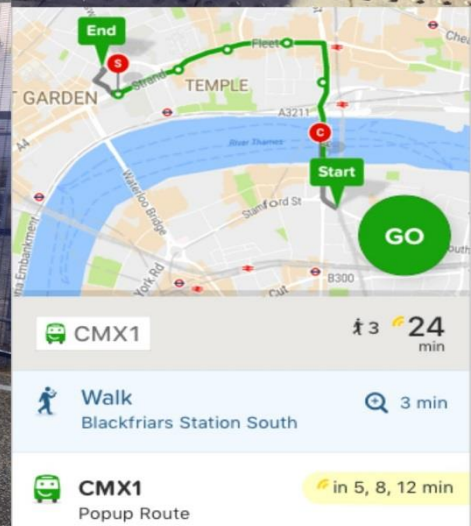
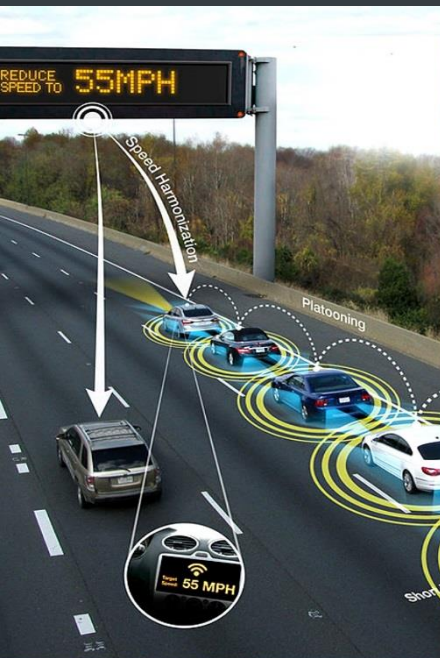


LONDON ASSEMBLY

Future transport

How is London responding to technological innovation?



Transport Committee
February 2018

Holding the Mayor to
account and
investigating issues that
matter to Londoners

LONDONASSEMBLY

Transport Committee Members



The Transport Committee holds the Mayor and Transport for London to account for their work delivering the capital's transport network. The committee examines all aspects of the transport network and presses for improvements on behalf of Londoners.

Contact

Richard Berry, Scrutiny Manager
TransportCommittee@london.gov.uk
0207 983 4000

Media enquires

Alison Bell, External Communications Manager
Alison.Bell@london.gov.uk
0207 983 4228

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Keith Prince AM

Chairman of the Transport Committee



These are exciting times in transport. The way Londoners move around the city is constantly evolving, but the pace of change has accelerated in recent years. Who among us can honestly say we know what the transport network will look like in twenty years' time?

There are so many positive aspects of the new technologies we see being developed.

Autonomous vehicles could make roads safer.

Dockless bikes could spread the benefits of

cycling to the whole city. Demand-responsive buses could give people a public transport service tailored to their needs.

None of these outcomes are guaranteed, and the risks are plentiful, but the opportunity to improve mobility for millions of Londoners is there and we have to take it.

London has been caught unaware by the application of new transport technology recently. To some extent this may be inevitable, but it reinforces the need for effective monitoring and planning by the Mayor and Transport for London.

To paraphrase Donald Rumsfeld, anticipating unknown unknowns is impossible. Failing to prepare for known unknowns is inexcusable.

“Who among us can honestly say we know what the transport network will look like in twenty years' time?”

I would like to thank the many people who have contributed to this report by sharing their time and expertise with the committee.

I believe we have identified the right steps the Mayor and TfL can take now to make sure London is ready for the future of transport.

Summary

Technological change is a constant process. Several developments in the transport sector mean that we are in the midst of a major upheaval. These innovations are likely to enhance the way Londoners get around the city, in many ways.

We have focused on technological change in three different, but closely related areas. In each case we have considered the key challenges that are likely to arise if and when this technology is more widely used. We also sought to learn lessons about how effectively the Mayor and TfL monitor and plan for the emergence of new technology in the transport sector:

- **Connected and autonomous vehicles (CAVs)**, also known as ‘driverless cars’. The introduction of CAVs to our roads is potentially the biggest change in the way we use cars, which remain the most prevalent transport method used by Londoners.¹
- **App-based services.** Londoners have been empowered by the spread of smartphone technology, with apps that have delivered information in new ways and enabled new types of transport service to be delivered on a large scale.
- **Drones.** In this category we include airborne drones, which have been in use for various purposes for a number of years but are now increasingly being used for freight delivery; and droids (or ground-based drones), programmed to transport goods along pavements and other pedestrian spaces.

Planning and monitoring

We have identified a number of steps the Mayor and Transport for London can make to take advantage of new technology for Londoners’ benefit. Firstly, we want to ensure effective planning and monitoring at TfL. There have been recent failures in London’s preparations for innovative transport services, notably the rapid growth of private hire operator Uber and the disruptive launch of dockless cycle hire service oBike. Embedding the work of TfL’s new Transport Innovation directorate across the organisation will help avoid this in the future.

Connected and autonomous vehicles

There is much hype around CAVs becoming a feature of our roads in the imminent future. This is not likely to be the case, with 2030-2040 more realistic for widespread rollout. CAVs could make our roads safer, and increase mobility for people who have difficulty accessing the transport network.

With traffic congestion having increased to unacceptable levels in recent years, however, it is vital that CAVs do not simply provide a like-for-like replacement for private, human-driven cars. There is a good opportunity to increase car sharing as CAVs are introduced, if TfL builds on the existing car sharing services London has to make this a normal way of getting around for Londoners. TfL needs to consider the implications of any proposed introduction of autonomous buses to London's roads, particularly safety issues and potential reduction in customer service for bus passengers.

App-based services

A large number of apps have been introduced to help people use the transport network. Two evolving transport modes enabled by apps are dockless cycle hire services and demand-responsive buses. In both cases we believe these can supplement existing transport services.

Dockless bikes allow people to take up cycling in areas not covered by TfL's Santander Cycles scheme. Demand-responsive buses could fill in the gaps in the bus network, providing a cost-effective alternative to the car. TfL should be working more proactively to shape the market for these services. For dockless bikes we believe a supportive Londonwide licensing scheme would be effective. Demand-responsive buses also need a new regulatory regime, although this will be more complex to introduce and requires further discussion with the Government.

Many transport apps are powered by TfL data. We welcome TfL's openness and commitment to supporting app developers. There should be reciprocity, however, so TfL can gather additional data from the apps they underpin, to inform further enhancements to the transport network.

Drones

Increasing freight traffic is a major contributor to London's congestion problem. Using drones—airborne or pavement-based (also known as droids)—could help alleviate this problem. We know a number of companies are pursuing this. In all likelihood drones will not remove a significant amount of freight traffic from our roads, and would only be suitable for the 'last mile' in the delivery chain. However, we do need more clarity on the likely scale of drone use. TfL should produce new projections.

The controlled use of drones should be explored if risks can be minimised. At present it is clear that planning for a future of increased drone use is not advanced. Airborne drones in particular need an effective control system to ensure they can deliver packages without being unsafe or causing excessive noise pollution. Such a system may need to be integrated with control systems for other modes, such as CAVs.

Healthy Streets

In this report we consider these technological challenges in the context of the Mayor's Healthy Streets agenda. This is the central principle of the Mayor's

new Transport Strategy, and mandates TfL to pursue policies that shift Londoners away from cars toward walking, cycling and public transport, and produce street environments that are more pleasant and less polluted.

Delivering healthy streets is a huge challenge, and we know from TfL's evidence to our investigation that TfL is aware of how new technology may contribute to or detract from its efforts to meet it:

“London's streets need to become safer (particularly for vulnerable road users), more attractive places to walk, cycle and spend time. Technologies such as fitness apps, new types of cycle hire or improved street lighting could contribute to encouraging greater physical activity. Improved engine technology can help reduce noise and emissions, while driver assistance systems, automatic speed control and enforcement technologies could reduce road danger and improve the street environment more widely. However, there could also be adverse health impacts if technology incentivises new non-active transport services for people who would otherwise have walked or cycled.”²

To help us understand how to combine support for technological innovation with the Healthy Streets approach, we have gathered a wide range of evidence from many contributors. Our call for evidence attracted over 40 submissions from transport providers, experts, technology companies, other stakeholder organisations and individual Londoners. At two committee hearings we heard from a number of these organisations and also took evidence from other cities in the UK innovating in ways London has yet to try. We also held informal meetings with a range of other organisations, including with app developers at a 'Dragon's Den' style session at City Hall. Finally, we have conducted two site visits during the investigation, the first to the GATEway project in Greenwich to view an autonomous vehicle trial, and secondly to view a Starship Technologies ground-based delivery drone in action.

In this report, we set out the conclusions of our investigation and make recommendations to TfL about how London can harness new technology to improve the transport system in line with the Mayor's key objectives. We recognise that the future is essentially an unknowable entity, but by being proactive and pragmatic, TfL can give itself the best chance of achieving this.

Recommendations

Recommendation 1

TfL should establish an advisory panel, with the Department for Transport, London boroughs and other key stakeholders, to have input to and oversee the work of the Transport Innovation directorate. This panel and Transport Innovation officers should be asked to regularly update the TfL Board on emerging technological trends in the transport sector and lead a discussion on action TfL needs to take in preparation. We ask the Mayor and TfL to confirm by the end of May 2018 whether a panel will be established and what process will be put in place to update the TfL Board.

