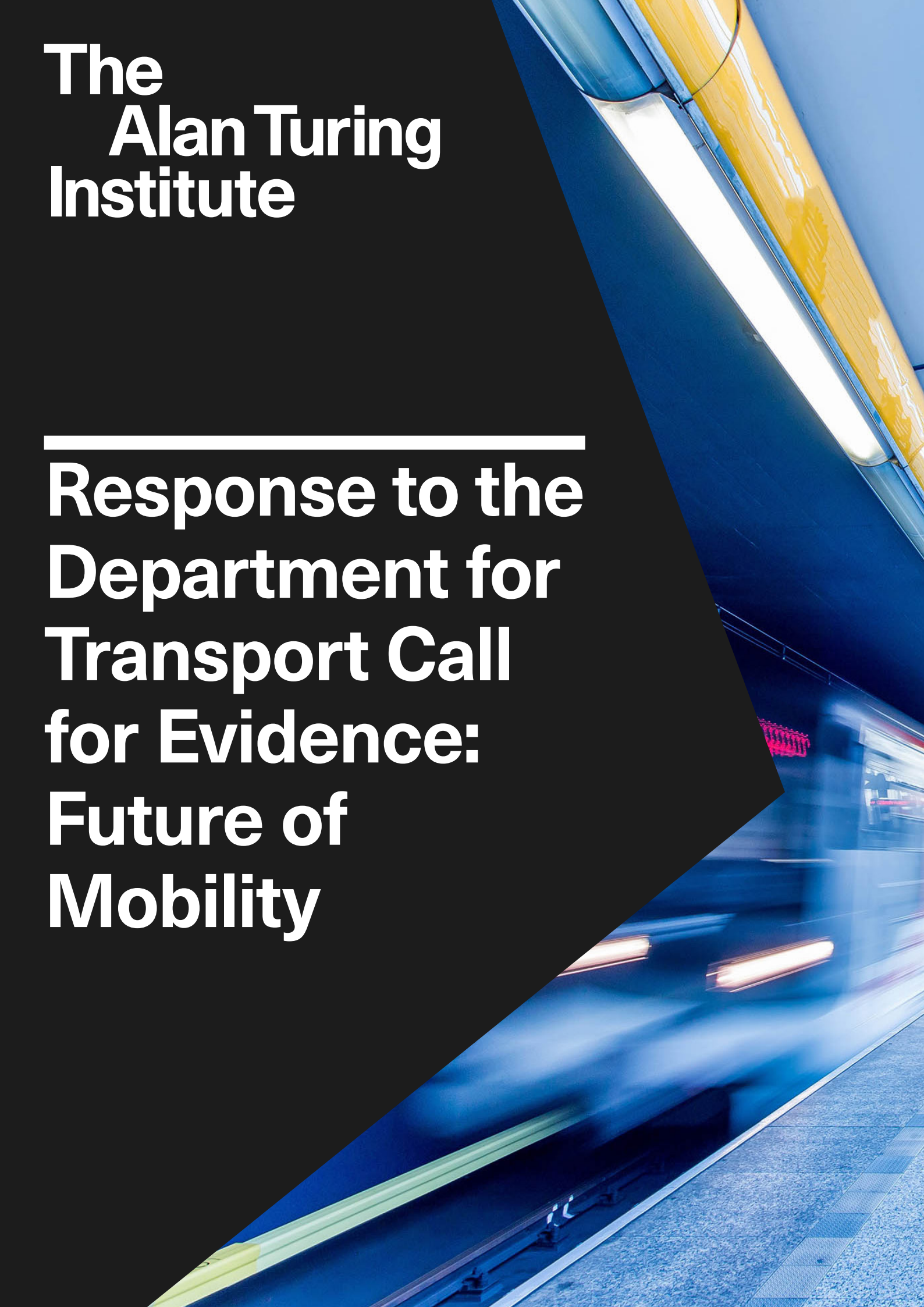
The Alan Turing Institute

Response to the Department for Transport Call for Evidence: Future of Mobility



The Alan Turing Institute response to the Department for Transport Call for Evidence: Future of Mobility

This document provides the response of The Alan Turing Institute to the Department for Transport Call for Evidence to inform its Future of Mobility Strategy and the wider Future of Mobility Grand Challenge under the Industrial Strategy. This response was put together on behalf of the Institute by Damon Wischik (Turing Fellow), Mark Birkin (Turing Fellow), Neil Walton (Turing Fellow), Alan Wilson (CEO), Helena Quinn (Senior Strategy Officer), Cosmina Dorobantu (Policy Fellow), in consultation with Frank Kelly (Turing Board of Trustees).

