KANTAR PUBLIC=

Department for Transport

Department for Transport
Future Roads: Public Dialogue
Exploring the public's reactions to future road technologies

Final report

May 2018

Contents

Executive Summary

1. Research background and context

This report presents findings from a public dialogue carried out with 99 members of the public[1] regarding four emerging road technologies – **electric vehicles, automated vehicles, connected vehicles and real-time information,** and **platooning** – and a range of **new mobility service models** that use these technologies**.** Over the course of three reconvened workshops lasting a total of 2.5 days, participants – primarily road users – were provided with information about the technologies, exposed to future scenarios, took part in activities and engaged in conversation with stakeholders from government, business and academia. The dialogue set out to explore:

- Current public attitudes toward and experiences of the technology service areas
- Expectations, hopes and fears about how the technology service areas might be employed 15-30 years from now, including potential barriers and enablers to uptake
- Potential responses to the technology service areas in terms of journey choice, mode of transport and other second-order effects, such as where people might choose to live / work

The following summary pulls out the key findings from across the dialogue and mirrors the structure of the main report (accompanying summaries can be found at the start of each section).

2. Current relationships with driving

Responses to the technology service areas were grounded in existing relationships with driving – understanding current attitudes and behaviours around driving provides the context needed to effectively interpret reactions to the prospect of change.

Most participants held strong practical and emotional attachments to driving, which was seen as both an integral part of managing the demands of modern life and a symbol of personal control and freedom. They tended to report an active enjoyment, which was often associated with a 'driving on the open-road' vision of freedom portrayed in car-advertising. The car was also valued as an extension of people's personality and personal space. This idealised vision of driving connected to emotional narratives about human freedom and independence, where driving is an action in which people can exert control over their lives, their personal space and their touch-points with the outside world.

This contrasted strongly with the reality of driving, which was largely felt to be characterised by congestion. However, the frustrations this caused were more than offset by the convenience, comfort and privacy offered by travelling in your own vehicle. Car ownership was considered the norm by most participants and seen as not just desirable but necessary by many. This was particularly the case outside of London, where there were seen to be few viable alternatives to car travel for most.

Transport decisions were led by consideration of individual factors, relating to journey time and reliability, accessibility, flexibility, personal space, privacy and cost. For most journeys, driving by car was seen to offer the best performance across all of these – and in practice many participants simply defaulted to car to meet their travel needs. One exception was commuters in London, where concerns about congestion and parking fees meant public transport was often considered more reliable for time-critical commuting journeys. There was relatively little consideration of more societal factors – such as congestion, emissions or air pollution – when making travel choices, although environmental factors were a factor for some in vehicle purchasing decisions and somewhat more salient in London, where air pollution had been more prominent in the media.

[1] 99 members of the public attended first workshops, with 88 attending all three waves

There was a high level of awareness and use of technologies to support car journeys, with virtually all participants using navigation apps and some making use of drive-assist features such as cruise control and parking assist. Technology was largely seen to be beneficial as long as drivers were able to retain control and override it whenever desired. Drive-assist features were not typically associated with fully automated vehicles, which were felt to represent a step-change in the driving experience. Only a small minority of participants had experience of driving or being driven in an electric vehicle.

3. Imagining the future of transportation

Spontaneous visions of the UK in 2050 tended towards utopian or dystopian imagery, reflecting the public's underlying hopes and fears. In utopian visions, participants imagined a growth in green technologies leading to longer, healthier lives and a more equitable society. In dystopian visions, imagery was dominated by fewer natural spaces and divided, over-populated urban centres, with an increased dependence on technology driving social disconnection. Spontaneous visions of transport in 2050 featured a proliferation of new travel choices and infrastructure, including flying cars, multi-storey roads and underground high-speed rail. Despite this, most participants saw vehicle ownership continuing on the basis of its relatively higher comfort, convenience and safety. They also predicted a more centralised road management system, which could lead to concerns about loss of control over route or other factors, such as the ability to choose speed.

At the outset of the dialogue, participants tended to be sceptical about the speed at which the technology areas are predicted to progress, particularly automated vehicles. Following further discussions about the different technology areas during Wave 1 of the dialogue, a shift in view took place for many participants, as exposure to information about the technology changed perceptions of feasibility. However, at this stage participants could still question the benefits to them of change and see developments as led more by commercial or government interests.

Participants were shown two future scenarios – a '2030' Transition scenario in which the new technologies were available alongside conventional petrol/diesel technology and a '2050' Future scenario in which the new technologies had largely replaced conventional petrol/diesel technology[2]. Reactions to the '2030' Transition scenario were mixed. Excitement about features focused on convenience (e.g. valet parking) and comfort (e.g. more in-car personalisation), were balanced by a more general scepticism that the infrastructure would develop fast enough for widespread adoption, and concerns that those not adopting more automated vehicles may face financial penalties or about how the technologies would interact with current vehicles. Participants were more easily able to imagine the '2050' Future scenario, with thinking less constrained by present-day conditions but, due to the relative uncertainty about social, economic and technological conditions at that time, responses were often still grounded in present day concerns . Regardless of their stance on the technologies, personal ownership remained a priority for most and there was little interest in automated shared services, which were felt to offer a sub-optimal service in terms of convenience, privacy and comfort.

4. Response to the technology areas

Electric vehicles

- Participants were initially sceptical about the technology. Most understood the environmental rationale and were theoretically in support of lowering emissions, although a significant number questioned whether the technology was as beneficial to the environment as claimed From an individual level though, electric vehicles were currently seen as prohibitively expensive, with inferior range, power and aesthetic appeal compared to conventionally powered vehicles. A perceived lack of charging infrastructure reinforced initial impressions that the technology was far from entering the mainstream.

[2] Please note, this research was not trying to predict specific technology outcomes for these dates, but used these points as a research device to help make the future more tangible for participants

- Across the dialogue there was a clear shift in attitudes for many and by the end of the dialogue a number expressed a clear interest in considering an electric vehicle for purchase. This was driven by an increased familiarity with the technology, a greater awareness of existing infrastructure and reassurance about likely improvements in performance. Once electric vehicles were perceived to offer comparative convenience, performance and cost – e.g. no personal sacrifice compared to now - then participants were motivated by the idea of wider societal benefits.
- Concerns remained around some specific issues such as how those without on-street parking would charge at home, the environmental impacts of batteries and how the government will recoup funds currently raised from vehicle tax and fuel duty once electric vehicle use enters the mainstream.

Automated vehicles

- Participants initially saw automated vehicle technology as futuristic and exciting but unproven and far from reality. Despite safety claims, participants' instinctive reaction was that they could not imagine ceding driving responsibility to machines. Given current emotional attachments to driving people saw few personal benefits and tended to focus on what they may lose in terms of control or enjoyment.
- There was a clear shift in attitudes across the course of the dialogue. With exposure to information about the technology and existing trials, participants came to see the technology as far closer to reality and also, to some extent, accepted claims about improved safety. Some also saw potential benefits to the technology, such as opening up road access to those currently unable to drive and taking the stress out of long trips on the SRN, making car travel more attractive for inter-city journeys and opening up the possibility of living further from work. However, in contrast to electric vehicles, scepticism about the benefits remained strong for many and the development of the technology was seen to be directed more at businesses set to benefit from productivity gains.
- Large public doubts remained about the technology. There were concerns about the impact on jobs and an expectation that the government assist those affected. Another set of concerns revolved around the 'transition' period and how automated vehicles could be safely accommodated on roads alongside existing technology. Control remained a concern and participants wanted reassurance that they would still be able to take control if desired, creating tension with safety claims. Finally, some wondered if widespread adoption of automated vehicles could worsen congestion, due to an increase in empty vehicles on the road, the broadening of access to those who currently can't drive themselves and an increased use of car travel for long distance journeys currently served by rail.

Connected vehicles and real-time information

- People were almost universally positive about increased in-car information about congestion and route planning, which they saw as an evolution of current widely used navigation apps.
- Whilst there was an acknowledgement that system-wide coordination could provide benefits by spreading traffic across the network, it was important to participants that they keep control over their route and raised questions about how the authorities could manage individual vehicle routes across the system without someone losing out. Data privacy did not come up as a significant issue although some participants did raise concerns about data being used for insurance or compliance purposes, to control aspects of the vehicles such as speed or to charge people for their road usage. Some were also worried about what risks increased connectivity may result in should the system be 'hacked'.

Platooning

- Platooning – the use of automated and connected features to allow two or more trucks to travel closely together on the SRN under the control of the driver of the lead vehicle – generated little public support as it was seen to benefit only large freight companies.
- Participants tended to focus on uncertainties and concerns about how platoons would interact with other vehicles on the roads. UK roads were not seen to be set-up to accommodate freight platoons and the

technology was seen to reinforce current concerns about the danger and inconvenience of high levels of freight traffic on the Strategic Road Network.

5. Response to new mobility services and shared service models

There was little spontaneous understanding of how vehicle automation might significantly change the way that people travel or lead to the development of new forms of mobility services. Experience of existing new driving service models was low. Whilst most had heard of Uber or similar services, there was little experience of use outside London. There was low awareness and use of UberPOOL or other shared options.

When prompted with a range of services – including a private automated car service, a shared automated car service and automated bus and minibus services - participants tended to assess them in reference to existing alternatives to car travel – specifically taxi services or public transport. As such, people tended to imagine using new services in similar situations to at present. Those currently travelling by means other than their own car could see benefits in terms of both cost and convenience. However, for the majority a personal automated vehicle was still seen to offer superior comfort, convenience and privacy compared to alternatives and remained the preference unless prohibitively expensive. Automated driving services were seen as a supplement rather than a replacement to ownership and few felt a proliferation of services would affect their attitudes to travel.