Recommendation 2

To ensure the introduction of CAVs is beneficial for London, the Mayor and TfL should produce an update to their car club strategy in 2018/19 which reflects the new Mayor's Transport Strategy and specifically considers how to embed car sharing in the context of the potential emergence of connected and autonomous vehicles. The Transport Innovation directorate and advisory panel should have input to the modified strategy. We ask the Mayor and TfL to confirm by the end of May 2018 that this work is underway.

Recommendation 3

The Mayor and TfL should consider the potential development and impact of autonomous bus technology on London. A review of this area should be undertaken during 2018/19 and the potential implications for London's existing bus network, including the risks of changing the way bus services are staffed. We ask the Mayor and TfL to confirm by the end of May 2018 that this work is underway.

Recommendation 4

TfL and boroughs should consider whether to introduce a London-wide licensing regime for dockless cycle hire. This could involve a small number of operators being granted permission to operate across London. Licensing requirements could specify commitments to provide services in outer London boroughs, and adherence to the terms of TfL's code of practice for operators. We ask the Mayor and TfL to confirm by the end of May 2018 that discussions on this proposal are underway.

Recommendation 5

The Mayor and TfL should engage in discussions with the Government, boroughs and operators to develop the principles of a new regulatory regime for demand-responsive bus services. These should include requirements to serve areas with less dense public transport coverage, and ensure accessibility for older and disabled passengers. Thereafter the Mayor and TfL should implement these principles where possible, and ask the Government to make any necessary legislative changes. We ask the Mayor and TfL to confirm by the end of May 2018 its plans to initiate these discussions.

Recommendation 6

TfL should continue to make its data open for use by app developers, but seek to enter reciprocal agreements whereby data produced by apps powered by underlying TfL data is shared with TfL. This should be a requirement for existing apps using TfL data and new apps seeking to do so. This principle should also be in the Mayor's upcoming Smart London plan. We ask the Mayor and TfL to confirm by the end of May 2018 what steps they are taking to deliver this.

Recommendation 7

The Mayor and TfL should seek to understand the likely scale and impact of commercial drone use in London, both airborne and ground-based. Any existing use of drones in London should be monitored, and discussions should take place with the logistics and retail industries and other stakeholders.

TfL should produce new projections for drone use in London to inform continued debate about how to regulate and manage their operations. We ask the Mayor and TfL to produce initial findings and projections by the end of May 2018.

Recommendation 8

The Mayor and TfL should proactively engage in discussions with the Government, London Boroughs, the drone industry, National Air Traffic Services and other relevant stakeholders about the future control system for drones in London, ahead of the expected publication of the Government's draft Drone Bill in Spring 2018.

TfL's aim should be to agree a common set of principles for a new control system, including the necessity for new TfL powers in this area. Consideration should also be given to the need for an integrated control system for ground-based autonomous vehicles and airborne drones, and how this could be implemented.

We ask the Mayor and TfL to update the committee by the end of May 2018 with details of discussions they are undertaking.

1. Planning and monitoring

Key points

- TfL faces a difficult challenge in attempting to predict and prepare for changes in technology and its application to the transport sector.
- Recent developments in the private hire and dockless cycle hire industries appear to suggest TfL has been unprepared for new uses of technology by the private sector.
- TfL's new Transport Innovation directorate is leading work to monitor and plan for technological change. Its findings and recommendations need to be embedded across TfL.

- 1.1 The key challenge for London is to predict and prepare for future trends in transport technology. In doing so, it is important to draw lessons from recent experience of technological change. The two examples we highlight here are: the emergence of one app-based private hire operator (Uber); and the launch of an app-based dockless cycle hire operator (oBike). Both of these developments have been disruptive – to the way streets are used, the way people book transport and to how Transport for London plans for new technology. For instance, London Councils told us:

“Where TfL drives the change to new technology, it is well-planned. Examples of this include cleaner vehicles, retrofitting of buses and introducing Ultra Low Emission Zone charges. However, where new technology comes from the private sector, TfL is slow to react. Examples of this include Uber and dockless cycles.”³

Private hire

- 1.2 Uber allows people to book private hire journeys via a smartphone app, connecting passengers directly to individual drivers. This service has proven highly popular in many cities, and contributed to a dramatic increase in the number of licensed private hire vehicles on London’s roads: this rose from 49,854 in March 2013 to 84,886 in November 2016 – an increase of 70 per cent in less than four years.¹ As discussed in our 2016 report on the topic, it is likely this has been a factor in the recent increase in traffic congestion.⁴
- 1.3 TfL has faced criticism that it did not foresee how far and how fast Uber would grow. Much of this has come from the company’s competitors, but it still leaves TfL with questions to answer. The trade union RMT, which represents taxi drivers and other transport workers, told us:

“Given that Uber and similar disruptors (such as Airbnb) had been operating in the USA for some time in a similar manner, before launching in the UK, TfL should have been able to react more effectively.”⁵

- 1.4 Taxi app firm Gett UK also queried TfL’s preparations, while recognising the difficulties the organisation faced:

“By the very nature of technology, it is sometimes difficult to adequately prepare for its large-scale adoption across an industry. The rise of app-based platforms has certainly been a radical change, which TfL has not been able to fully prepare for, with many issues perhaps not anticipated.”⁶

- 1.5 Arguably, TfL had limited room for manoeuvre to influence or respond to Uber’s growth as its regulatory powers are limited. And this episode has led successive mayors to lobby for TfL to have increased licensing powers, such as a cap on the number of private hire licences. We have previously examined

¹ We are not in this report making any comment on whether or not Uber has breached the terms of its private hire licence in London. At the time of writing this is a matter before the court.

this topic in our traffic congestion report and will not repeat the discussion here.⁷ However, it is disappointing that London could only begin to lobby for these changes on a *reactive* basis after the disruption associated with Uber's growth was evident.

Dockless cycle hire

- 1.6 Uber was not a one-off. A comparable situation developed, even more rapidly, when a 'dockless' cycle hire scheme was launched in London in 2017 by oBike. This service allowed users to hire a cycle from on-street locations using a smartphone app to unlock it.ⁱⁱ It is similar to TfL's Santander Cycles scheme, but bikes can be collected and left anywhere, rather than at dedicated docking stations.
- 1.7 After oBike launched in London, without notifying TfL or London boroughs, there were reports of significant disruption to street environments. Bikes were left in inappropriate places, blocking pedestrians and other road users.⁸ Subsequently, TfL and boroughs began to seize the company's bikes. oBike is not currently operating in London, although other dockless cycle hire services are doing so.
- 1.8 Michael Hurwitz, TfL's Director of Transport Innovation, explained TfL's perspective on the episode at our meeting in October 2017:

"There were issues with oBike. They did not tell anyone they were coming; they launched without a helpline, without a proven operating model, without an understanding of the complexity of boroughs and the powers of the transport authority, and therefore there were issues and it caused a number of boroughs, and us as well, significant concerns. We ended up asking them to remove the bikes and they did. We did not crack down immediately because we want to try to welcome innovation, and the fact is this is potentially something that could really increase access to cycling."⁹
- 1.9 Conversely, Westminster City Council's submission to our investigation was critical of the Mayor and TfL's failure to foresee what would happen:

"The draft Mayor's Transport Strategy in July 2017 did not predict the launch of dockless cycle hire three weeks later, because it has virtually no consideration of transport trends, such as 'on demand', Mobility as a Service, autonomous vehicles, homeworking and deliveries, and alternative vehicles (pedicabs, hoverboards, electric bicycles, etc)... This is a fundamental weakness as the final MTS needs to address this by analysing these 'disruptive technologies' and measuring them against its aims."
- 1.10 The bike-sharing firm ofo (an oBike competitor) also argued TfL could have been better prepared:

ⁱⁱ Dockless cycle hire schemes are discussed further in general in Chapter Three of this report.

“Like any large organisation, TfL struggles to respond as quickly as necessary when new technology emerges. A better ability to recognise and respond to emerging trends may have seen a more positive introduction of free floating bike share to the capital this summer.”¹⁰

TfL planning

1.11 What do these examples tell us about how TfL should be responding to technological change? Clearly, predicting technological advancement and its implications can never be a perfect process. This point has been made strongly during our investigation, including in a submission from the Institution of Engineering and Technology (IET):

“It is our opinion that TfL does effectively plan for the possible largescale adoption of new technology however the difficulty here is that both the likely take-up and the impact is often difficult/impossible to predict and so planning for specific instances of adoption of new technology is also difficult.”¹¹

1.12 We are encouraged to see that TfL recently established its Transport Innovation directorate, which describes its role as:

“TfL’s Transport Innovation directorate is responsible for identifying areas where disruptive business models and emerging technology could potentially impact TfL’s business. Its purpose is to identify, anticipate and advise on emerging business models to ensure they deliver Mayoral and city objectives. The Transport Innovation directorate also investigates the potential negative consequences arising from emerging business models. TfL’s job is to make sure all innovations and developments within the transport market support the Mayor’s Transport Strategy, to ensure TfL operates safe, efficient and sustainable services.”¹²

1.13 This is a step forward but to be successful, of course, this team’s work will need to be taken into account and implemented across TfL. This will require a significant cultural shift in other parts of TfL, requiring teams to move from simply focusing on current service pressures to predicting developing trends. Such an intangible change may be hard to track, but TfL has governance procedures in place that can help ensure this happens as far as possible.