As the National Institute for Data Science and Artificial Intelligence, The Alan Turing Institute strongly supports the Secretary of State's observation in the Foreword to this Call for Evidence that "the Future of Mobility will… capitalise on UK strengths in Artificial Intelligence and Data".

In order to leverage the power of data science and artificial intelligence (AI) to the maximum, the following elements are especially crucial:

(1) Development of training and skills in AI and data science to increase capability for innovation across the whole sector including new business start-ups, planning agencies, transport engineers and manufacturers;

(2) The power of data is greatly enhanced by the ability to combine and link data from multiple sources. UKRI is developing infrastructures to allow such sharing to take place within environments which are secure and trustworthy. Government departments, local authorities and business organisations should be encouraged to share data through these infrastructures;

(3) Data is proliferating at an increasing rate, especially from sensors, apps, in real-time and across whole populations. Demand management through positive incentives (like social nudging) or deterrents (e.g. congestion charging) can be developed, such as through simulation, optimisation and natural experiments, but only with additional funding for research. The Alan Turing Institute is ideally placed to stimulate new research through its national networks;

(4) Multidisciplinary research and innovation which places future mobility in the context of changing demographics, innovation in engineering, and in medicine – especially medical bioinformatics and health data research;

(5) Designing future transport solutions must take a system view of how the different modes interact, and the flow of users between them;

(6) Local government must be given the tools and enforcement mechanisms to manage the interaction between different transport modes and providers if Mobility as a Service (MaaS) is to be achieved.

Question 1: We have identified above the main technologies and trends that we believe will affect urban mobility in the coming decades. Are there any missing?

1. Here, we will address considerations that may be missing under the identified trends.
2. Across the trends identified, there will be investment and innovation, however local government infrastructure may not be able to support the changes they bring about. Transport planners and modellers need to be able to engage with them. At present, transport problems are addressed through models and simulations that will have to adapt, with associated changes in skills required for local authority transport planners.
3. Another consideration for local government and urban planners is that they must, alongside transport providers, become stakeholders in the vision being developed by private companies such as Uber and Lyft, who see a future in which there is no more private vehicle ownership in city centres. If these players do not become stakeholders, this vision will pass them by and become reality without them, meaning they will not have an ability to shape that reality. This is where collaboration with the research expertise in data science and artificial intelligence within The Alan Turing Institute can support national and local government bodies in this area.
4. A framework for considering how society can benefit from the development of these new technologies and trends is the Shared Mobility Principles.
5. Currently, skills in Python and R software are needed to write the myriad lines of code necessary to answer more complex questions of interest to urban planners, to help them understand the various interests of transport system users. There is not yet any standard software tool that is straightforward enough to permit widespread use of data-driven decision making about transport in local authorities.
6. To incentivise how people move around a city, the government could have an app that prices the way people commute. For example, the government could price routes more cheaply if they include a significant walking or cycling component. The government could hereby change the priorities in different parts of the city.

Question 2: We want our urban infrastructure to support these trends and deliver benefits to society. What changes are required to urban infrastructure?

7. Local authorities need to be able to monitor and enable different transport modes to interact. One way to do this is where a transport provider has an app that supplies a ticket that a user can scan on the underground, then also scan on the bus for the next part of their journey. A start-up called Whim[1] has trialled this concept of integrated ticketing in Helsinki, and is starting a trial in Birmingham. However, if this is left solely to private companies, any externalities cannot be mitigated, such as from congestion. The city would need to monitor this process and system so that the ticket and transport modes can be priced appropriately to incentivise different ways of travelling to promote societal wellbeing.

[1] See https://whimapp.com/uk/

8. In designing urban infrastructure, a key consideration for urban transport designers is being aware that travellers behave in a way that follows their own interests; however, collectively this does not meet society's interests. Sensitivity analysis to understand travellers' behaviour is crucial.

Question 3: What evidence do you have to enhance our overview of the impacts of these trends on cities and their use of urban space? Are any impacts missing?