There was particular resistance to sharing, especially in smaller vehicles, where close proximity to other passengers was seen as a risk to personal comfort and safety. Accommodating other people's needs was also seen to compromise convenience and most felt that they would only share with people that they knew through some kind of social connection. Participants were more open to the idea of sharing in larger vehicles, which they tended to compare to current mass transit options and could imagine using for specific purposes if offered by an organisation or as an improved form of public transport.

The idea of an integrated platform providing information and seamless payment across a range of different mobility options generated excitement and felt like a natural progression of apps like CityMapper and Google Maps. People valued the idea of a personalised and transparent service enabling a more rational consideration of which option may best suit them for a journey, rather than defaulting to habit. At best, some could see how such services might encourage them to reduce household ownership from two cars to one car if other options seemed affordable, although most didn't want to relinquish ownership altogether.

6. Public reactions to policy options and resulting considerations

Participants typically expected the government to be responsible for implementing the infrastructure necessary to support electric and automated vehicles, with little recognition of the role of industry. This led to some concerns about whether there was the money, capacity or capability for the infrastructure to be implemented as quickly or effectively as was being predicted and discussed within the workshops.

The government's role in relation to transportation was perceived to be one of maintaining an effective transport system that moved people from place to place safely and efficiently. As such, only a small minority of participants recognised and praised the government for investing in roads technologies from the perspective of supporting industry and the economy. There appeared to be little grasp that government is a multifaceted entity working towards multiple objectives and interests - at least when considering transportation policy. Indeed, perceptions that the government were playing a role in directly or indirectly promoting the adoption of new technologies and services could lead to concerns that vehicle owners or drivers of 'conventional' vehicles would be penalised in future, restricting their choice and potentially forcing them into the adoption of unproven technologies.

Congestion was considered a problem by many, but it was also an issue that people had become accustomed to and tolerated as it was largely predictable. Overall, the convenience and relatively low cost offered by road travel outweighed frustrations. People rarely reflected on their own role in contributing to congestion and more often saw it as a result of poor traffic management. On reflection participants could recognise the role of individual choices in congestion, and were highly positive about the benefits that

reduced congestion and car ownership would provide (e.g. in terms of the physical environment and air quality), these were not sufficient to encourage people to change their behaviour.

Participants were presented with a range of initial ideas for policy aimed at encouraging people to travel less by car. When considering these, participants expressed a strong preference for incentives over taxes or charges. Many participants were unwilling to support the idea of raising taxes even for heavier road users, though participants in London were more open to charging for certain roads or at certain times, perhaps due to familiarity with the congestion charging zone. Incentives such as discounts, promotions or loyalty schemes for using sharing schemes were more popular and could encourage people to trial them, although this did not counter underlying concerns about the relative inconvenience of sharing vehicles compared to travelling in one's own car. Despite widespread concerns about congestion, the idea of building more roads or widening existing roads was generally not seen to be a viable long term solution, neither was the introduction of car-sharing lanes as they were seen as likely to cause congestion for the majority of drivers and leave sections of the road empty much of the time.

Changing the behaviour of drivers and the paradigm of car ownership will require attractive, safe, reliable and affordable alternatives to ownership. Alongside this, it will also require significant input from government and industry in helping people to live in ways that reduce the need to use the roads so uniformly, in promoting the benefits of sharing vehicles and in helping to establish a new framework of social norms about the individual's role in helping to manage congestion (e.g. via behaviour change initiatives and campaigns).

7. Likely public responses to future technologies and services

Behavioural thinking provides a means of interpreting public responses and exploring implications. System 1 and System 2 are two distinct modes of decision making. System 1 is automatic and influenced by habits, heuristics (mental shortcuts) and the context in which decisions are taken. System 2 is more reflective and influenced by the conscious assessment of legitimacy, efficacy and cost/benefits.

Immediate participant reactions to the transport technologies and services can be seen to driven by System 1. For example beliefs or assumptions that electric vehicles are slow, unreliable and unaffordable; that current infrastructure is not designed in a way that could permit automated technologies to operate as safely as a human being; that Real Time Information is attractive because it builds on services that people are habitualised to (such as Google Maps); and that shared services are an unfamiliar hybrid between private and public transportation, with neither the safety of public transport nor the convenience of a private vehicle.

When presented with additional information and asked to reflect on their likely future behaviour, participants adopted a more rational (System 2) approach to assessing options. Assessments were made around the perceived viability of a service/technology, whether it added value, and whether it compromised or enhanced the control/flexibility people had over journeys. From this more considered view, the rationale and benefits of electric vehicles became more apparent, but significant concerns remained for both automated vehicles (in relation to loss of control/enjoyment and safety) and shared services (in relation to convenience and safety).

As new services and transport options become more viable, adoption will depend on people feeling able to judge the benefits as outweighing the costs. This judgement incorporates financial calculations but also a range of other costs and benefits relating to personal and social circumstances (e.g. relative values placed on time, convenience, comfort, safety and privacy; perceived opportunity costs; level of risk aversion etc.).

Discussions of expected future behavior was framed within the context of an existing paradigm of convenient and affordable vehicle ownership that typically gets them from A to B within an expected timeframe, supported by a wider system of public transportation that is largely fit for purpose. Clarity will be required around many issues (e.g. home charging infrastructure; how partial automation can operate safely; what the automated vehicle 'experience' would feel like; the future tax or regulatory situation etc.) for people to assess both the legitimacy and costs/benefits of the proposed technologies/services, and therefore to judge their own behaviour. In the absence of this, the reaction to new technologies or services seeking to alter the existing paradigm typically involved scepticism if not outright dismissal.

That said, a range of factors emerged likely to influence adoption for the key technologies. Across the technologies, the general public were more likely to be motivated by options which personally benefit them by making their lives easier in some way or that reflect social norms, than they are by rational macro-level benefits around congestion or reductions in pollution.

Electric vehicle adoption is likely to be influenced by:

- the relative supply, availability and affordability of both electric and petrol/diesel vehicles
- electric vehicle performance
- access and convenience of supporting infrastructure (both for electric and petrol/diesel)
- financial incentives and regulation which influences attractiveness of owning petrol/diesel vehicles

Increased electric vehicle adoption has the potential to significantly reduce the cost of road travel, which could at the margin increase road usage amongst those concerned with costs. However, if this results in increased congestion the likely impact will be that people turn to other forms of transportation (e.g. public transport or shared services).

Automated vehicle adoption will be influenced by:

- the relative availability, affordability and safety of automated technologies
- the performance and experience of using automated vehicles as compared to conventional vehicles and/or public transport
- the effectiveness of communications which convey the safety and benefits (convenience, reliability, comfort and cost effectiveness) of the technology
- the speed and efficacy of the transition between driver assistance technology (Level 1 and 2) and true self-driving automation (Level 3, 4 and 5)

Increased automated vehicle adoption would increase the range (and potentially volume) of people who use the road network, and could lead to increases in the volume and length of car journeys as long car journeys become more attractive due to the increased capacity to carry out other activities (e.g. sleep or work). This in turn may influence where people choose to live, with people moving from urban centres or commuter towns.

The adoption of shared services will be influenced by:

- Legislation or regulation that reduces the attractiveness or convenience of private vehicle ownership
- The relative costs of private vehicle ownership
- Shared services being demonstrated to be reliable and safe forms of transportation, comparable to the efficiency of public transport and/or convenience of private vehicles
- Shared services increasing their personalization of offer (e.g. different types of vehicle or service) and geographic coverage
- Shared services being fully integrated within Mobility as a Service
- The prevalence of people that have the capabilities (and licences) to drive

Shared services are seen to be neither public nor private transport – an offer which is currently largely undefined and un-experienced by most people. Sharing is a compromise which people are reluctant to make outside of public transport options where it feels normalised. With increased automation, it is likely that norms will be challenged, providing an opportunity for greater sharing. However, at present there is limited evidence to suggest sharing in private services will become normalised without a significant push from both government and industry.

1. Research background and context

Planning the UK's future road network

An effective transport system is at the very heart of our economy, helping to move people and goods around the country, and a key contributor to a wide range of employment, health, leisure and social outcomes both for individuals and for wider society. The motorways and major trunk roads which make up the Strategic Road Network (SRN) form a core part of England's transport infrastructure in providing the critical connections between cities, communities and major ports, airports and rail terminals.

Since 2001 traffic in England has increased seven times faster on motorways than on other roads. The SRN today carries a third of all national road traffic, as well as two thirds of freight traffic. Future traffic trends and road user behaviour are hard to predict but parts of the transport network are full as it stands and the Government is committed to ensuring that the country keeps on the move, making journeys simpler, faster and more reliable. To this end there has been a commitment to increase the level of investment in the transport system by 50% by 2020, and specifically to fund over 100 major road schemes by 2021 through an investment of £15 billion as part of the first Road Investment Strategy (RIS1).

The Department for Transport (DfT) are now in a position to look further ahead and work has started to develop the second Road Investment Strategy (RIS2) to prioritise activities between 2020 and 2025. This public dialogue project into the future of road use has been designed to understand road users (and potential road users) responses to emerging transport services and technologies. In recent years, technology has severely disrupted and transformed industries as diverse as fast moving consumer goods, finance and media. With the emergence of services like Uber and Citymapper, and increasingly sophisticated sensor technologies that support or even automate travel, it could be argued that transport is currently in the process of its own transformation. What is clear is that current and future advances in technology could revolutionise the way in which people use and engage with both SRN and non-SRN roads. The Government is not being passive in this area, and alongside RIS2 has committed over £100 million in 38 research and development projects to generate low carbon, connected and automated vehicle technologies.