1.14 This process is starting. In July 2017 this directorate submitted a paper for discussion at TfL’s Customer Service and Operations Panel on emerging trends with autonomous vehicles and demand-responsive transport. To ensure these and other trends remain at the forefront of TfL’s thinking, we would want to see this exercise repeated regularly, and taking place at TfL Board level as well as the sub-Board level. To be most effective this work should be carried out with input from other major stakeholders from central and local government, independent experts, and professional engineering institutions.

Recommendation 1

TfL should establish an advisory panel, with the Department for Transport, London boroughs and other key stakeholders, to have input to and oversee the work of the Transport Innovation directorate. This panel and Transport Innovation officers should be asked to regularly update the TfL Board on emerging technological trends in the transport sector and lead a discussion on action TfL needs to take in preparation. We ask the Mayor and TfL to confirm by the end of May 2018 whether a panel will be established and what process will be put in place to update the TfL Board.

2. Connected and autonomous vehicles

Key points

- Connected and autonomous vehicle (CAV) technology has significant potential benefits for road safety and mobility.
- Predictions vary widely on when and how CAVs will be used on London's roads. TfL faces a difficult challenge in planning for different possibilities.
- The main objective of the Mayor's Transport Strategy is to reduce private car use in London. CAVs may put this in jeopardy if they simply replace existing cars or encourage greater car use.
- The most effective strategy for TfL is to embed sustainable transport choices ahead of CAV rollout. Shared usage of CAVs is likely to be the most sustainable way of harnessing this technology in London. TfL can take steps now to encourage car sharing, to embed this as part of the transport network.
- There could be significant job losses in driving professions if CAV technology becomes widespread.

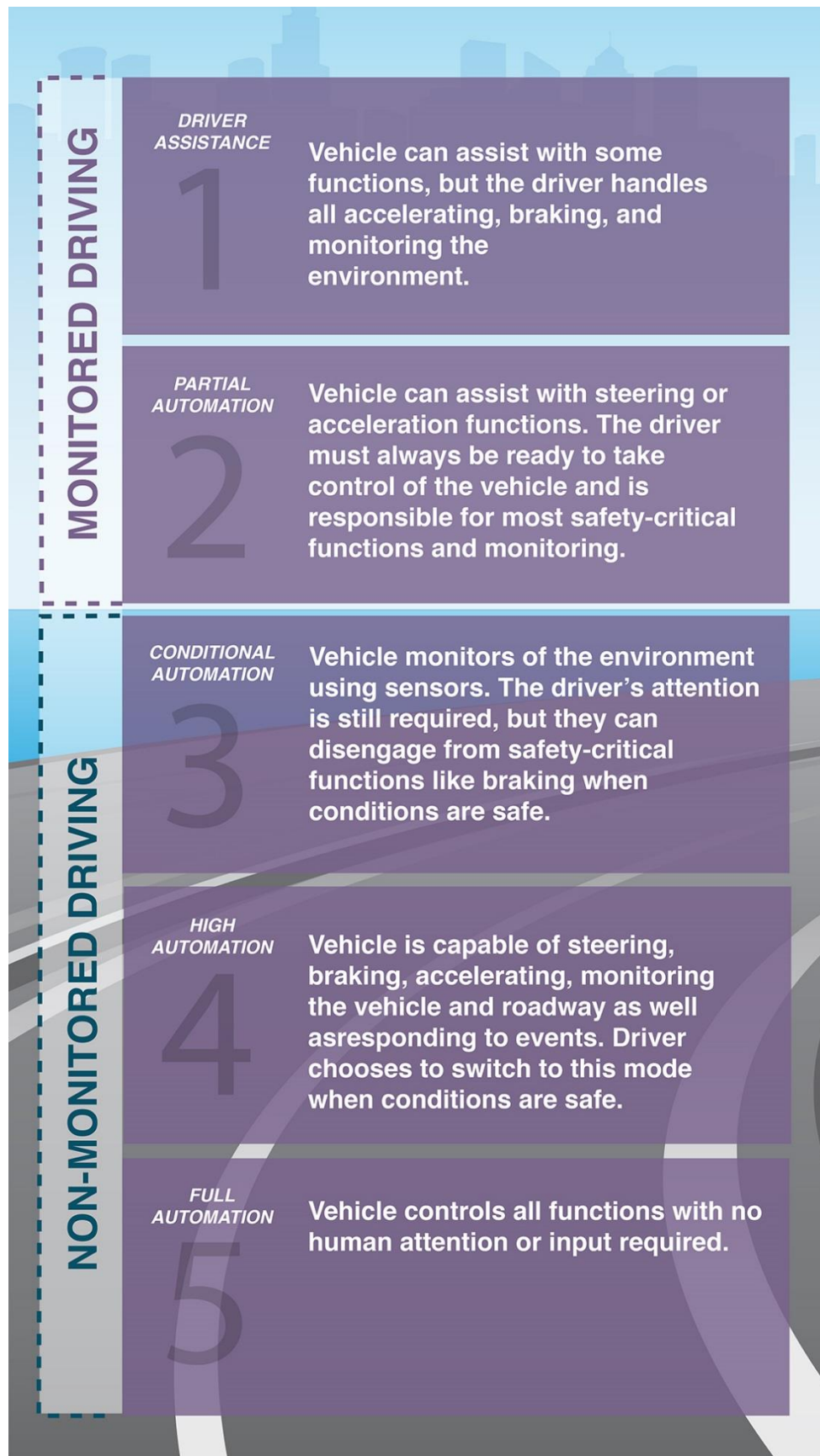
- 2.1 Potentially the most far-reaching technological change affecting London’s transport system is the development of connected and autonomous vehicles (CAVs). CAV is a term referring to motor vehicles that can travel with reduced or no input from a human driver, and which are able to communicate with other networked vehicles. The ‘autonomous’ aspect of this technology in particular has garnered significant media and political attention in recent years, with these vehicles often being described as ‘driverless’ cars.
- 2.2 To some extent this technology is already being used on London’s roads. There are differing levels of autonomy for cars. For instance, many cars are already equipped with features such as cruise control or anti-lock braking. Cars with much higher levels of autonomy are being tested, including in London, but are not yet available for public use. See Figure 1 on the next page for an explanation of the distinct levels of autonomy. As TfL explained in its submission:

“Far before fully driverless vehicles, features such as autonomous emergency braking, steering assistance and pedestrian detection or alerts will become more prevalent, all having the potential to reduce road danger... Less can be said definitively about the speed at which we will see the introduction and commercial availability of highly or fully autonomous vehicles. This depends on the pace of technology development, which is rapid and backed by significant investment worldwide, and also on regulations and vehicle type-approval mechanisms, which is often developed internationally and at a slower pace.”¹³

- 2.3 Existing forms of autonomy in cars mean that TfL should be in position to react to future advances. Nobody knows the likely timescale and extent of the introduction of CAVs on London’s roads. Predictions vary considerably, and depend on definitions of autonomy. In November 2017, the Chancellor of the Exchequer predicted that ‘fully driverless cars’ would be on Britain’s roads by 2021.¹⁴ In our meeting on this topic with a range of experts there was a broad consensus that the widespread rollout of advanced CAVs—for instance, cars without a steering wheel—was more likely to occur over the period from 2030 onwards.¹⁵ Professor Natasha Merat of the University of Leeds told us the longer timeframe was because of the range of factors that will influence uptake beyond the CAV technology itself:

“I would say much later for a fully automated vehicle that can take me from A to B and I do not have to intervene. I am thinking more like 2030 to 2040 because the issues are around acceptability, trust, uptake, affordability, infrastructure availability, connectivity and so on.”

Figure 1: Levels of autonomy in vehicles¹⁶



- 2.4 Public acceptability, in particular, may be a barrier to a quick rollout of CAVs. Many people remain sceptical about travelling in or alongside these vehicles.¹⁷ Goodyear Tyres undertook survey research with the London School of Economics in late 2016 which found that, for instance:
- 55 per cent of respondents would feel uncomfortable driving on roads alongside CAVs.
 - 64 per cent agreed that humans should be in control of their vehicles.
 - 78 per cent of UK drivers would want a steering wheel in a CAV to allow the driver to override the system.
- 2.5 It is likely public misgivings would dissipate, however, as people become familiar with the technology and its safety record is proven. The Docklands Light Railway in London already operates without human drivers on board. It does appear likely that CAVs will become a significant feature of London's roads over the next two decades. We have therefore considered what the benefits and risks of this change might be, and what the Mayor and TfL can do to enhance the former while minimising the latter.

Safety, accessibility and efficiency

- 2.6 CAVs have the potential to deliver a number of benefits for the transport system. Indeed, anticipated features of this technology may help achieve the Mayor's ambition to create healthy streets across London. First, CAVs could help improve road safety. This could happen if CAVs are programmed to give more space to vulnerable road users, driving in a way that reduces risk of collisions. At present, of course, the safety benefits of CAVs operating on public roads alongside a variety of different road users are still unproven, and some legal issues such as liability for collisions need to be clarified. CAVS are expected to reduce the impact of human error—in whole or part—which is a contributory factor in many road collisions. As we heard from Rob Wallis of the Transport Research Laboratory:

“Of the deaths and serious injuries on the road anywhere in the world, 95 per cent predominantly have some element of human interaction that has made a contribution to that accident. If you are able to take the driver out of the equation, some of the time or all of the time there should be demonstrable reduction in deaths and serious injuries. The societal benefit of that alone says that it is worth pushing really hard to see if we can make it work.”¹⁸

- 2.7 CAVs could improve mobility for those who have difficulty accessing the transport network. This includes older and disabled Londoners, who may not be able to drive or face restrictions in using public transport because of distance or poor service design. There is no guarantee this will happen, of course. It is probable that using—or summoning—a CAV will require a level of

digital literacy that may continue to exclude many older and disabled people.¹⁹



Autonomous vehicle trial run by the GATEway project in Greenwich.