9. For the trend towards automation, one impact will be on infrastructure to enable autonomous vehicles to operate safely. This infrastructure could also interact with vehicles to respond to environmental conditions – for example, where a hybrid vehicle enters a high emissions zone, the infrastructure it is connected to could prompt the vehicle to go into electric mode to reduce emissions. This would be more feasible for public transport than for privately owned vehicles.

Question 4: What possible market failures might emerging technologies and trends give rise to that could require intervention by Government?

10. The Mobility as a Service (MaaS) market could have serious market failures associated with it. In London, for example, buses are controlled by the local authority, meaning that provision of service between different transport modes can be coordinated. However, in other cities such as Manchester, the city has no control over its buses, with the implication that the different transport services cannot be coordinated to make a MaaS system work.
11. Outside London, the capacity to have a MaaS market maker is limited. Policymakers must provide incentives for different transport modes to cooperate and work together. In the absence of these incentives, private service providers will produce a federated system that does not link up, and MaaS will not be possible.
12. In addition, the government's strategy for measuring emissions in cities is inadequate. The Saturn model is used to look at the equilibrium flow of traffic, from which the amount of traffic on a road can be deduced, and based on this an estimation of the emissions is made. This is then used to decide emissions targets. There is currently no way to measure actual emissions in different cities in the UK, and then link these to policy. If this were the case, local authorities would be able to control emissions in different neighbourhoods using real emissions data.
13. Despite recent advances, pollution sensor networks are still extremely fragmented – for example, the city of Leeds with a population of more than 750,000 has only seven fully specified sensors. Mathematical techniques for the interpolation of air quality metrics are needed, as well as engineering solutions to increase the portability, cost effectiveness and functionality of devices.
14. An important further consideration is that private companies such as Uber do not reduce the number of trips people make, but do add cars to the road because they travel empty between trips, which also has implications for pollution levels and congestion.

Question 5: We are committed to a transport network that works for everyone. What role should Government play in helping ensure that future transport technologies and services are developed in an inclusive manner?

15. To achieve the ambition of mobility as a service (MaaS) it is important to consider how various groups, such as the elderly, people with disabilities, or those who cannot afford technologies like smartphones or a data package, will interact with such services. Even if there is a cutting edge smartphone app, if these groups are unable to use it, they are limited in the transport modes they can access, and the extent to which they can use them.
16. Developing inclusive plans and strategies for future transport technologies and services is an area for research. The Alan Turing Institute is well-positioned to support this research through its unique convening power.

Question 6: How can Government ensure that future urban transport systems support people's wellbeing and flourishing, healthy communities?

17. Demand management is the future of transport. The key to designing transport systems that are able to meet the needs of the population is the ability to understand why people make the choices they do, and how their habits will change over time.
18. Whilst it may be true that 'on average people are travelling and driving less' (Call for Evidence, para 1.2) the picture is mixed. For example, of all the major cities only London has experienced a reduction over the last decade, traffic on the national trunk network continues to grow, and the overall trend is now upwards since the last economic downturn. The UK continues to suffer from the worst road congestion in Europe.[2]
19. Pilot projects that test a concept must be provided follow-on funding to allow them to scale up and turn into fully-fledged transport solutions. Often this is not the case.
20. Decisions that one department or authority makes about the transport system will have an impact on the choices of the end-user, and thus on other departments. A system view is needed that takes proper account of what the end user is thinking, and how interventions impact on what the user does. Consider the following examples:
    a. The Alan Turing Institute is currently undertaking a project in collaboration with the Toyota Mobility Foundation that is looking into improving traffic control by simulating what happens when multiple sources of data can be pulled together. Currently, traffic control is undertaken through the knowledge contained in the heads of individual traffic controllers. There is little understanding of what is happening over time and what that data could tell them. The impact of certain interventions cannot be investigated as there is no infrastructure for this at present.

[2] See http://inrix.com/press-releases/inrix-reveals-congestion-at-the-uks-worst-traffic-hotspots-to-cost-drivers-62-billion-over-the-next-decade/

b. Consider an example where there is congestion in one area of a city, so the traffic controllers decide to limit the traffic in that area by putting up some barriers or creating a diversion. They may achieve the objective of reducing the congestion in that chosen spot, however that intervention has consequences on the choices that bus users make. They may consider that because of this change in their journey, the bus is not reliable, so may choose another mode of transport, which may have ramifications for the other chosen mode.

c. In a related scenario, the traffic controller makes a decision about traffic lights and timings for a particular area, and simultaneously the mayor has set an objective about healthy streets, encouraging people onto public transport or encouraging people to walk, each of these decisions will impact on the other party.