What is the public view on new road technologies?

Given the role new technologies could play for the UK economy and society more broadly (e.g. in facilitating connectivity between people and places), it is important that DfT understands how new technologies can address current and predicted future needs, and anticipates how use of public roads may change as a result of using these services. Understanding public perceptions of new technologies – and their implications – is key not only to the Department's work on RIS2 but also to the wider Future of Mobility Grand Challenge established in the Industrial Strategy[3].

[3] BEIS (2017) *Industrial Strategy: The Grand Challenges* https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/industrial-strategy-the-grand-challenges

To this end, DfT commissioned Kantar Public, in partnership with The Centre for Transport and Society (CTS) at the University of West England, to conduct a public dialogue to capture the perspectives of individuals and businesses in relation to four emerging transport technology areas:

- **Electric vehicles:** Vehicles that use electric motors powered by in-car storage batteries for propulsion, as opposed to conventional petrol or diesel engines. Expected improvements to the quality and variety of electric vehicles available on the market, enhanced charging technology and infrastructure, and government incentives motivated by carbon reduction targets are expected to drive uptake of the technology.
- **Automated vehicles:** Vehicles that use a range of sensors and computerised technology to guide themselves to varying degrees without human input, building on current technology such as cruise-control and self-parking (see Appendix A) for more details on the different levels of automation).
- **Connected vehicles and real-time information (RTI):** Services that utilise vehicle-to-vehicle and vehicle-to-infrastructure technology to provide up-to-date information on planned / unplanned disruption, congestion and alternative routes. Vehicles could also feed information back to transport authorities, allowing for traffic optimisation across the network and enhanced information around infrastructure repair needs.
- **Platooning:** Technology that utilises automated and connected features to allow two or more trucks to travel closely together on the SRN under the control of the driver of the lead vehicle.

Across the course of the dialogue, the scope of discussions expanded to also consider a range of new mobility service models utilising these technologies:

- **New Mobility Service Models:** New transportation models leveraging the other technologies, particularly automated and connected vehicles, including shared and individual automated rental models and Mobility as a Service (MAAS), a digital subscription service incorporating multiple forms of transport and planning journeys according to user preferences and real-time conditions.

More specifically, the dialogue set out to explore:

- Current public attitudes toward and experiences of the transport technology and service areas
- Expectations, hopes and fears about how these emerging services might be employed 15-30 years in the future, for example in relation to convenience, safety, cost, privacy, data protection, and the environment
- Potential responses to emerging technologies in terms of journey choices, switching to other modes of transport and other second-order effects, such as where people might choose to live / work

Deliberative Dialogue

Deliberative dialogue aims to recognise the value that members of the general public can add to decision-making around policy and legislation, particularly around complex issues that may be considered sensitive or controversial and are likely to have broad ranging and potentially far-reaching implications for different groups in society. It is a form of participatory decision-making that draws together a broad cross-section of the public with policy-makers and other professionals to collectively discuss the issues surrounding a topic and develop an informed understanding of potential societal impacts and policy responses. By involving the public in discussions around the choices to be made, policy-makers are able to benefit from access to public knowledge, lived experiences and social networks, leading to better decisions, more informed decision-making and more successful implementation of solutions.

This work involved a total of 99 participants, primarily road-users, recruited to represent a variety of different backgrounds across three locations – London, Newcastle and Sutton Coldfield[4]. The focus of deliberative dialogue is on participants' viewpoints after they have been presented with the opportunity to 'deliberate' the issues in question. Across a series of one half-day and two full-day workshops, participants were brought together with government, academic and commercial stakeholders, and exposed to a range of stimulus materials aimed at building their understanding of the technology service areas and their potential impacts around 15 years and 30 years into their future. The programme of workshops followed an iterative path, with stimulus materials developed over the course of the dialogue, responding to participant views and providing additional information when the need arose. Participants were also tasked with completing activities in-between workshops, prompting them to do their own research and deepening engagement. In total, the dialogue extended over a period of over three months, enabling time for ongoing reflection and consideration of the issues from a variety of angles.

The sample for the dialogue included coverage of a full range of existing and potential road users to help inform our understanding of potential future travel behaviours and road demand, including a quota of car users with disabilities/health conditions who may stand to benefit from the new technologies. = All findings are qualitative and aim to represent the range of attitudinal and potential behavioural responses to the technologies, not an indication of how many might respond in that way. They are indicative rather than representative of the broader population, but have aimed to incorporate views from a broad cross-section of UK road-users in relation to demographics, comfort with technology, frequency and type of travel, and location (Greenwich, New Castle and Sutton Coldfield). Given the audience, findings should be interpreted as principally representing the views of car owners and users, and further research would be needed to understand how views may differ amongst those who do not travel by car.

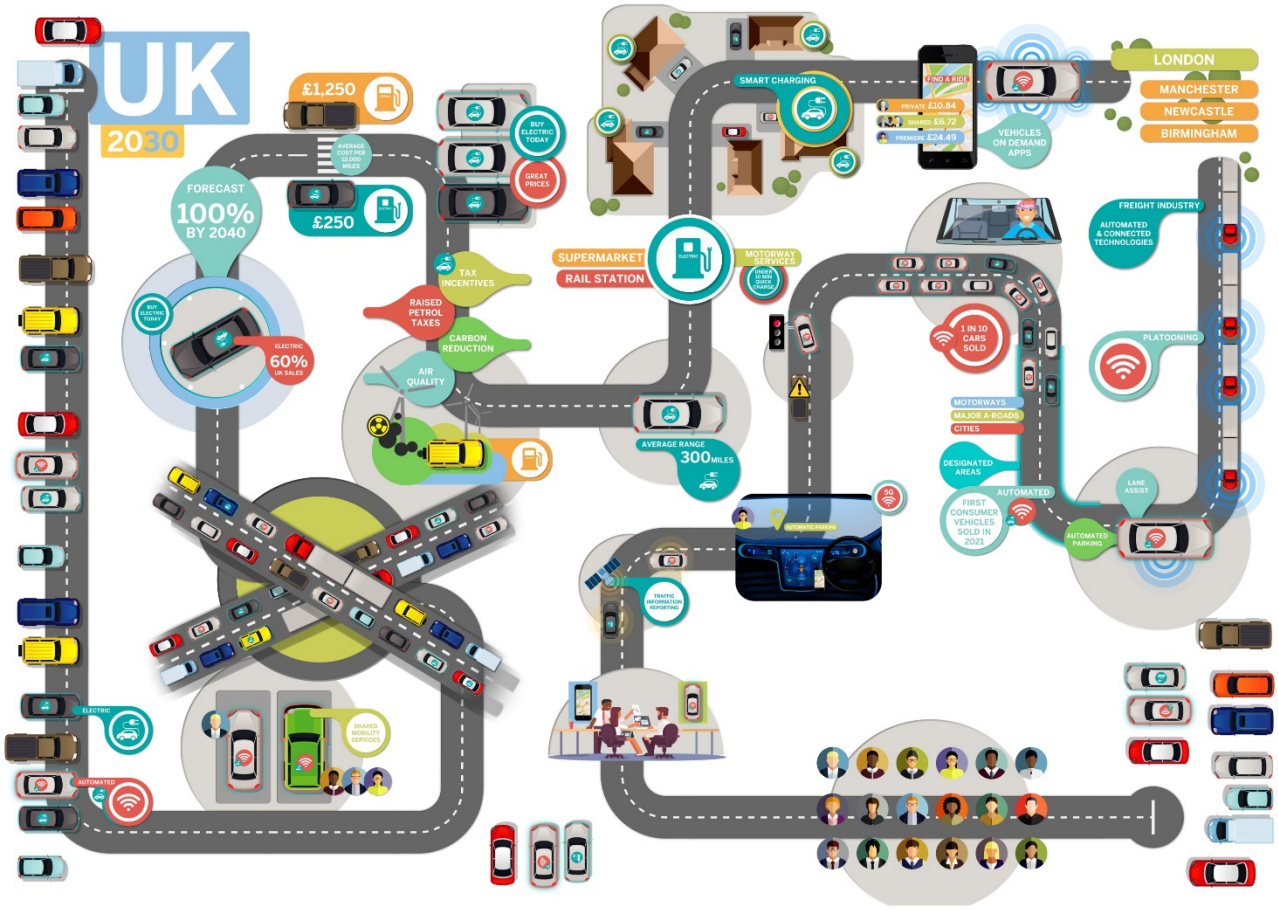
A full methodology and sample table can be found in Appendix B.

Involvement from government, industry and academia

Whilst the research was primarily concerned with understanding and accounting for the views of public road-users, it also drew heavily on the input of a range of stakeholders from government, including representatives from the Office for Low Emission Vehicles (OLEV), the Centre for Connected and Autonomous Vehicles (CCAV), private companies involved with emerging road technologies, including the Ford Motor Company, and academia (see Appendix C for a list of stakeholders that participated directly in the dialogue). Stakeholders input throughout the process, including participation in a series of co-creation workshops prior to the public workshops to feed into stimulus development, helped ensure that materials used to prompt discussion were credible, balanced and reflected the most up-to-date thinking in the field. Stakeholders were also involved during the public workshop sessions, listening to public views and working with moderators and participants to fill information gaps when they arose, enabling genuine two-way discussion with decision-makers and helping to ensure the credibility of the process for participants. In addition to this, colleagues from the Centre for Transport Studies at the University of the West of England were involved in an advisory role throughout the dialogue to feed into the development of materials and peer review outputs.