- 2.8 CAVs should also be able to use road space more efficiently, in comparison to human-driven cars. The shape and size of vehicles may differ from conventional cars, allowing them to use less space. CAVs can be programmed to travel more closely together, perhaps in convoy. This could create more space for other road users, particularly cyclists. If CAVs accelerate and decelerate less this would smooth traffic flow and help maintain speed limit compliance. The Cross River Partnership (while also recognising potential downsides) highlighted how this could happen:

“With autonomous vehicles reducing the need for braking distances, traffic lights, accidents, and other congestion-causing phenomena overall London’s street network could operate more efficiently.”²⁰

- 2.9 The Mayor’s draft Transport Strategy also summarised this benefit of CAVs:

“This technology could also improve how efficiently road space is used, such as through route choice that avoids congested areas, optimising gaps between vehicles or simultaneous acceleration at junctions.”²¹

- 2.10 Professor David Metz of University College London agreed but also explained there would need to be a lot of CAVs on the road to achieve greater efficiency:

“It is possible that autonomous vehicles could operate at reduced headways (in platoons in the most extreme case) on narrower lanes,

and could be more efficiently managed at junctions, thus increasing effective road capacity... The implications of varying levels of autonomous vehicle deployment and styles of behaviour have been explored in traffic simulation modelling. The general conclusion of most such studies is that there is little impact on traffic flow and capacity until relatively high penetrations of vehicles with high levels of automation.”²²

- 2.11 We have heard that specific steps need to be taken, whether by TfL, central government or industry, to enable these efficiency gains to be made. The British Standards Institute argued that common standards are needed to ensure interoperability of CAVs, to enable communication between CAVs and supporting infrastructure.²³ Similarly, the Institution of Engineering and Technology argued that CAVs will place a higher demand on communications infrastructure that will need to be met.²⁴ This is discussed further in the chapter on drones.

Congestion impacts

- 2.12 Although CAVs could use road space more efficiently, there are still concerns about their impact on the transport network. These concerns are mainly related to the behavioural choices that Londoners may make if and when the technology becomes available. Put simply, people who currently drive very little or not at all may decide to take advantage of CAVs by travelling in cars more often. If this happens on a large scale, this would mean CAVs may contribute to traffic congestion, and/or prevent a hoped-for shift towards more sustainable transport modes.
- 2.13 A potential increase in congestion and car usage has been highlighted by a number of contributors to our investigation. As reported by the committee in early 2017, congestion has increased significantly in London in recent years, with more time lost to traffic delays, a drop in traffic speed and rise in bus waiting times.²⁵ Westminster City Council argued that CAVs could exacerbate this:

“The impact of autonomous vehicles on the Mayor, TfL and boroughs is probably the greatest challenge faced by the draft Mayor’s Transport Strategy as it is likely to increase driving, congestion, pollution (in the short term), and reduce bus passengers, probably cycling and even walking.”²⁶

- 2.14 London TravelWatch similarly warned about the potential impact on public transport fares:

“Autonomous vehicles could reduce the need for people to walk, cycle or use public transport, or make the use of these modes [less convenient] or unreliable by increasing congestion... Reduced use of public transport also brings pressure to raise fares for other passengers.

This in turn makes public transport less affordable and therefore likely to lead to a further reduction in usage.”²⁷

2.15 A related concern is about the impact of CAVs on individuals’ health. The Mayor has a target for all Londoners to undertake at least 20 minutes of active travel per day by 2041, in order to improve health outcomes.²⁸ If people choose to travel in CAVs rather than walking or cycling, this may not be achieved.

2.16 The Mayor has highlighted these sorts of risks in his draft Transport Strategy:

“There are also risks to be managed. Increasing access to car sharing could bring benefits, but these would be outweighed by the impacts on congestion, emissions and health if cheap, convenient car travel is extended to Londoners who do not own a car or do not have a driving licence. Even if technology is able to improve how efficiently cars use road space, connected and autonomous cars will not be as space-efficient as walking, cycling or public transport.”

2.17 The Mayor and TfL do not as yet have any detailed policies on how they will respond to CAVs. TfL told us that they have commissioned work from the Massachusetts Institute of Technology (MIT) to help model the impact of CAVs; this work is due for completion in summer 2018. The Mayor’s draft Transport Strategy sets out some broad principles of how TfL will approach new technology—for instance seeking to encourage a shift away from car travel—but does not set out any detailed policy responses.

2.18 In our investigation, we have heard from a range of contributors that the best outcome for London will be if CAVs become a shared resource, rather than being privately owned on a mass basis. Dan Phillips of the GATEway project—an autonomous vehicle trial in Greenwich—told us that CAV technology will lend itself to car sharing, in part because people will not need to have a car parked at home in order to access a CAV. However, new business and service models to support shared usage will have to be developed to achieve this aim.²⁹ As Professor Merat explained, we do not yet know if or how this will happen, and there are a range of complex factors to consider:

“On the one hand, it would be good to have shared autonomous vehicles but, on the other hand, how do we encourage the public to use them? There are things like the fact that normally at the moment a lot of people use their cars just because of a habit. It is making people understand that actually, if they just drop that habit and be able to car-share, it will reduce the number of privately owned vehicles. What will make us car share? Things like if it is comfortable, if it is low cost, if it reduces our time, if it is with people we like, if it has connections, and so on.”³⁰

2.19 Car sharing services are already established. We have explored the provision of car clubs in London. TfL has an ambition to increase the number of car club members to one million by 2025, up from around 200,000 today. DriveNow, a

car club, argued that embedding the use of car clubs will help the transition to shared CAVs as Londoners will see vehicles as a service rather than a possession to own.³¹ The previous Mayor launched a Car Club Strategy in 2015, with London Councils and other stakeholders.³² However, we have heard that provision remains scarce in some areas, especially outer London, and car clubs face difficulties, such as agreeing parking spaces. As David Wong of the Society of Motor Manufacturers and Traders (SMMT) told us:

“What is critical is what our vehicle manufacturing members have experienced in terms of running car sharing services. They have been telling us that, because of the fragmentation of the boroughs in London and sometimes conflicting priorities, they have run into various stumbling blocks in terms of deploying car sharing services. One of them exited the London market and exited the UK market altogether a few years ago for largely the same reasons: they just could not make car sharing work despite how promising car sharing services are because of the conflicting priorities of some of these London boroughs.”³³

- 2.20 It is crucial, and possible, to ensure the introduction of CAVs is beneficial for London. The Mayor’s draft Transport Strategy indicates his support for car clubs, but is short of detail on specific measures he will take to increase membership or encourage boroughs to facilitate their provision. Given the looming development of CAVs, we believe there should be a renewed focus on this area, to help embed car clubs as a viable transport option. Doing this would go some way to addressing concerns about CAVs causing congestion. It would not directly address the risk of CAVs discouraging active travel, however, so we would also urge the Mayor to prioritise walking and cycling measures; we will have further recommendations on this topic in an upcoming report on cycling infrastructure.

Recommendation 2

To ensure the introduction of CAVs is beneficial for London, the Mayor and TfL should produce an update to their car club strategy in 2018/19 which reflects the new Mayor’s Transport Strategy and specifically considers how to embed car sharing in the context of the potential emergence of connected and autonomous vehicles. The Transport Innovation directorate and advisory panel should have input to the modified strategy. We ask the Mayor and TfL to confirm by the end of May 2018 that this work is underway.

Autonomous buses

- 2.21 Autonomous buses are a subset of CAVs which raise a host of further issues. Autonomous buses have been trialled in various places, including on a public bus route in Estonia in 2017.³⁴ TfL currently funds and commissions public bus services in London, including designing routes, and setting service specifications and vehicle standards. It would therefore have a significant role to play in the possible introduction of autonomous buses.
- 2.22 As a shared form of transport, we would welcome autonomous buses, as an alternative to people driving their own private CAVs. This would be the most efficient use of road space and help minimise any congestion impact. Safety concerns and customer service issues need to be addressed, however.
- 2.23 We have also recently investigated bus safety in London, making recommendations on issues such as driver fatigue and distractions, as well as operator contract incentives and TfL staff bonuses.³⁵ We believe the introduction of CAV technology has the potential to reduce collisions and injuries, providing robust trialling proves the safety of the technology. However, this is not a substitute for TfL taking substantive action now to improve the safety of bus passengers and those sharing road space with buses; we have expressed disappointment with TfL's response to our report.³⁶
- 2.24 Clearly, the introduction of autonomous buses would have implications for bus staffing. Thousands of Londoners are employed as bus drivers and their positions may be at risk with the rise of this technology. This may also apply to other driving professions, including in the freight, taxi and private hire sectors. Job losses as a result of automation may have a negative economic impact on London. As we heard from Rob Wallis of Transport Research Laboratory:
- “The introduction of greater levels of automation and driver assist or indeed potentially no driver can only improve the safety aspects of that over time, once those technical solutions are proven and robust and licensed. One of the downsides of that, of course, is what that means for all of these bus drivers currently operating in London... The introduction of autonomy could suddenly have a massive economic issue for any country or any city embarking on levels of automation.”³⁷
- 2.25 Removing on-board staff altogether would also affect passengers, as the customer service drivers provide would be unavailable. London Councils has argued that an autonomous bus should have a staff member on board to prevent fare evasion and anti-social behaviour.³⁸
- 2.26 The provision of autonomous buses on London's roads is likely many years in the future, and we do not yet know what service models will be used. However, TfL should be preparing for this change, engaging with bus operators, manufacturers, trade unions and others. In particular, there should be in-depth study of the implications for bus staffing. Our strong view at this stage is that TfL should be planning for public buses to remain staffed even if

they are driven autonomously, with on-board staff providing customer service to passengers.

