a cash reward. If they are already travelling at the ideal time, they receive points, rewards or cash prizes. On the ‘stick’ end of the spectrum, Singapore’s dynamic congestion charge Electronic Road Pricing (ERP) has been in place since 1998. In-vehicle units are installed in vehicles and automatically register a charge, which varies according to traffic levels and times of day. As Singapore aims to become a ‘car-lite’ city, the ERP is arguably central to making private cars prohibitively expensive at peak times, and other modes more attractive.
CHAPTER 4: Conclusion

The way we move people, goods, and services through our cities is rapidly changing. With the COVID-19 outbreak, this change is certainly accelerated through logistics and autonomous transports. The last mile is a hub of experiment and innovation, and only the most proactive cities and industries will emerge victorious. So, how best to prepare?

We may soon see the first cities emerge with a clear last mile blueprint – one perhaps filled with bikes, pedestrian zones, micromobility, electric buses, delivery bots and drones – that others can confidently copy.

Citizens are demanding an end to the traffic congestion that blights urban life – and government is listening. EU law states that every citizen has the right to clean air, yet the daily congestion caused by internal-combustion engines and energy production have led to illegal pollution within most European cities. As one countermeasure, many cities in Europe have introduced urban access restrictions to help reduce congestion and pollution, improve efficiency for business, and improve the general quality of life for residents and visitors.

The issues go beyond air quality however. Independence from fossil fuels also makes electric vehicles and active transport an energy-security issue. And thinking beyond what goes on city roads, is the notion of space allocation itself.

The most efficient – or environmentally friendly – use of road space at present is to provide for active transport (i.e. walking and bicycling), enable electrification and promote mass transit. This means that city governments are re-evaluating car-lanes, and implementing bicycle and scooter infrastructure, as well as the open-data systems to enable shared use of micromobility. For freight, there may be similar options available. If a city has invested in cycling infrastructure, recently significantly increased due to the COVID-19 pandemic in a number of urban areas around the world, and there is already a network of app-based cycle couriers willing to cycle your goods for the last mile, you may opt for these. Cities and companies will also look to explore autonomous delivery further.
Creativity, standard-setting, and a willingness to experiment are essential. According to Arcadis,

“There are two competing visions for the potential for government to adapt to the changing landscape. On a national level, government has the ability to set standards, direct funds to endeavours with sufficient scale... At the same time there are benefits to a nimbler approach from smaller governing bodies with an eye towards experimentation.”

As Clarence E. Anthony CEO and Executive Director National League of Cities, writes: “Since the first Model T rolled onto the streets of Detroit in 1908, the automobile has reigned as the predominant mode of transportation in America. Cars quickly became a cornerstone of the American identity – and influenced the way America’s cities, towns and villages took shape. More than a century after the Model T’s first trip, the smartphone has opened the door for a new wave of transportation options. Now, app-based mobility services present local leaders with an opportunity to reimagine the mobility environment.”

The car-only model for the last mile has reached the end of the road. Now is the dawn of a new era: multi-modal and emissions-free. Urban congestion is increasingly being replaced by efforts to promote greater liveability, electrification, pedal power and automation.
About the Authors

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Lukas and Tim have collaborated on numerous books and white-papers since 2015.
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