[4] A total of 99 participants started the dialogue, with 88 completing all three waves; an additional 30 interviews with individuals (n=12) and those driving for business (n=18) took part in a series of preliminary depth interviews (see Appendix D)

Envisioning the future



Materials were designed to help participants imagine how the emerging technologies might impact on their future attitudes and behaviour, exploring two scenarios in particular:

- **'2030' Transition scenario:** A near future scenario in which automated and electric vehicles in particular had come into common use alongside conventional petrol and diesel technologies.
- **'2050' Future scenario:** A more fully fledged future scenario in which electric and automated technology had largely replaced conventional petrol and diesel technologies and enabled the development of a range of innovative shared mobility services.

The scenarios were brought to life via a range of custom-designed multimedia stimulus materials, including video interviews with key stakeholders, infographic animations illustrating the transport landscape and personas portraying the choices available to future road users. Although the scenarios were associated with certain dates, when presented to participants it was explained that they were not trying to make firm predictions about these dates but merely present some possibilities in order to help drive discussion.

Throughout the research, we asked participants to imagine their future behaviour in response to the development of the technology service areas. Inevitably, responses were grounded in present-day situations and actual future behaviour will depend on a range of other contextual factors that are impossible to accurately predict. However, responses were able to highlight existing hopes and fears in relation to the technology.

Reading this report

This report begins with an exploration of road users' current relationships with driving in Section 2, creating a contextual base from which to understand subsequent responses. Section 3 then provides an overview of public visions of the future, both unprompted and in relation to the two future scenarios. Section 4 outlines public reactions to the four technology service areas and how these changed over the dialogue, and Section 5 does the same thing for a range of automated shared service models. Section 6 details public reactions to a range of policy options related to the technologies and draws out potential considerations for government policy-makers. Finally, Section 7 draws out some of the implications for the research, particularly in relation to the barriers and enablers that are likely to affect public uptake of the new technologies.

2. Current relationships with driving

In this chapter we explore existing relationships with driving, car ownership and technologies relating to driving, laying out the context for reactions to the emerging technologies and future scenarios…

Responses to the technology service areas were grounded in existing relationships with driving – understanding current attitudes and behaviours around driving provides the context needed to effectively interpret reactions to the prospect of change.

Most participants held strong practical and emotional attachments to driving, which was seen as both an integral part of managing the demands of modern life and a symbol of personal control and freedom. They tended to report an active enjoyment, which was often associated with a 'driving on the open-road' vision of freedom portrayed in car-advertising. The car was also valued as an extension of people's personality and personal space. This idealised vision of driving connected to emotional narratives about human freedom and independence, where driving is an action in which people can exert control over their lives, their personal space and their touch-points with the outside world.

This contrasted strongly with the reality of driving, which was largely felt to be characterised by congestion. However, the frustrations this caused were more than offset by the convenience, comfort and privacy offered by travelling in your own vehicle. Car ownership was considered the norm by most participants and seen as not just desirable but necessary by many. This was particularly the case outside of London, where there were seen to be few viable alternatives to car travel for most.

Transport decisions were led by consideration of individual factors, relating to journey time and reliability, accessibility, flexibility, personal space, privacy and cost. For most journeys, driving by car was seen to offer the best performance across all of these – and in practice many participants simply defaulted to car to meet their travel needs. One exception was commuters in London, where concerns about congestion and parking fees meant public transport was often considered more reliable for time-critical commuting journeys. There was relatively little consideration of more societal factors – such as congestion, emissions or air pollution – when making travel choices, although environmental factors were a factor for some in vehicle purchasing decisions and somewhat more salient in London, where air pollution had been more prominent in the media.

There was a high level of awareness and use of technologies to support car journeys, with virtually all participants using navigation apps and some making use of drive-assist features such as cruise control and parking assist. Technology was largely seen to be beneficial as long as drivers were able to retain control and override it whenever desired. Drive-assist features were not typically associated with fully automated vehicles, which were felt to represent a step-change in the driving experience. Only a small minority of participants had experience of driving or being driven in an electric vehicle.

Practical and emotional attachments to driving

To make sense of public views on emerging transport technologies, it is important to first understand their current relationships with driving. The majority of those participating in this dialogue used their cars on a daily basis - variously for commuting, shopping, visiting friends/family and transporting children or other family members - and on more of an ad-hoc basis for taking longer leisure trips. The car, for these participants, offered many practical benefits compared to other travel modes and was seen as the most reliable, convenient and personal form of transportation. In many ways, car ownership was seen as necessary to enable current lifestyles and the ability to be in control of personal travel needs was often equated with a sense of personal freedom. This attachment to the personal motor vehicle as a mode of transport was a consistent theme throughout the dialogue, underlying participant responses to the future technologies and services.

> *"I take my mum food shopping every week because she doesn't drive herself and can't get to the shops."*

> *"My boyfriend drives me to work mostly, but if he can't, I take the bus. Takes aaaages that way though."*

There were differences across the three locations in how reliant individuals were on their cars – particularly between London and elsewhere. Participants living or working in central London tended to use public transport (or to a lesser degree bicycles) on a daily basis to commute to work and these alternative modes could be seen as more reliable than driving as congestion and challenging parking made arrival times less predictable. However, even in London, travel by car was still preferred for many journeys, particularly in more suburban areas. Outside of London (particularly those living outside of urban centres), some participants reported that infrequent bus services and less-developed public transport infrastructure meant driving to work was the only reliable option. Similarly, unless there were very convenient public transport links, families with younger children typically transported their children to school using their car. In many cases people felt that, for those journeys currently made by car, alternative options were either non-existent or discounted as being less practical or convenient.

As we will discuss later in this report, participants expressed a strong emotional connection to driving (and the idealised vision of freedom associated with car ownership), and cars were often seen as an extension of people's personality and private space. Driving was felt to be a skill, reinforced by the extensive learning process, and there was a real pride and rite of passage associated with passing your test. The young learner drivers involved in the workshops were excited about the prospect of driving and the increases in independence that this would bring them; the older drivers still retained this view that car ownership provided the highest degree of freedom and control relative to other forms of transportation. A strong top-of-mind association for most people when thinking about their car was the 'driving on the open-road' vision of freedom and enjoyment often portrayed in car-advertising. This idealised vision of driving connects to emotional narratives about human freedom and independence, where driving is an action in which people can exert control over their lives, their personal space and their touch-points with the outside world.

> *"I like being on my own in the car with the music really loud and singing."*

> *"It's being on the free, open road isn't it. Weaving in and out of traffic."*

Congestion, other road-users, pedestrians, roadworks, traffic calming and enforcement measures are all obstacles which people see as infringements, reducing the speed, efficiency and pleasure of their journey. The ideal is felt to be attainable, if it weren't for other people or the authorities. In this respect people are focused on their personal needs when it comes to car journeys; their view is very much of them versus the system (where they focus on their personal gains in time or speed), as opposed to being part of a system (where they focus on the benefits to wider road users in overall journey time).

"There's just too many people now. It used to be around here that you'd drive for miles and it would all be green, but now there's new housing developments everywhere. If they keep going, there'll be no space left!"

The reality of driving on the roads in 2017/18 was often felt to be the antithesis of participant's more idealised vision of driving. In contrast to the feelings of freedom and control, participants described driving as a frustrating and stressful experience, characterised by feeling *stuck* in traffic. Car use was typically associated with everyday commutes under busy conditions, rather than the leisurely 'me-time' of their driving ideal. Negative driving experiences were also linked with perceptions of ever-increasing costs of driving, rising congestion and crowded roads, and a perception of general under-investment in, or inadequate infrastructure.

While there was recognition that driving, particularly in urban areas, could be frustrating (e.g. due to congestion and the behaviour of other road users), this was more than offset by the convenience, comfort and privacy afforded by travelling in your own vehicle. Similarly, people are very focused on their own perspective and interests when it comes to car ownership, which is the current paradigm. The norm amongst those participants involved in this research was to own a car and there was a strong sense that car ownership was not just desirable but absolutely necessary in some circumstances. For some people there was either no viable alternative, or no acceptable alternative. In lieu of access to their own personal vehicles participants felt they would be compromising comfort, convenience, safety, privacy and independence, and in some cases reliability, speed and cost-effectiveness. This was a strong and consistent narrative that influenced participant views of the future technologies and services.

"Without a car, I wouldn't be able to take my kids to school on time."

Within each of the workshops there were a small number of participants that were frequent passengers on road journeys either because they were unable or preferred not to drive. For these participants there was clearly less of an emotional attachment to 'their' vehicle (where it was a family car they were a passenger within) and the use of alternative transport options more acceptable and more common-place. Non-drivers in locations where there was reliable and frequent public transport did not report any significant impact of lack of driving on their ability to get around. However, participants living outside of London, or urban centres elsewhere, reflected that not being able to drive themselves did result in a heavy reliance on others to maintain their independence.

Transport decisions are driven largely by personal considerations

Throughout the workshops the discussions resulted in a clear picture of those factors that influenced participant's transport choices and decision making. Though the relative influence of these factors differed somewhat across individuals and the purpose of journeys (commuting as compared to leisure for example), for most journeys driving by car was seen to best meet personal needs. It is also important to note that considerations were led very much by personal factors rather than societal considerations, such as effect on congestion of the environment. Below we summarise the most important factors shaping travel choices:

- **Convenience, flexibility and accessibility**

  Participants placed a high premium on convenience and preferred transport options that aligned with their lifestyle needs, which they tended to see as unique to themselves. They expected transport to meet their particular schedules and demands, for example the need to incorporate school drop-offs into the work commute, or stops at particular shops en *route* home.