21. Changing the way people use transport systems involves understanding the incentives under which they make decisions. In areas of high urban density, overcrowding of bus and train services is a regular and significant concern. One could use a purely financial incentive, however during an experiment in Singapore Turing Fellow Damon Wischik found that minimal financial incentives to individuals did not produce a change in how many people used trains to commute to work from 8:00-8:30am. However, when his team switched to 'social nudging', in which they asked people to work with a friend to reach a particular target time for commuting, and thereby collect points together, they were successfully able to reduce the demand on the trains during that particular period of time.

Question 8: What changes do you expect to the mobility-related labour market? How can Government best support people and businesses affected by these changes?

22. There is a lot of concern around transport workers losing their jobs in large numbers. However, this is not likely to happen immediately. More likely is that workers in the mobility-related labour market will make better use of the information available to estimate traffic flows.

23. Companies such as Lyft and Uber project themselves as AI automation companies, however they are essentially app companies that perform the same function as a taxi company would – they pick up a person from one location and drop them off at another. However with a better pool of data and resources they can offer a better service.

24. Government must enforce existing employment rules for workers employed by these new companies.

Question 9: What other actions should Government prioritise to help people, businesses and cities prepare for the future?

25. If the aim is to realise MaaS Government needs to look into how this will operate in practice for local authorities. This could either be *laissez faire* where private

companies are allowed to organise themselves; or it could be where the local authority effectively runs a cartel of providers; or it could have complete control over the whole local transport system. The legal issues of the local authorities' stake in the chosen arrangement would have to be considered.

26. There will have to be changes in how infrastructure operates. Currently local authorities are working with infrastructure that is thirty years old, in comparison with companies that have modern technologies. The pipeline of bringing cutting edge research into local transport authorities is broken. Up to date research goes into consultancy companies, which is then packaged and sold to local transport authorities; this often takes 20 years to occur. Private companies can operate much faster than this.
27. There are skills shortages in transport in local authorities – particularly there is a shortage of training of people who can do modelling. Those operating with outdated modelling techniques are designing outdated infrastructure models.
28. Relatedly, the analytic capability of these models needs to include the understanding of how people use transport modes – this should be incorporated particularly into generalised cost functions that allow city planners to explore new transport modes and their impact.

Question 10: Which 'missions' in the areas we have identified could be most effective in driving innovation and investment?

29. *Safer streets* and *Liveable cities*: innovation will result in incremental changes. For example, there is no evidence that autonomous vehicles have a higher or lower death rate than traditional cars. Smaller changes to existing vehicles can have a large impact, such as the Israeli government's policy that all cars have a detector attached that sound when there is about to be a collision. Early warning systems is where technology will advance; for example, the Volvo XC60 has never caused a fatality because of its collision avoidance technology; or on-vehicle automation and vehicle-to-infrastructure communication about incidents.
30. *Improved access to transport*: efficiencies in cities are unlikely to result in greater resources for more rural areas.
31. *Cleaner freight*: the use of drones for freight must be carefully considered – there will be various companies operating these drones, but who would decide what routes they should use, and whether these are safe? A new automated flight control system would be needed to determine where drones can fly so that they do not crash into each other, and where they should or should not fly.

Question 11: How should Government funding be targeted to help UK innovators build and scale transport solutions?

32. Transport authorities and operators currently use a standard model of transport flows, usually using consultants. This must be updated, for example to be able to handle new

modes of transport. Funding could be targeted towards this, and the modes could then be made available through a national government initiative to all authorities and transport operators.

33. Government funding could be used to answer several key questions, including:
    a. How do you deal with the skills shortage in data science in transport authorities?
    b. How do you deal with the relationship between large sets of fleets?
    c. How do you legislate and run large consortia of different transport providers in MaaS?
34. The Alan Turing Institute works together with partners from industry, government and the third sector to develop innovative solutions to real-world challenges. More funding for collaborative research between academic institutions and industry partners could significantly boost the ability of innovators to find and build solutions to transport problems.