Recommendation 3

The Mayor and TfL should consider the potential development and impact of autonomous bus technology on London. A review of this area should be undertaken during 2018/19 and the potential implications for London's existing bus network, including the risks of changing the way bus services are staffed. We ask the Mayor and TfL to confirm by the end of May 2018 that this work is underway.

3. App-based services

Key points

- App-based services have already had a major impact on London's transport network, in positive and negative ways.
- Although TfL provides few app-based services itself, the organisation is a vital enabler of these services by making its data freely available. Londoners may see more benefit from this if the private sector made its data available to TfL in turn.
- Dockless cycle hire schemes are an example of a new app-based service that could make getting around London easier and more sustainable. TfL could actively shape this market. A new light-touch, Londonwide regulatory regime could realise these benefits while minimising risks.
- Buses are the mode most liable to radical change as a result of this technology, as new providers offer bus journeys booked by app. At present there is no dedicated regulation of these services, which would be necessary to encourage their growth while maintaining public service requirements.

- 3.1 Smartphone apps have already transformed the transport system, and the way Londoners experience it. This includes apps helping Londoners plan journeys, or track service disruptions on social media. Some apps are designed to interact with services, such as apps telling people about the availability of bikes and docking spaces for the Santander Cycles services. Others allow people to book and pay for transport services, including some private hire and dockless cycle hire services.

Dockless cycle hire services

- 3.2 In Chapter 2 we discussed London's first dockless cycle hire service, oBike, which proved to be highly disruptive and was launched without the cooperation of TfL or local boroughs. Since then, several similar services are now operating in different boroughs, including Ofo, Urbo and MoBike.
- 3.3 TfL's Santander Cycles scheme is a cycle hire service in which bikes are collected from and returned to dedicated docking stations. The scheme has proven popular with Londoners and visitors, with over 10 million journeys annually. However, it requires an operating subsidy from TfL: this was £3.6 million in 2016/17, down from an average of £10.5 million in the previous five years.³⁹ The scheme is also limited geographically to central London, with TfL having no plans to extend it.
- 3.4 Dockless cycle hire services are operated via apps. Members can find the locations of available bikes on the app, and then use their phone to unlock a bike. Bikes can be left anywhere once at the end of a journey, although firms running these services take measures to help ensure bikes are left in appropriate locations; for instance, by rewarding members for returning a bike to an approved location.



On-street parking area for Ofo, a dockless cycle hire service.

3.5 We believe that dockless cycle hire services, combined with other measures, can help increase cycling take-up, especially in areas not covered by Santander Cycles. We are currently running a separate investigation into how the Mayor and TfL can improve London’s cycling infrastructure. In our future transport investigation we have identified ways in which TfL can help enable dockless cycle hire services to flourish in a way that meets Mayoral objectives.

3.6 London’s local government landscape poses a significant obstacle to the growth and take-up of these services. At present—with the exception of the unexpected oBike launch—operators have entered into arrangements with individual London boroughs to allow them to offer the service within that borough. This includes, crucially, permission to establish dedicated parking areas for the bikes.⁴⁰ Richard Dilks of London First, which represents businesses in London, told us how this may be problematic:

“People do not cycle by borough boundary, so what they do not need is a borough with lots and lots of bikes, absolutely nothing, and then not much, and then lots, a patchwork. We have heard in other kinds of cycling infrastructure that does not work very well. There is clearly a co-ordination need here. It is difficult because of London’s governance landscape that it has, but nonetheless the need is there.”⁴¹

3.7 Similarly, Drive Now told us that some potential users will be discouraged because restricting journeys within borough boundaries will prevent people making one-way trips.⁴² Dr Justin Spinney of the University of Cardiff shared findings of his research in China, where these services are popular, and warned that having a plethora of different operators would be difficult for users and transport authorities:

“For a number of reasons, I would suggest the fewer operators the better. From the user perspective in Shanghai, we have seen that most users only are signed up to one or two operators. You do not want a phone full of 30 different apps, each one for a different bike operator. In the London context, with each borough having a different operator, it could be quite problematic. In terms of integration with other kinds of ticketing, the fewer operators the better. In terms of just a broader sustainable mobility plan, trying to co-ordinate with 33 different public bike operators, how they fit into TfL’s broader masterplan, becomes more problematic.”⁴³

3.8 TfL is actively engaging with the dockless cycle hire sector. It has produced a code of practice for operators; see the box below for details.⁴⁴ We welcome this initiative from TfL. To help operators to offer this service in a way that encourages take-up of cycling among Londoners, TfL could go further by actively seeking to shape the market. The objective of doing this would be to enable Londoners to make cycling journeys without being restricted by borough boundaries, while ensuring the code of practice is implemented and any disruption to other road users is minimised.

TfL code of practice for dockless cycle hire services

TfL launched the code of practice in September 2017, in the wake of the disruptive launch of oBike several months earlier. The code sets out a variety of requirements for operators, such as:

- Meeting safety standards for their bikes, and having robust maintenance regimes
- Preventing bikes from causing obstruction to other road users, and promptly removing any bikes causing an obstruction
- Sharing anonymised trip data with highway authorities to help them enhance the cycling network
- Offering 24-hour communication channels for customers, including a telephone number

- 3.9 One way to achieve this is for TfL and the boroughs to work collaboratively to license a number of operators to provide their service across London. The number of operators should be set in order to allow for competition, but avoiding an excessive number of unused bikes being left to clutter pavements and roads. Operators would still require borough agreement on the locations of dedicated parking spaces; in general, such spaces should be available to all approved operators.
- 3.10 While there is currently no legislative provision for TfL to regulate this market and impose mandatory conditions on operators, TfL and boroughs should still be able to take these steps using existing powers. That is, only approved operators would have access to the support provided by TfL and boroughs, including permission to establish parking spaces. TfL and boroughs could in turn require that operators adhere to the code of practice, and provide services in areas currently not served by Santander Cycles.

Recommendation 4

TfL and boroughs should consider whether to introduce a London-wide licensing regime for dockless cycle hire. This could involve a small number of operators being granted permission to operate across London. Licensing requirements could specify commitments to provide services in outer London boroughs, and adherence to the terms of TfL's code of practice for operators. We ask the Mayor and TfL to confirm by the end of May 2018 that discussions on this proposal are underway.

Demand-responsive bus services

- 3.11 Demand-responsive bus services are an emerging form of transport. Although they are in their infancy and could develop in a variety of ways, we expect they will differ from traditional bus services in several respects. While traditional bus services operate on fixed routes and follow a regular timetable, for demand-responsive services these would be determined by journey requests made by users.
- 3.12 Londoners would use a smartphone app to request a particular journey from the service, and a route would be designed to accommodate that request. Buses would not arrive at a person's home, but at designated 'virtual bus stops' nearby, to which the app would direct passengers. This bridges a gap between conventional buses and the 'ride-sharing' service some private hire operators provide. In many ways, these services would operate in a way similar to the Dial-a-Ride minibus service TfL offers for disabled people, but with the intention of responding in real-time to journey requests and on a larger scale.
- 3.13 The Mayor's draft Transport Strategy, published in July 2017, endorses the principle of these services. The strategy explains some of the potential benefits:
- “Demand-responsive bus services, which operate without necessarily fixed routes or frequencies, are one particular application that could potentially cater for gaps in service provision where public transport is required. This could offer benefits particularly in outer London where travel patterns are characterised by trips having many different start and end points, and consequently conventional public transport is less able to provide services that cater for people's needs. These demand-responsive services could also help address demand pinch-points or provide alternatives.”
- 3.14 The Mayor's draft strategy states that TfL will 'explore and trial' demand-responsive bus services. In October 2017, Michael Hurwitz of TfL told us they were “thinking through whether and where a trial would be helpful,”⁴⁵ although no further details have been released. We have heard of at least three companies planning to introduce different forms of demand-responsive bus service:
- Citymapper is known for providing a journey planning app used by many Londoners. The company has recently launched the CM2 night bus service in east London on Friday and Saturday night, and revealed plans to launch demand-responsive services in the future. TfL has worked with Citymapper to help it establish its east London service, although this is effectively a conventional bus route and not a demand-responsive service.

- Via has run demand-responsive bus services in the United States since 2013, with operations now in New York, Chicago and Washington, D.C. It provides around 1.5 million journeys per month. Via applied to TfL in April 2017 for a license to run the service in London.
- The Chariot shuttle bus service, operated by Ford, has been granted permission by TfL to launch a shuttle bus service, for around a year on a trial basis.⁴⁶ Chariot will run on four routes, with seats booked using an app. Chariot is already operating in five US cities.