  Participants valued the flexibility afforded by private vehicle ownership, which was seen to offer instant accessibility, high levels of control and the freedom to travel at any time. This, in turn, was felt to be more convenient and less stressful than the planning required for public transport, allowing

people to feel like their *'own boss',* in control of their own time. Where public transport was convenient and accessible, for example in London, this was often used for regular journeys such as the commute to work, which also helped avoid the inconvenience of parking. However, for most participants on most journeys, public transport was seen as a compromise or not a viable option.

- **Journey time and reliability**

  We know from past research, that customer expectations for journey time are influenced by prior experience, setting a standard for what is seen as satisfactory at a particular time and place and allowing users to plan around the 'service'. This aspect of predictability was typically more important for road users than the absolute journey time. Congestion was recognised as an issue by most participants but was largely accepted as an annoying fact of life and figured into travel plans, with frustration arising mainly when a journey took longer than predicted.

  When there was seen to be a choice between public transport and car travel, decisions were therefore influenced by the degree to which options were seen to enable reliable and consistent journey times. For short commutes the car was often seen as more convenient as it presented fewer chances for reliability to be compromised. For longer commutes, particularly into urban centres, participants could opt for public transport, which was seen to offer more reliable arrival times.

- **Personal space and comfort**

  Most participants that drove regularly valued the privacy that their own vehicle offered them, seeing their car as a refuge from other people, personalised to meet their individual needs, and reflective of their individual personality and status. This private and personal space, which some participants described as an extension of their own home, was felt to offer unparalleled convenience and comfort. Participants perceived a clear delineation between private and public forms of transport, to which there was a tangible aversion for some people for privacy, comfort or hygiene reasons.

  Many participants also described an emotional attachment to driving as a form of *"me-time"*. This may be because driving is one of the few remaining areas of modern life in which people are forced not to be distracted by their phones, computers etc., and concentrate on a relatively mechanical activity for a period of time. Some participants described driving as a kind of meditative experience, where they were afforded the time to think, or do as they pleased within the confines of their car.

- **Cost effectiveness**

  Choices were also influenced by perceptions of cost-effectiveness. Given the practical and emotional benefits already described, for many participants – including the majority outside of London – car ownership was seen as a necessity, with purchase prices treated largely as a 'sunk cost', meaning that value calculations tended to centre on the day-to-day cost of getting around (i.e. petrol/diesel and parking costs versus the cost of a taxi, bus or train ticket). Indeed, for some participants ownership was seen as a justification for choosing car travel, due to the money already invested in purchase, insurance etc. Cost considerations, particularly fuel efficiency, were also a consideration when deciding what car to purchase, particularly for lower SEG groups.

  For commuting into London in particular, the greater convenience and reliability of public transport was bolstered by perceptions that car travel would be more expensive (due to congestion and parking costs) making public transport relatively more attractive, in spite of privacy/comfort issues. For those participants living in more rural areas and/or commuting into smaller urban areas where congestion was less of an issue, there was a perception that driving was the more cost effective, convenient and reliable option, as well as offering greater comfort.

- **Societal impact**

The vast majority of participants did not consider wider societal impacts (e.g. congestion or environmental impact) when making transport decisions. People generally recognised that their decision to use their own private car had an impact on traffic, air quality and carbon emissions, but tended to discount the impact of their personal choices. Many felt that they had no reasonable alternative but to use their own car and felt justified to maintain their lifestyle whilst everyone else did the same. Furthermore, the effects were largely unfelt (e.g. air quality degradation is relatively subtle) or acceptable (e.g. congestion remains stable and predictable). As such there was no felt social imperative for change.

A very small number of people did use alternatives to the private car to get around (e.g. public transport, bicycles or walking) for environmental or social reasons although these tended to be older individuals, from higher SEGs living within larger urban centres where there were excellent public transport links and therefore little need to compromise on lifestyle. Environmental concerns were also somewhat more prominent in the London groups, where air pollution had been in the news and was more connected to every-day concerns, although still limited to a relatively small proportion of participants.

Current technology valued when it enables driver control

There was a high level of awareness and use of technologies to support car journeys (ranging from satnavs and parking apps to help plan journeys, to car features like cruise control and parking assist, to vehicles running on alternative power sources such as electric cars) regardless of whether participants saw themselves as favourable/comfortable towards technology or not.

Participants varied greatly in their use of technology in making car journeys, with the level of adoption largely driven by participants' level of comfort with technology and the degree to which they wanted to retain personal control. Older participants and those of lower SEG reported less use of new technologies, and while women were also more likely to be conservative in their use of technology, once they had used in-car technology they were also the most likely to use these regularly, recognising the benefit to their driving. For those participants that were less comfortable in using new technologies, this was primarily due to a fear of passing control over to a technology that they did not understand or trust.

> *"I took my daughter to university the other day, and let's just say without a satnav, we'd still be trying to find it."*

There was great variety in the socio-demographics of those participants that were more comfortable with technology. This group were more likely to use an array of different smartphone apps or in-car applications to improve their driving experience. Overall, in-car technology was seen as highly beneficial; associated with improved efficiency, increased control and pleasure when driving. As a result, these participants were more likely to value greater personalisation features (i.e. services that are geared toward personal preferences and benefit).

> *"Driving is more efficient now than it was."*

,Across the audience, there were some concerns around the negative impact that technology could have on the driving experience. In some instances, new technologies were linked with decreasing skills levels of drivers, particularly around map reading and parking. Participants were therefore worried about the impact that over-reliance on assistive technologies would have on drivers' ability to respond to 'out-of-the-ordinary' situations (e.g. what would happen if technology suddenly stopped working). Similarly, the vast majority of participants felt it was critically important for humans to maintain control over the technology (i.e. having the ability to override and turn off the technology when it suited them) to maintain the sense of personal freedom offered by driving. There was a clear sense that many people – especially those who were more comfortable using technology – had high regard for their driving abilities and that they would know in which

circumstances technology could support them and in which circumstances it would be a hindrance. As such, increasing automation was primarily seen to be beneficial when it increased levels of choice and control when driving. A small minority of participants that were highly comfortable with technology even looked to strip out technologies in favour of maintaining a 'purer' driving experience.

> *"I think it's a man thing isn't it: I don't use it [cruise control], I like being in control. It takes the joy out of driving. I want to be able to vary my speed and over-take"*
>
> *"I set it at 30mph so that I stick to the speed limit. It's made me a much better driver"*

Participants broadly differentiated between two core sets of technologies: those that help to plan and augment the driving experience; and those that directly impacted on the fundamental driving experience itself.

Technologies that help to plan or augment the driving experience were generally top-of-mind and the first services mentioned spontaneously by participants were almost always navigation aids, which ranged from traditional satnavs, to apps on smart phones (such as Google maps, Apple maps or Waze). Participants generally felt the introduction of this form of technology had greatly aided their ability to navigate the roads, avoid traffic, and find services close by (particularly where travelling on less familiar roads), despite some frustrations around accuracy and reliability. To a large degree, satnavs have paved the way for people's use of a wide range of other services that people now use to plan their journeys (including petrol pricing apps, so that they could get the best cost per litre of fuel, or parking apps to ensure that they could reduce costs or walking distances associated with parking in urban centres).

The salience of technologies that fundamentally changed the underlying vehicle technology varied. While hybrid and electric vehicles were mentioned at the early stages of this research (and participants were generally highly aware of electric vehicles), they did not feature heavily in discussions about technology and few participants had any experience of using this technology. More commonplace were in-car features that aid the driving experience, such as cruise control and park assist, though these were associated with driver assistance rather than automation. Some participants viewed increasing levels of automation with a reduction in driver skill and control which, in turn, was associated with a sense that you increase the risk when driving by relying on (personally) untested features or a reduction in the pleasure of driving through the relinquishing of control.

At present, participants' wanted to retain control over the technology, and to override it wherever and whenever they felt the need to do so. As will be discussed in Section 3, people were averse to ceding control to technology as this option to take control and to maintain independence is tightly bound with conceptions of what it is to be 'human'. However, the technologies currently employed in modern cars have advanced rapidly and people are increasingly relying on the assistance they offer, suggesting that in future years it will become more normalised for people to default to automated functions.

3. Imagining the future of transportation

In this section we present an overview of the ways in which participants imagined the future of transportation, both their own spontaneous views and in reaction to '2030' and '2050' scenarios…

Spontaneous visions of the UK in 2050 tended towards utopian or dystopian imagery, reflecting the public's underlying hopes and fears. In utopian visions, participants imagined a growth in green technologies leading to longer, healthier lives and a more equitable society. In dystopian visions, imagery was dominated by fewer natural spaces and divided, over-populated urban centres, with an increased dependence on technology driving social disconnection. Spontaneous visions of transport in 2050 featured a proliferation of new travel choices and infrastructure, including flying cars, multi-storey roads and underground high-speed rail. Despite this, most participants saw vehicle ownership continuing on the basis of its relatively higher comfort, convenience and safety. They also predicted a more centralised road management system, which could lead to concerns about loss of control over route or other factors, such as the ability to choose speed.

At the outset of the dialogue, participants tended to be sceptical about the speed at which the technology areas are predicted to progress, particularly automated vehicles. Following further discussions about the different technology areas during Wave 1 of the dialogue, a shift in view took place for many participants, as exposure to information about the technology changed perceptions of feasibility. However, at this stage participants could still question the benefits to them of change and see developments as led more by commercial or government interests.