Question 12: Which laws or regulations not currently being addressed need to be amended or created to help harness the benefits and mitigate any risks associated with new transport technologies or services?

35. Previously mentioned gaps include those for measuring emissions and regulating new freight modes such as drones.
36. A significant regulatory challenge is how to reconcile many types of transport providers with the encouragement of good social outcomes.
37. For cities (outside London) to achieve coordinated MaaS, incorporating environmental and health benefits, they are likely to need legislation to permit them to impose regulation and incentives on transit providers. For example, they might require taxi companies to provide trip data or surge pricing data, or they might impose a no-passenger surcharge on taxis.
38. Privacy issues and access to data are further issues – to what extent should local authorities have access to the same data as Google or Uber?

Question 13: How could the experience of working with local and/or national regulators be improved for transport innovators?

39. Local authorities and national regulators need to be able to work on a much faster timescale in order to get the greatest benefits of working with transport innovators. Start-ups have innovative approaches to future transport problems, however a key barrier to their success in working with city planners is that the relationship building and project development phase takes too long; often up to three years. Start-ups have to operate at a much faster rate to survive. An unfortunate side effect of this slow development of projects in local authorities is that aggressive, antisocial companies spring up and set the agenda without trying to coordinate with what cities want.

40. At present, there is a relatively small number of large companies that undertake most big infrastructure projects, such as Thales and Siemens. Innovative transport start-ups tend to be bought out by these larger companies, which leads to a less federated marketplace, with less competition, resulting in software lock-in. This slows innovation.

Question 14: What further actions should Government prioritise for resolving barriers to data sharing and use in the mobility sector while protecting privacy and security?

41. Increasing volumes of data are becoming available from sources such as smart tickets, personal journey planning and social media apps, and traffic sensors. Data availability will continue to accelerate with the advent of 5G mobile networks. The computational systems of individual vehicles will continue to become more complex, in particular with growing interaction between autonomous vehicles. However in the absence of uniform open standards for the data which are generated by vehicles and networks, variations in both content and quality will persist. Through our membership and broader influence, The Alan Turing Institute will continue to promote advanced data science methods including compensation for bias, imputation and predictive analytics.
42. New infrastructure is needed in order to promote increased sharing of mobility data as open data or within secure and trusted environments. The initiative of UKRI and its constituent Research Councils to create Research and Innovation Infrastructures (e.g. the ESRC's Big Data Network, Urban Big Data Centre and Consumer Data Research Centre) is an important contribution. Building public confidence and trust e.g. through new structures such as the Ada Lovelace Institute will be crucial.
43. Countries that are able to combine different data sets together to understand their populations will be able to take advantage of information on what choices are being made and why. The United States has a lawsuit-conscious population, and the implementation of GDPR in Europe mean there is potential for paranoia developing around data use, leading to possible stifling of innovation in these regions. Finland and Estonia have much greater access to the data needed to stitch together the 'stories' of people's choices.
44. Transport planners do not have a long term data vision to tie together what has been happening in the past, and what ought to happen in the future. Planners in smaller cities have even less likelihood of having access to this kind of data.
45. City planners and local authorities must be empowered to establish their own regulatory authority to be able to have flexibility in policy development for that local area. The regulatory mechanisms that cities have is severely lacking. Cities need legislative instruments to be able to mandate data sharing agreements.
46. They need power over their own legislative instruments for a further purpose; to give them teeth against private companies. For example, cities have the power to regulate

what they themselves build, and pay for products and services. This can create a dependency; if a company has been running a bus lane, and then decides to withdraw it, if the city finds it useful the company asks for payment to put it back into operation. The city therefore effectively subsidises the bus lane.

47. De-risking data sharing is another priority.

Question 15: Do you have any further suggestions or comments on the subject of this call for evidence?

48. Future mobility cannot be considered in isolation from other areas of medicine and science. For example, the long term respiratory impacts of exposure to poor air quality, future demographic and social influences on travel demand/ behaviour and engineering solutions for infrastructure and devices demands a multidisciplinary approach to Future Mobility research and business solutions. Through a research network which spans Urban Analytics, Data Centric Engineering and Health Data Research, The Alan Turing Institute is ideally placed to encourage such research and innovation amongst its academic, commercial and government partners.

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