3.15 There are a range of opportunities and risks of demand-responsive bus services. Professor Maria Kamargianni of University College London told us that these services can fill gaps in the transport network and may be able to reduce cost:

“With the demand response services, we can offer users door-to-door mobility. As we mentioned before, one of the problems is the last mile or the access into the main transport mode. With all demand services, we can solve this issue and offer more flexible travel... It can also reduce the cost of the public transport system. For example, nowadays, we operate some bus lanes to some areas where the demand is not high. With on-demand systems, we can save this money to subsidise the bus route and initiate an on-demand service.”⁴⁷

3.16 This suggests demand-responsive buses could supplement the existing transport network by offering journeys that are not currently possible except by private car. Arguably, however, they could undermine conventional bus services if they siphon off potential passengers, or if they increase traffic congestion by putting more vehicles on the road. Making existing services less viable may be detrimental particularly for older passengers, who rely on the bus network and may be less familiar with the technology needed to use demand-responsive services. Regarding traffic impacts, Chris Lane of Transport for the West Midlands told us:

“You need to be careful of your mass transit network. Having lots and lots of dynamic services could start to threaten your mass transit and, as I said, you are not building new roads in London. You have less and less road space... you need to be careful where these services are because you do not want to slow your mass transit down and make that less attractive. It has to complement what is happening there and potentially look at the gaps.”⁴⁸

3.17 A significant unanswered question about these services is how they can and should be regulated. TfL commissions public services in London and directly operates Dial-a-Ride, while licensing other types of buses (for instance tourist coaches) and private hire services. It is not clear which regulatory regime demand-responsive services should fall under. Citymapper and Via have both applied for private hire licences, but their similarities to conventional buses suggests this may be not be appropriate. The Chariot service has obtained a

London Service Permit from TfL, which can be granted to buses that are not part of the London bus network (such as sightseeing tour buses). Michael Hurwitz of TfL discussed this issue at our meeting:

“What we are learning from this agenda is that the regulatory environment does not quite match. The nearest thing we have for this space at this moment is something called the London Service Permit (LSP), which is designed for tour buses or buses that run outside the London bus network. We are thinking through right now whether we need to put advice to the Mayor with proposals to revise that to make it fit for the emerging technology services.”⁴⁹

- 3.18 There are wider questions for the transport network, too. For instance, many London roads have dedicated bus lanes, which any vehicle with at least 10 seats can use. If demand-responsive buses are smaller than this, but efficiently run—in the sense that they are often full to capacity and enabling people to make essential journeys—this would strengthen the case to allow them to use the bus lanes. Allowing this, in turn, may affect other bus lane users. More generally, TfL will need to consider whether demand-responsive services form part of London’s public bus network, or if they are a separate entity.
- 3.19 TfL needs to remain closely involved with the development of demand-responsive bus services. They offer potential benefits for Londoners and may be more efficient than alternative services. While there are risks, we have previously called for reform of the bus network to make sure capacity goes where it is needed, particularly in outer London.⁵⁰ Managed properly, this type of service could help enable this change to happen.
- 3.20 As the sector develops, the details of a new, supportive regulatory regime will need to be considered by all relevant stakeholders. Unlike with the private hire regulation being used currently, a new form of regulation could guarantee public service requirements, such as serving areas with poor connections.

Recommendation 5

The Mayor and TfL should engage in discussions with the Government, boroughs and operators to develop the principles of a new regulatory regime for demand-responsive bus services. These should include requirements to serve areas with less dense public transport coverage, and ensure accessibility for older and disabled passengers. Thereafter the Mayor and TfL should implement these principles where possible, and ask the Government to make any necessary legislative changes. We ask the Mayor and TfL to confirm by the end of May 2018 its plans to initiate these discussions.

Mobility as a Service

'Mobility as a Service' (MaaS), refers to new ways for individuals to arrange and pay for transport services. The key innovations behind MaaS platforms are that multiple public and private transport operators can offer services via a single gateway, a smartphone app.

Via the app, users can plan and pay for a journey using any providers' services. Services may go beyond conventional public transport, for instance to include cycle hire, private hire or car clubs. Users can tailor their journey for specific requirements, such as speed, cost or accessibility. Payment can be made for specific journeys or by regular subscription.

Since October MaaS has been trialled in the West Midlands using the Whim app, first launched in Helsinki in 2016. We heard from MaaS Global, the company behind Whim, that app users have increased their public transport use and reduced personal car use, although they have also increased taxi usage.⁵¹ We have heard some concerns that MaaS may discourage people from walking and cycling, as paid-for, less active modes become more convenient.

TfL told us that London already has a form of MaaS in its integrated Oyster system, through which users can pay for journeys across providers.⁵² However, London does not have an app offering the full functionality of journey planning plus booking and payment. We will review the findings of the West Midlands MaaS trial to assess how these could be applied in London.

Data-sharing

- 3.21 Apps that enable new transport services rely on data. This may include, among other things, data about transport users and the journeys they make, geographical data, data on road conditions, or operational data for the public transport network.
- 3.22 TfL publishes a large amount of data. This includes real-time data sets on the operation of the transport network, such as live bus arrival times or Santander Cycles availability. TfL told us how this data now underpins a huge number of apps used by transport users:

"The tens of millions of trips made on London's transport network every day create a huge quantity of (anonymous) information about how and where people are travelling, which helps us to plan and manage our networks more efficiently... We have opened up our data, such as bus arrival times, to third parties, allowing over 600 apps and other customer-facing channels to be developed. These are used by 42 per cent of Londoners, and combined with the arrival boards at more than 2,500 bus stops, allow us to improve customer satisfaction and make bus services more attractive."

3.23 We welcome TfL's commitment to open data, and believe this has stimulated a vibrant marketplace for transport apps to the benefit of Londoners. We have heard, however, that the flow of data should ideally be two-way, with app developers that use TfL data also agreeing to share their data with TfL. Professor Kamargianna told us this could help identify gaps in the transport network, referring to the opportunities provided by the Citymapper journey planning app:

“Citymapper, by having all this data about Londoners, identified the gaps in the public transport system. Imagine if they had some agreements with not only Citymapper but with all the transport modes available in the city and all the transport operators. They will have amazing data about the demand for all transport modes and the citizens' needs. It is very important to have a two-way flow of data, therefore, yes, definitely provide the data but also for the companies to give back the data and especially the data from on-demand services which can provide the public authorities more information about how people move around.”⁵³

3.24 Similarly, Chris Lane of Transport for the West Midlands argues that the more complete data an app developer may hold could inform transport investment decisions:

“Some of these companies might see it as their commercial intellectual property, that information they have gained, but if there is an inefficient part of the transport system and you do not know about it, you cannot do anything about it. That might be best filled with a new bus service. It might be that a company that knows this would fill that with taxis. You need to know about it... You do know your public transport trips but what the apps know is where somebody started from their home address to their final address and that is also a really critical piece of information because you do not know whether it is a good route to get somebody from their housing on to the transport network in the first place.”

3.25 Reciprocal data-sharing is an established principle at TfL. In the code of practice for dockless cycle hire services, as discussed above, TfL asks operators to share anonymised trip data with TfL and boroughs, to help enhance the cycling network. Although we are mindful of the need for private companies to protect their competitive advantages, we believe data-sharing should be the norm for any app that requires TfL data to function.

3.26 The Mayor is currently developing a Smart London plan, which is expected to have a strong emphasis on sharing and using data to improve services, including through new city-wide data partnerships.⁵⁴ TfL partnering with app developers with reciprocal data-sharing arrangements should be an integral part of this agenda.

Recommendation 6

TfL should continue to make its data open for use by app developers, but seek to enter reciprocal agreements whereby data produced by apps powered by underlying TfL data is shared with TfL. This should be a requirement for existing apps using TfL data and new apps seeking to do so. This principle should also be in the Mayor's upcoming Smart London plan. We ask the Mayor and TfL to confirm by the end of May 2018 what steps they are taking to deliver this.

4. Drones

Key points

- Congestion is increasing in London, in part because of an increase in delivery vehicle traffic. We have previously recommended ways to address this issue.
- Airborne and pavement-based drones are two emerging methods of making deliveries that are potentially more efficient and free up road capacity.
- The likely scale of the introduction of drones is uncertain as the business case is not proven and there are specific challenges using them in dense urban areas.
- Although there are existing rules around drone use, these are likely to come under pressure if companies embrace the technology for deliveries on a large scale. We need to see a more proactive approach from TfL and partners to agree how to manage London's airspace and pedestrian space.

- 4.1 Freight traffic is a major contributor to traffic congestion in London. We identified in our 2017 report on this topic that van traffic had increased 11 per cent over just four years. This change appears to have been driven primarily by a shift towards online retail, with Londoners increasingly having shopping delivered to them at home or their workplaces.
- 4.2 In our congestion report we recommended ways to reduce the level and impact of freight traffic. Measures we recommended included the introduction of more consolidation centres, an expansion of 'click and collect' at stations, use of sustainable modes such as cargo bikes and restrictions on workplace deliveries in central London.
- 4.3 In the current investigation, we have also considered whether making deliveries by new modes could also contribute to this; in particular, the use of drones. Broadly speaking, 'drone' is a term used to describe a vehicle that is controlled remotely. It has mostly been used to describe aerial vehicles without a pilot, although we have also seen ground-based drones operating in London (also sometimes referred to as droids or delivery robots). Drones can also be autonomous.