Participants were shown two future scenarios – a '2030' Transition scenario in which the new technologies were available alongside conventional petrol/diesel technology and a '2050' Future scenario in which the new technologies had largely replaced conventional petrol/diesel technology[1]. Reactions to the '2030' Transition scenario were mixed. Excitement about features focused on convenience (e.g. valet parking) and comfort (e.g. more in-car personalisation), were balanced by a more general scepticism that the infrastructure would develop fast enough for widespread adoption, and concerns that those not adopting more automated vehicles may face financial penalties or about how the technologies would interact with current vehicles. Participants were more easily able to imagine the '2050' Future scenario, with thinking less constrained by present-day conditions but, due to the relative uncertainty about social, economic and technological conditions at that time, responses were often still grounded in present day concerns . Regardless of their stance on the technologies, personal ownership remained a priority for most and there was little interest in automated shared services, which were felt to offer a sub-optimal service in terms of convenience, privacy and comfort.

Visions of the future framed by present-day circumstances

Throughout the course of the workshops, participants were tasked with considering how they might react to changes in the technologies associated with road travel. To enable them to do so, they were presented with both opportunities to imagine the future, and with scenarios representing different points in the future and perspectives on how technologies may develop. This process created a canvas on which participants could project their own feelings about how they might engage with changes to the travel options available to them. However, even when provided with materials to help them imagine the future, reactions were inevitably rooted in present day experiences and concerns.

To understand how participants imagined the future, it helps to take a step back and situate their views within their present-day landscape of concerns. Across the research, a number of wider macro-level factors influenced expectations of the future, shaping the way participant reactions to the information and scenarios presented. These factors played a role in whether individuals were able to envision elements of the future as a tangible or realistic prospect, as well as the perceived credibility of the technologies and services to address actual problems or concerns.

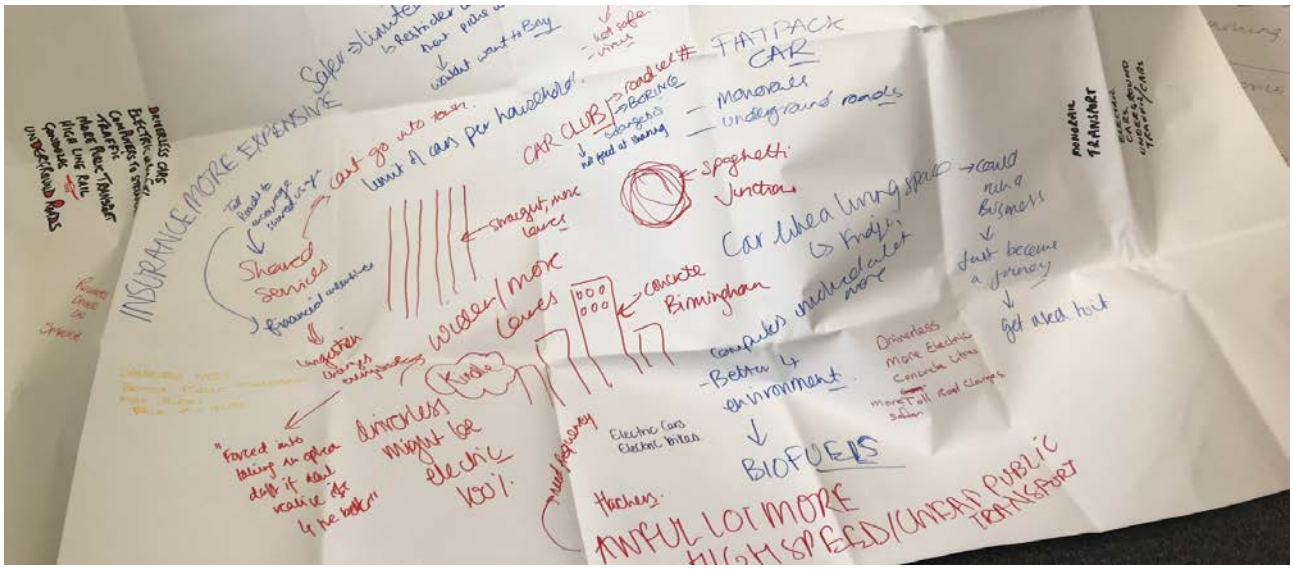
First, uncertainties surrounding the UK's future political and economic climate impacted on participants' ability to imagine what they envisaged to be considerable infrastructural investment required to support the technology areas. This was often accompanied by cynicism about the government's ability to oversee or pay for major infrastructure schemes. On a personal level, uncertainty could lead to concerns about the affordability of new vehicles and many participants already felt that buying second-hand was the only feasible current option for them, distancing them from the immediate effects of new technologies

Second, whilst participants were typically positive about the benefits of technology, this was often accompanied by concerns about over-reliance or loss of control. There were particular concerns about the growth of artificial intelligence-based technologies and how these could shift control from human beings into the hands of unaccountable machines and corporations. This reflected rational concerns about the loss of jobs in certain sectors but also more deep-seated fears about human de-skilling. An increasing rate of technological change was also understood to be driving a general increase in the pace of life, which many found unsettling. In addition, for some, an over-reliance on technologies was seen to be creating new systemic risks, such as the creation of new monopolies or threats from hacking.

> *"We are becoming more reliant on technology. Technology is NOT 100% reliable. It can fail. Do we have a plan B? It will also lessen our own independent way of checking and reacting to a situation by becoming reliant on technology to do everything for us."*

Finally, responses were also framed by a tension between a focus on individual needs and concerns about social disconnection. Although participants bemoaned having to share transportation with other people (see Section 3) there was also an opposite concern that society had become fragmented, leading to less social interaction between people and greater feelings of disconnection. This presented a clear conflict for people as they identified with a future that was increasingly individualistic, and desired transport options that maintained a high degree of privacy and separation, while at the same time recognising that this disconnection was not positive in all respects for individuals, communities or society.

Public visions of the future: Utopias and dystopias



'Take a step into the future, close your eyes for a few seconds and imagine what life might be like 30 years from now in 2050…'

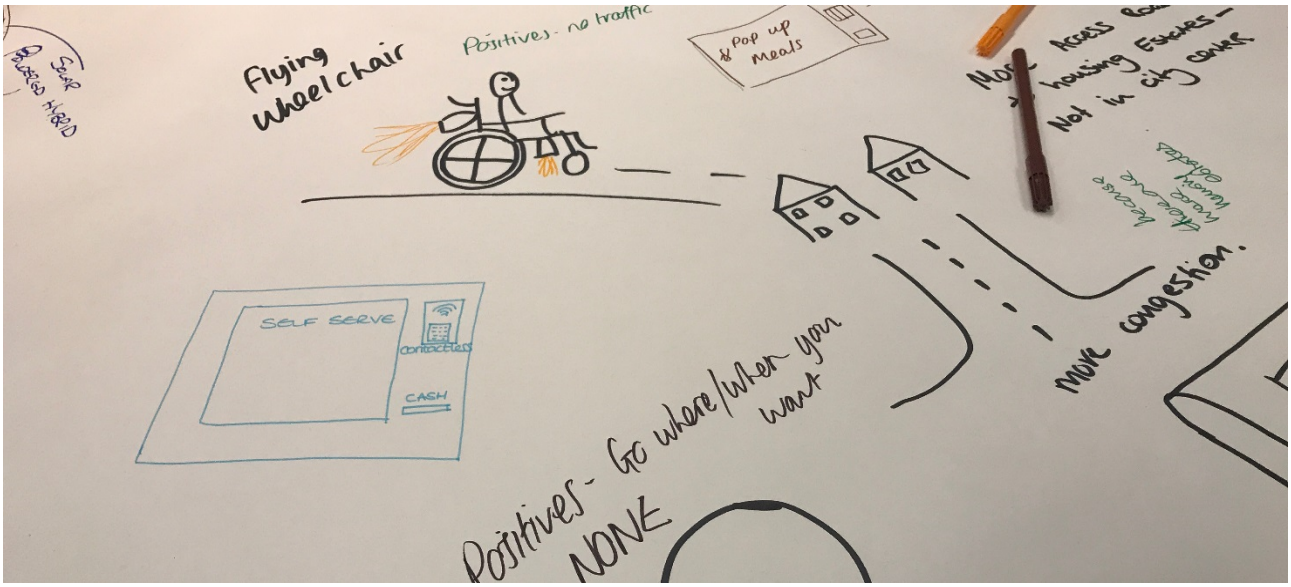
Before they were exposed to the future scenarios, participants were first asked to draw and describe their own visions of the UK in the year 2050. Views were grounded in current technological developments extrapolated into the future, also drawing on a range of popular 'science fiction' or media representations, and included a jumbled contrast of utopian and dystopian elements, often combined in contradictory ways. Faced with the 'unknown', people tended towards more extreme images of the positive and negative impacts likely to stem from societal and technological change, reflecting their underlying hopes and fears about the future.

In utopian visions, participants imagined a cleaner and more eco-friendly environment, with a proliferation of renewable energy sources and an increase in 'green' living. Technology was seen to provide a potential solution to problems that participants associated with the future such as climate-change, the degradation of the environment and deteriorating physical and mental wellbeing. In dystopian visions, imagery was dominated by the diminishment of natural spaces and growth of over-populated urban centres, with ever greater competition between people for space and resources reinforcing the divide between the 'haves' and 'have nots'. An increased reliance on technology and 'screens' was feared to diminish social ties and lead to a more atomised, lonely and unhealthy society. In this view, technology was seen in part as the cause of societal issues, shifting society away from a 'simpler time' and impacting on the ability of humans to live healthy, happy and connected lives.

> *"They [robots] will take over all the jobs, won't they?"*

This will be important to consider when communicating with the public about new technology. Concerns about the future were rooted in fundamental understandings of what it means to be human, notably the value of freedom, autonomy and social interaction. It is important that future technology - and the systems of ownership supporting them – are seen to support rather than curtail these deep-seated values.

Public visions of future transport: Flying cars and centralised networks



Participant's visions of transport within the UK in 2050 were heavily influenced by depictions of transport in science-fiction films, road and technology innovation areas reported within the media, and by current trends such as the internet of things. Common reference points included science-fiction films, and the innovations reported by companies like Tesla and Google.

Imagery was typically dominated by a proliferation of new travel modes, including flying cars and underground bullet trains, and road infrastructure designed to meet the needs of densely populated urban living patterns, including multi-story roads and underground roads,

Most participants imagined that private car ownership would continue to be the norm, at least as long as it remained affordable. A minority, particularly in London, felt that there would be an increasing necessity to lease or share vehicles with other road-users in response to rising costs and populations, although most resisted shared-usage as a compromise on comfort, convenience, safety and hygiene. There was an expectation that the way roads are paid for may change and many participants envisaged a totally privatised road-system, where users would be expected to pay via a digital and automatic toll system, rather than road tax.

Reflecting the burgeoning 'connectedness' of modern life, many participants described a centralised and computerised network tasked with ensuring maximum efficiency and optimisation of transport systems. This system was associated with a safer and more 'orderly' road network, where drivers would have to accept uniformity around speed and journey route. Although participants could see the benefits of this for safety, there were concerns about relinquishing control of individual choices and also about the potential vulnerabilities of a centralised network to systemic breakdown or exploitation (either by those in control over the system, or hackers/terrorists). In communications with the public about the benefits of the new technology, it will be important to consider that safety concerns extend beyond the narrow issue of road traffic incidents, and that safety as a whole will need to be balanced against other concerns such as autonomy.

A shift in views across the course of the dialogue

Across the course of the dialogue, participants were introduced to the emerging technologies as part of a staged approach: for Wave 1 information was provided regarding their current state and predicted path of development; for Wave 2 the technologies were integrated into a '2030' Transition scenario in which they had come into use alongside conventional petrol/diesel vehicles; and for Wave 3 they were integrated into a '2050' Future scenario in which they had replaced conventional vehicle technologies (see Section 1 and Appendix B). As the dialogue progressed, there was a clear progression in participant views, particularly in relation to automated and electric vehicles..

At the outset of the dialogue participants could be sceptical about some of the claims made about the technology areas. This was particularly the case for automated vehicles, which were seen to be very far from becoming a reality, but also applied, to some extent, to electric vehicles and platooning. Enhanced Real Time Information was understood more as an extension of what was already available and so was less controversial, although participants could question the benefits to them of more system-wide integration.

By the beginning of the Wave 2 workshops though a shift in views had taken place for many participants, particularly in relation to automated technology, which had come be understood as already in existence and in use, to varying degrees, on roads within the UK and internationally. As such, scepticism of the idea that electric vehicles and automated vehicle technologies would become more common decreased, although some still questioned the feasibility of the timeframes presented to them. This was also often accompanied by an increased prevalence in macro-level concerns about the pace of change, an over-reliance on technologies, and the implications of automation on control.

> *"While I'm more convinced that EVs and AVs will be viable in the future, I just think the effect on the economy of all the investment will be terrible! I'm a working mum and I would only buy an EV if it was cheaper for me to buy, but how and where will the government recoup the money it's lost from subsidies and from petrol/diesel taxes?"*

> *"I'm a bit apprehensive regarding the future. We are increasingly becoming reliant on technology but technology isn't 100% reliant. I fear that the robots will take over and then we'll be vulnerable to attack. I know that my job won't exist in the future, and that makes me feel as though my value and skills will no longer be worth anything in the future. It's alright for younger people, they were brought up with technology and can adapt – it's not like that for my generation."*

In this light, participant responses to the '2030' Transition scenario were mixed. Many were excited by the idea of how close some of the technologies were to becoming a reality, particularly the prospect of greater in-car personalisation options and services aimed at increasing convenience, such as valet parking. Given this increase in comfort and convenience, around half of participants envisaged travelling more in this future and very few imagined reducing their travelling time. At the same time, there were concerns that the scenario was quite utopian. People questioned the speed of uptake of electric vehicles, sceptical as to whether the infrastructure could develop at the necessary speed, particularly outside of urban centres. Some also worried that, for penetration to increase substantially, the government would need to effectively penalise those still choosing to use conventional technology (or unable to afford to switch to electric vehicles). In relation to automated vehicles, participants struggled to engage with the rationale for their introduction, leading to a consensus that this future was being driven largely by commercial and government interests rather than public demand. Overall, given the near-future timeframe most participants struggled to imagine substantial change from present conditions, with concerns about the difficulties of managing the new technologies alongside current vehicles further undermining credibility.

Participants were more easily able to imagine the '2050' Future scenario, in which fully fledged automated and electric vehicles had become the dominant technology, with the more distant timeframe meaning that reactions were less constrained by thinking about the present. At the same time, the greater potential for unknown societal, technological and cultural change meant that participants could struggle to imagine the

broader context of the scenario. As such, responses were largely shaped by current day experiences of technology / road travel, with the exception of some well publicised macro-trends such as the move towards more flexible working and denser residential areas.

Within the 2050 scenario, electric and automated vehicles were accepted as the norm. Attitudes towards electric vehicles demonstrated a distinct shift by this time, with many participants accepting that they would engage with the technology once it had reached performance and price parity with conventional vehicles, enabling them to feel good about contributing to wider societal benefits without making compromises in terms of performance, convenience or cost. Issues of control remained salient for automated vehicles and participants continued to question how this would improve their personal experience of driving, although there was little overt opposition to the technology if reassurance was offered that the driver could still take control if desired. The prevalence of the technology also headed off questions about how the new technologies would interact with conventional technology, bringing further into relief public concerns about the ‘messy’ transition period and how this could be managed in a safe and equitable way.

Regardless of their stance on the technologies themselves, personal ownership of a vehicle remained a priority for the majority of people across both scenarios. Given the perceived benefits of ownership over other existing models, the suggestion that ownership would be less prevalent in future felt regressive and prompted negative reactions. There was little in the shared service models presented that shifted people from their current mindsets and, in the absence of contextualised and detailed information about the comparative cost and experience of new services, it was challenging for people to accurately assess how they would behave in future.

By the end of the dialogue, many participants acknowledged their current behaviour was the result of habituation. Attitudes and behaviour concerning new travel modes could shift over time if the public develop trust in the technology, if alternatives to private ownership proved considerably more convenient or necessary, or if definitions of the ‘social norm’ change. However, even in these cases most attributed shifts in behaviour to some ‘other’ rather than themselves – for example younger people who may grow up habituated to the use of the technologies – and felt that change would be driven at least in part by external pressures such as incentives or legislation.

4. Response to the technology areas

This section provides specific details on participant responses to the technology areas and how these views shifted over the course of the dialogue…

Electric vehicles

- Participants were initially sceptical about the technology. Most understood the environmental rationale and were theoretically in support of lowering emissions, although a significant number questioned whether the technology was as beneficial to the environment as claimed From an individual level though, electric vehicles were currently seen as prohibitively expensive, with inferior range, power and aesthetic appeal compared to conventionally powered vehicles. A perceived lack of charging infrastructure reinforced initial impressions that the technology was far from entering the mainstream.
- Across the dialogue there was a clear shift in attitudes for many and by the end of the dialogue a number expressed a clear interest in considering an electric vehicle for purchase. This was driven by an increased familiarity with the technology, a greater awareness of existing infrastructure and reassurance about likely improvements in performance. Once electric vehicles were perceived to offer comparative convenience, performance and cost – e.g. no personal sacrifice compared to now - then participants were motivated by the idea of wider societal benefits.
- Concerns remained around some specific issues such as how those without on-street parking would charge at home, the environmental impacts of batteries and how the government will recoup funds currently raised from vehicle tax and fuel duty once electric vehicle use enters the mainstream.

Automated vehicles

- Participants initially saw automated vehicle technology as futuristic and exciting but unproven and far from reality. Despite safety claims, participants' instinctive reaction was that they could not imagine ceding driving responsibility to machines. Given current emotional attachments to driving people saw few personal benefits and tended to focus on what they may lose in terms of control or enjoyment.
- There was a clear shift in attitudes across the course of the dialogue. With exposure to information about the technology and existing trials, participants came to see the technology as far closer to reality and also, to some extent, accepted claims about improved safety. Some also saw potential benefits to the technology, such as opening up road access to those currently unable to drive and taking the stress out of long trips on the SRN, making car travel more attractive for inter-city journeys and opening up the possibility of living further from work. However, in contrast to electric vehicles, scepticism about the benefits remained strong for many and the development of the technology was seen to be directed more at businesses set to benefit from productivity gains.
- Large public doubts remained about the technology. There were concerns about the impact on jobs and an expectation that the government assist those affected. Another set of concerns revolved around the 'transition' period and how automated vehicles could be safely accommodated on roads alongside existing technology. Control remained a concern and participants wanted reassurance that they would still be able to take control if desired, creating tension with safety claims. Finally, some wondered if widespread adoption of automated vehicles could worsen congestion, due to an increase in empty vehicles on the road, the broadening of access to those who currently can't drive themselves and an increased use of car travel for long distance journeys currently served by rail.