Use of drones in London

- 4.4 Drones are already used in London for a variety of purposes. Many individuals use airborne drones for recreation, for instance. In late 2017 the Metropolitan Police initiated a drone trial programme, with plans to use them to search for missing people or suspects, undertake weapon sweeps or identify cannabis factories.⁵⁵ TfL also envisages using drones to manage the transport network:

“We do see clearer value in drones for certain functions, such as our use of the technology for asset management purposes. This could allow us to improve the safety of staff by reducing exposure to hazardous environments, such as monitoring live electrified track or using harnesses for bridge and tunnel inspections.”⁵⁶
- 4.5 Our investigation has mainly focused on the potential commercial use of drones for deliveries. This is not yet happening with airborne drones in London, although some companies are pursuing this delivery mode: retailer Amazon has experimented with drone deliveries in Cambridge,⁵⁷ while logistics firm DHL has an established drone programme in Germany.⁵⁸
- 4.6 Ground-based drones are already being used for deliveries in London, although so far this is on a small scale. During this investigation we visited the London base of Starship Technologies, a company using this technology to deliver takeaway food on behalf of a number of retailers, including Just Eat and Domino's Pizza. The company has operations in 100 cities around the world.
- 4.7 The likelihood is that drones would be used for the 'last mile' in the distribution chain, toward the customer's home or workplace. This stage of the journey is often the most inefficient, in that the number of vehicle miles

undertaken per item is much higher. Furthermore, drones are not likely to have as long a range as road vehicles, in large part because of battery life.⁵⁹



Starship delivery robot at pedestrian crossing, Southwark⁶⁰

- 4.8 We have sought to establish the likely scale of drone use for deliveries in London. The Institution of Engineering and Technology told us their use to deliver small packages of high importance is likely to increase rapidly, although they may not be cost effective compared to road delivery for larger items.⁶¹ Professor Alan McKinnon of Keuhne Logistics University in Germany told us that the economics of drone delivery in urban areas are likely to mean they are not used on a large scale in London:

“Drones’ competitive advantage against vans tends to increase as the density of the population diminishes and so there would be a role for it in those [remote] areas.... Conversely, I do not see much future for the use of drones in inner urban areas where there is a dense population and where you have all sorts of safety and security issues about drones overflying large populations and buildings.”⁶²

- 4.9 The use of drones will also be affected by the regulation put in place to control them, or the lack of regulation, as we discuss in the next section. The Government has announced its intention to publish a draft Drones Bill in Spring 2018.⁶³
- 4.10 At present, we do not know the likely scale of drone use in London. A number of companies are considering or planning their use for deliveries. However, this seems likely to be limited to the ‘last mile’ of the delivery chain, and even

there the logistical challenges may prove very difficult. Our best estimate is that they will replace some deliveries currently made by road vehicles, but probably not to the extent of having a significant impact on traffic congestion levels. Even on a small scale, however, drones would have an impact on Londoners and need to be effectively controlled.

- 4.11 We expected that the Mayor would address drones in his upcoming Transport Strategy. His draft strategy, however, does not mention drones.⁶⁴ This is a missed opportunity to consider the potential risks and benefits of this technology and to set out how the Mayor and TfL intend to respond. The next step the Mayor and TfL can take to inform this discussion is to produce much clearer projections on the likely use and impact of drones.

Recommendation 7

The Mayor and TfL should seek to understand the likely scale and impact of commercial drone use in London, both airborne and ground-based. Any existing use of drones in London should be monitored, and discussions should take place with the logistics and retail industries and other stakeholders.

TfL should produce new projections for drone use in London to inform continued debate about how to regulate and manage their operations. We ask the Mayor and TfL to produce initial findings and projections by the end of May 2018.

Management and regulation

- 4.12 Realising the potential benefits of drones and minimising the risks requires effective regulation of how the technology is used. This should support drone use where appropriate, while ensuring drones do not have a negative impact on Londoners and the transport network.
- 4.13 At present, the Civil Aviation Authority is responsible for regulating London's airspace. The CAA's remit, however, does not extend to all airspace or all types of aircraft. Further information is provided in the box below. TfL does not have any powers in this area, although some boroughs have imposed byelaws on the use of drones in their areas.
- 4.14 We have explored some of the safety risks and environmental impacts of drones. For airborne drones, there are risks of collisions with buildings and other aircraft, which would need to be controlled. Drones would require safe landing zones if delivering packages, which may not always be available in densely populated areas.⁶⁵ They would also create noise pollution, which would be exacerbated if used in large numbers.⁶⁶ There are also privacy concerns if drones fitted with cameras are flying in populated areas. TfL has

set out its own concerns about airborne drones in a submission to our investigation:

“Drones must overcome a series of safety, noise and legal hurdles, in addition to gaining public acceptance, before their commercial use is acceptable. Prime among these concerns is the irresponsible use of this technology and the use of airspace above a crowded city, as London’s airspace is some of the busiest in the world. It is also possible that drones flying overhead could have an impact on the attractiveness of the street environment below.”⁶⁷

4.15 For droids, or ground-based drones, concerns are focused on how they interact with people on pavements and other pedestrian areas. As we heard from Living Streets:

“Pedestrians already find the footway littered with obstructions, including street furniture and vehicles parked on the pavement. Pavement-based droids are an additional obstacle and introduce a new threat because they are moving. They will particularly affect blind, partially sighted and disabled users of the pavement.”⁶⁸

Drone legislation

A range of laws and regulations apply to the civilian use of drones in the UK:

- Legislation relating to drones is mainly contained in the Civil Aviation Act 1982 and the Air Navigation Order 2016, with additional guidance set out by the Civil Aviation Authority (CAA).
- All airborne drones must be flown within direct, unaided visual line-of-sight of the pilot, or operator.
- Drones weighing more than 7kg must not be flown at a height of more than 400 feet or no further than 500 metres from the pilot, in controlled airspace, or within an aerodrome traffic zone during the notified hours of watch of the air traffic control unit.
- Drones fitted with cameras must not fly within 50 metres of a person, or within 150 metres of congested areas or large gatherings of 1000 or more people.
- Commercial operations require permission from the CAA. Pilots working for organisations conducting regular flights must undergo assessment by the CAA.
- The Air Navigation Order 2016 defines congested areas as “any area of a city, town or settlement which is substantially used for residential, industrial, commercial or recreational purposes”.
- Ground-based drone use is not governed by legislation. In London, one operator has agreed memorandums of understanding with boroughs to sanction their use.

4.16 Our assessment of the ground-based drones we viewed in action during our investigation was that they interacted safely with pedestrians. Safeguards have been put in place to ensure this is the case. However, if used in larger numbers it is more likely these drones would cause an obstruction to pedestrians. Even if they do not present a significant risk of injury, they may still get in the way of Londoners making use of pedestrian space; this outcome should be avoided.

4.17 A recurring concern of our investigation is that an effective system for controlling drones has not yet been put in place. Referring to the use of drones for small packages, the Institution of Engineering and Technology told us:

“But even this relatively low risk activity cannot happen until a safe control system is in place. As far as we are aware, thinking on how such control systems might be established and operated is not advanced and, therefore, we cannot see even small unmanned aircraft systems (SUAS) coming under effective airspace control over or close to urban areas for at least 5 years.”⁶⁹

4.18 London Councils specified the range of issues that needed to be addressed in designing a management system for drones:

“We suggest that access to airspace will need to be managed carefully. How much will depend on how prolific they become. Drones may require different legislation depending on who is operating them. If they are owned by a family or person (like a car) a driving-licence style approach might be appropriate, overseen by a body similar to the Drive and Vehicle Licensing Agency. Were their usage and ownership more exclusive, for example only by companies, a different way of managing access might be more appropriate and may require all the highways authorities to come together...”⁷⁰

4.19 Another issue brought to our attention is that in the future we are likely to see interchangeability and close interactions between different forms of transport. Some drones may carry passengers; for instance, it is conceivable that low-flying drones could be used to establish new river crossings over the Thames. Some vehicles may be able to operate on the surface and in the air, in which case it may be beneficial to have an integrated system that can control and monitor vehicles wherever they go.⁷¹

4.20 There is a pressing need for clarity about how the use of drones in London will be overseen in the future. There are indications that the private sector will seek to use drones for deliveries, both in the air and on the ground, although the viability of doing this in London is unproven. It is vital that the Mayor and TfL are part of the discussion about this, and shape the future regulation of drones. At present we do not see this happening. Although we understand the Mayor’s and TfL’s concerns about how drones may be used in London, they need to be proactive in responding to this technology if the mistakes of the

past are to be avoided.

Recommendation 8

The Mayor and TfL should proactively engage in discussions with the Government, London Boroughs, the drone industry, National Air Traffic Services and other relevant stakeholders about the future control system for drones in London, ahead of the expected publication of the Government's draft Drone Bill in Spring 2018.

TfL's aim should be to agree a common set of principles for a new control system, including the necessity for new TfL powers in this area.

Consideration should also be given to the need for an integrated control system for ground-based autonomous vehicles and airborne drones, and how this could be implemented.

We ask the Mayor and TfL to update the committee by the end of May 2018 with details of discussions they are undertaking.

Appendix 1: Views and information

Meetings

We met the following guests at our committee meeting on 12 September 2017:

- Jonn Elledge, Editor, CityMetric
- Dr Maria Kamargianni, University College London
- Chris Lane, Head of Smart Travel, Transport for West Midlands
- Brian Matthews, Milton Keynes Council
- Professor Natasha Merat, University of Leeds
- Dan Phillips, GATEway project/Royal College of Art
- Rob Wallis, Transport Research Laboratory
- David Wong, Society of Motor Manufacturers and Traders

We met the following guests at our committee meeting on 10 October 2017:

- Henry Harris-Burland, Starship Technologies
- Tony Henley, Royal Aeronautical Society (RAeS)
- Michael Hurwitz, Transport for London
- Professor Alan McKinnon, Keuhne Logistics University
- Lauren Sager Weinstein, Chief Data Officer, Transport for London

During the investigation Committee Members and officers have also met with Citymapper, Drone Major Group, Faxi, ofo, Travel ai, and Via.

Site visits

We visited Starship Technologies in Southwark on 1 November 2017. We visited the GATEway project in Greenwich on 13 November 2017.

Submissions

We received submissions from the following individuals and organisations:

- British Standards Institute
- Camden Cycling Campaign
- City of Westminster
- Cross River Partnership
- DJI
- DriveNow
- Emovis

- FiveAI
- Flit Technologies
- Gett UK
- Goodyear Dunlop Tyres
- Govia Thameslink Railway
- HERE Technologies
- Inrix
- Institute of Mechanical Engineers
- Institution of Engineering and Technology
- Kingston Environment Forum
- LEVC
- Living Streets
- London Councils
- London, East and South East Region of the Trades Union Congress
- London TravelWatch
- Professor David Metz, University College London
- MaaS Global
- NATS
- Norton Rose Fulbright
- ofo
- PCH Innovations
- Policy Network
- Royal Aeronautical Society
- RMT
- Society of Motor Manufacturers and Traders
- Starship Technologies
- Sustrans
- Transport for London
- University of Southampton, University of Westminster, University of Lancaster and University College London (Freight Traffic Control 2050)
- Dr Chris Tennant, London School of Economics & Dr Sally Stares, City, University of London
- Wayfinder
- WSP

References

- ¹ Transport for London, [Travel in London – Report 10](#), December 2017. In 2016, 10 million journey stages were undertaken in London by car (driver or passenger) in an average week, compared for instance to 6.6 million by walking, 6.2 million by bus, and 3.7 million by tube.
- ² Written submission from Transport for London, September 2017. Written submissions are available to download via: <https://www.london.gov.uk/about-us/london-assembly/london-assembly-publications?order=DESC>
- ³ Written submission from London Councils, October 2017
- ⁴ London Assembly, [London Stalling: Reducing traffic congestion in London](#), January 2017
- ⁵ Written submission from RMT, October 2017
- ⁶ Written submission from Gett UK, October 2017
- ⁷ London Assembly, [London stalling: Reducing traffic congestion in London](#), January 2017
- ⁸ Evening Standard, [Cycle hire company oBike accused of ‘littering London’s streets as bikes vandalised](#), 21 July 2017
- ⁹ Michael Hurwitz, TfL, Transport Committee meeting, 10 October 2017. Transcripts of committee meetings are available via: <https://www.london.gov.uk/moderngov/ieListMeetings.aspx?Committeed=173>
- ¹⁰ Written submission from ofo, October 2017
- ¹¹ Written submission from Institution of Engineering and Technology, November 2017
- ¹² TfL Customer Service and Operational Performance Panel, [‘Future Mobility Business Models’](#), 13 July 2017
- ¹³ Written submission from Transport for London, September 2017
- ¹⁴ BBC News, [Hammond: Driverless cars will be on UK roads by 2021](#), 19 November 2017
- ¹⁵ Dan Phillips GATEway Project; Professor Natasha Merat, University of Leeds; David Wong, Society of Motor Manufacturers and Traders, Transport Committee meeting, 12 September 2017
- ¹⁶ Text adapted from Isabel Harner, IoT For All, [The 5 Autonomus Driving Levels Explained](#), 6 November 2017

- ¹⁷ Written submissions from Goodyear Tyres; British Standards Institute; Dr Chris Tennant, London School of Economics & Dr Sally Stares, City, University of London, October 2017
- ¹⁸ Rob Wallis, Transport Research Laboratory, Transport Committee meeting, 12 September 2017. The Committee uses the term ‘collision’ rather than ‘accident’. However, terminology used in direct quotes from contributors has not been edited.
- ¹⁹ Written submission from London TravelWatch, October 2017
- ²⁰ Written submission from Cross River Partnership, September 2017
- ²¹ Mayor of London, [Mayor’s Transport Strategy: Draft for public consultation](#), June 2017
- ²² Written submission from Professor David Metz, September 2017
- ²³ Written submission from British Standards Institute, October 2017
- ²⁴ Written submission from Institution of Engineering and Technology, November 2017
- ²⁵ London Assembly, [London Stalling: Reducing traffic congestion in London](#), January 2017
- ²⁶ Written submission from Westminster City Council, September 2017
- ²⁷ Written submission from London TravelWatch, October 2017
- ²⁸ Mayor of London, [Mayor’s Transport Strategy: Draft for public consultation](#), June 2017
- ²⁹ Dan Phillips GATEway Project, Transport Committee meeting, 12 September 2017
- ³⁰ Professor Natasha Merat, University of Leeds, Transport Committee meeting, 12 September 2017
- ³¹ Written submission from DriveNow, October 2017
- ³² Transport for London, [A Car Club Strategy for London](#), 2015
- ³³ David Wong, Society of Motor Manufacturers and Traders, Transport Committee meeting, 12 September 2017
- ³⁴ BBC News, [‘No major incidents’ as driverless bus launches in Estonia](#), 2 August 2017
- ³⁵ London Assembly, [Driven to Distraction: Tackling safety on London’s buses](#), July 2017
- ³⁶ London Assembly, [Report impact review](#), December 2017
- ³⁷ Rob Wallis, Transport Research Laboratory, Transport Committee meeting, 12 September 2017

- ³⁸ Written submission from London Councils, October 2017
- ³⁹ Transport for London, [Santander Cycles performance to end of September 2017](#), 2017
- ⁴⁰ Living Streets has argued that dockless bikes should be parked on roads where possible, or not in areas that will obstruct pedestrians if on pavements. Written submission from Living Streets, November 2017
- ⁴¹ Richard Dilks, London First, Transport Committee meeting, 10 January 2018
- ⁴² Written submission from DriveNow, October 2017
- ⁴³ Dr Justin Spinney, University of Cardiff, Transport Committee meeting, 10 January 2018
- ⁴⁴ Transport for London, [Dockless bike share code of practice: For Operators in London](#), September 2017
- ⁴⁵ Michael Hurwitz, TfL, Transport Committee meeting, 10 October 2017
- ⁴⁶ The Guardian, [Your Chariot awaits: shuttle bus service gets green light in London](#), 29 January 2018
- ⁴⁷ Professor Maria Kamargianni, University College London, Transport Committee meeting, 12 September 2017
- ⁴⁸ Chris Lane, Transport for the West Midlands, Transport Committee meeting, 12 September 2017
- ⁴⁹ Michael Hurwitz, TfL, Transport Committee meeting, 10 October 2017
- ⁵⁰ London Assembly, [London's bus network](#), August 2017
- ⁵¹ Written submission from MaaS Global, October 2017
- ⁵² Written submission from Transport for London, September 2017
- ⁵³ Professor Maria Kamargianni, University College London, Transport Committee meeting, 12 September 2017
- ⁵⁴ Greater London Authority, [Smarter London Together](#), January 2018
- ⁵⁵ Metropolitan Police Service, [Met Police trials use of drones](#), 11 September 2017
- ⁵⁶ Written submission from Transport for London, September 2017
- ⁵⁷ The Telegraph, [Amazon makes first drone delivery to house in Cambridge](#), 14 December 2016
- ⁵⁸ DHL, [Successful trial integration of DHL parcelcopter into logistics chain](#), 5 September 2016
- ⁵⁹ Notes of visit to Starship Technologies, 1 November 2017

- ⁶⁰ Image from Starship Technologies / [Twitter](#)
- ⁶¹ Written submission from Institution of Engineering and Technology, November 2017
- ⁶² Professor Alan McKinnon, Keuhne Logistics University, Transport Committee meeting, 10 October 2017
- ⁶³ Department for Transport, [New powers for police to address illegal and unsafe use of drones](#), 26 November 2017
- ⁶⁴ London is one of five cities participating in Nesta's Flying High challenge, to design how drone technology could operate in complex city environments. See: [flyinghighchallenge.org](#)
- ⁶⁵ McKinsey & Company, [Parcel delivery: The future of the last mile](#), September 2016
- ⁶⁶ Written submission from Cross River Partnership, October 2017; Professor Alan McKinnon, Keuhne Logistics University, Transport Committee meeting, 10 October 2017
- ⁶⁷ Written submission from Transport for London, September 2017
- ⁶⁸ Written submission from Living Streets, November 2017
- ⁶⁹ Written submission from Institution of Engineering and Technology, November 2017
- ⁷⁰ Written submission from London Councils, October 2017
- ⁷¹ Informal meeting with Drones Major Group, 12 January 2018

Other formats and languages

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Chinese

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Hindi

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Arabic

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Gujarati

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Greater London Authority

City Hall
The Queen's Walk
More London
London SE1 2AA

Enquiries 020 7983 4100
Minicom 020 7983 4458

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