Connected vehicles and real-time information

- People were almost universally positive about increased in-car information about congestion and route planning, which they saw as an evolution of current widely used navigation apps.
- Whilst there was an acknowledgement that system-wide coordination could provide benefits by spreading traffic across the network, it was important to participants that they keep control over their route and raised questions about how the authorities could manage individual vehicle routes across the system without someone losing out. Data privacy did not come up as a significant issue although some participants did raise concerns about data being used for insurance or compliance purposes, to control aspects of the vehicles such as speed or to charge people for their road usage. Some were also worried about what risks increased connectivity may result in should the system be 'hacked'.

Platooning

- Platooning – the use of automated and connected features to allow two or more trucks to travel closely together on the SRN under the control of the driver of the lead vehicle – generated little public support as it was seen to benefit only large freight companies.
- Participants tended to focus on uncertainties and concerns about how platoons would interact with other vehicles on the roads. UK roads were not seen to be set-up to accommodate freight platoons and the technology was seen to reinforce current concerns about the danger and inconvenience of high

Electric vehicles

Participants were initially sceptical

At the outset of this research participants typically entered with some awareness of electric vehicles, including plug-in hybrids, formed through a combination of television shows, media reports, awareness of government incentive schemes and seeing vehicles or charging infrastructure on UK roads (particularly in London). There was widespread understanding of the rationale behind electric vehicles as a way to reduce carbon emissions, air pollution and reliance on fossil fuels. While there were some sceptics, as detailed further below, there was a general acceptance that electric vehicles had the potential to answer a clear societal problem in the form of reducing pollution caused by petrol/diesel cars. However, whilst a number of participants across the sessions had purchased vehicles that they considered to be low emission, none currently owned electric vehicles. Only a handful had experience of driving or riding in an electric vehicle, through test drives or in a friend's vehicle.

While participants could appreciate that electric vehicle adoption may provide societal benefits, the majority view was that they were currently an unappealing proposition for replacing conventionally powered vehicles. Participants perceived electric vehicles as having a relatively (and often prohibitively) high initial purchase price, which made them feel out of reach for most people. Beyond this however there were a wide range of assumptions and concerns that, put simply, made people feel that an electric vehicle would mean compromising on convenience and performance. They were seen as restricted to a limited range so tended to be associated with urban driving, and even those using their cars predominately for short city runs tending to focus on the rare cases in which they may need to make longer journeys. On a more emotional level, electric vehicles also suffered from something of an image problem for some participants, who saw them as inferior in performance to petrol vehicles, unattractive and unable to offer the same experience – the feeling of raw power - as a 'real' car. The need to plan journeys around the availability of charge points was also seen to constrain spontaneity and freedom. In short, electric vehicles were (currently) perceived to be an inferior product for a higher price.

"The only cheap ones will be the poorer quality technology."

"If you can charge on the go, that would be fine, but it would be massively inconvenient if you have to plan and charge for every journey."

'If you ran out of charge you'd be stranded – it's not like petrol where you can ring a friend and ask them to bring you a can! You can't bring a can of electricity."

A range of other concerns also centred on doubts about the long-term viability of the technology. A perceived lack of charging infrastructure – particularly outside of London - was seen to signal that the technology was still far from entering the mainstream. A sizable minority of participants also questioned the claimed environmental benefits, questioning where the energy needed to power all these electric vehicles would come from (and what the implications would be on energy costs of this increased demand), and how batteries would be disposed of. The technology also prompted concerns drawn from experiences with other products that run on batteries, such as smartphones. For example, participants worried about situations in which they might run out of battery unexpectedly or about battery life deteriorating over time. Smart charging could also raise particular issues in this respect, driving fears about unexpectedly waking up to find that your car had not charged.

Given these concerns, participants were initially sceptical about the government target of 100% electric/hybrid vehicle sales by the year 2040 and had strong concerns that the government were effectively looking to force people into purchasing vehicles that offered a substantively worse performance than other vehicles currently available at a lower price point (in relation to the initial outlay). Even for those who were most interested in the technology, there was a lack of trust in the ability of the government to guarantee the development of a comprehensive charging infrastructure within that time period, particularly in more rural areas, or to make a long-term commitment to the technology. These concerns arose in part from the shift in policy regarding diesel, which the government enacted in response to revised technical advice, but which was little understood by the public. There was a fairly wide awareness of government incentives to purchase electric vehicles, but again scepticism about how far these would continue into the future given the need to recover public funds lost on fuel duty and road taxes. In all, the public seemed uncertain about the government's motives for supporting electric vehicles and whether those motivations might change in future. Some went further, believing that they weren't being told the whole story and that incentives, for example, were 'too good to be true'.

"Once the public are a captive audience prices will go through the roof."

A positive shift in attitudes across the dialogue

Despite these initial concerns there was a clear shift in attitudes amongst participants across the course of the dialogue. By the end of the final workshop some were expressing clear interest in purchase or actively looking into purchase, and one had actually gone ahead and bought an electric vehicle as a result of participating in the workshop. For others, the technology was presently still seen as prohibitively expensive, but was seen as an interesting proposition to be monitored as it developed. These shifts seem to have been facilitated by a number of factors.

Firstly, increased familiarity with the technology seems to have helped participants overcome some of their initial knee-jerk concerns and resistance to the technology. Participants reported noticing electric vehicles and charge points more in the news and on the roads during the course of the research. The awareness of offers from more mainstream or high-end brands, such as Volkswagen and BMW, seems to have helped increase acceptability and create a better brand image for the technology, bringing it more into the mainstream yet with something of a 'cool' technological edge compared to conventional cars. This process of

familiarisation could also be seen in the experience of individual participants. Those who had used or knew someone else who owned an electric vehicle were more likely to be positive and see the technology as a viable option.

Secondly, information about the likely increase in range of electric vehicles in the near future reassured participants about the effectiveness of the technology. When these were coupled with predictions about the relative cost performance of electric vehicles versus petrol cars, participants became able to rationally justify purchase. Seen in this light, electric vehicles came to be seen to effectively offer similar performance at a comparable price. When participants were able to justify purchase on this personal level, they were also then able to embrace the societal/environmental benefits, creating a further reason to feel good about buying-into the technology.

> *"I care about the environment, but let's be honest, if this doesn't make driving considerably cheaper for me – if I'm not going to be rewarded for switching - I wouldn't do it. Sorry but that's the truth."*

Thirdly, appeal grew when participants were able to overcome concerns about charging infrastructure and electricity supply. Some participants were reassured by the idea of being able to charge at home and others had noticed an increased number of charge points available since becoming more aware of the technology, although for most people some concerns remained around infrastructure (see below). It is interesting to note that reassurance was offered by hybrid vehicle technology, which was seen to potentially offer the best of both worlds and to act as a 'stepping-stone' into full electric vehicle use. The idea of retaining petrol capabilities as a backup for times when charge was not available did a lot to assuage fears about power supply and was seen as a much safer option by many for a first foray into the world of electric vehicles.

Some concerns remained

Interest in electric vehicles grew over the course of the dialogue; participants accepted that electric vehicles were likely to come into the mainstream at some point in the near future and few retained any strong objections to the technology. However, with the exception of some early adopters, most still felt that the technology had some way to go before they were ready to seriously consider purchase. Most importantly, they expected performance and price parity with their current vehicle, with little willingness to feel that they were 'trading down' in any way on cost, performance or convenience before switching. For the majority, there was resistance to acting as a 'guinea pig' for the technology and an expectation that it enter the mainstream before purchasing.

> *"I think EVs will be great: pollution will be massively reduced and that can only have positives on the environment and health. I'm concerned that charging times and range will never be improved which will stop people accepting them. Investing in tech is essential – less emissions means a healthier place. I'm concerned that without incentives people won't invest in EVs."*

Beyond vehicle performance and cost, another set of concerns related to infrastructure. Participants questioned the government's ability to ensure that the availability of public charging infrastructure developed at an appropriate speed to meet demand. This was partly built on a misunderstanding about the government's role, which was understood to be in directly developing infrastructure. However, even when this was clarified, doubts remained about whether the private sector would take the initiative and build sufficient charge stations until enough consumers were buying electric vehicles, creating a chicken and egg situation. Related to this, many participants living in urban environments were doubtful about the prospect of charging at home (if future 'home' charging looks similar to current arrangements), either because they lived in flats or couldn't guarantee a parking space outside of their house. Even those with a space could question how this would work in practice given the need to physically wire up to the grid, especially in homes with

multiple cars. Prospective alternatives, such as charging directly from the road infrastructure, seemed too far in the future to begin to address these concerns.

> *"I just feel so pessimistic about road works – even if the technologies have advanced how vehicles work – there are more issues with how the road works that need to be addressed. There is constantly road works and building works. They have big ideas for the future but can't even manage the day-to-day maintenance of the roads. If the roads are rubbish now, how can you trust them to sort it out efficiently when they upgrade them?"*

Questions also remained about some aspects of the technology itself. In particular, participants felt they needed more information about batteries, including how long they would last, how they can be disposed of and how much they cost to replace. Some participants also raised concerns about the effect that the use of the technology may have on the power grid, including whether an increase in demand for electricity due to a rise in the number of electric vehicles might raise the overall costs of power. This latter concern was less important in influencing decisions to consider or purchase but was an issue impacting people's willingness to engage with communications around the environmental benefits of electric vehicles.

The final set of concerns related to how the government might manage the transition from conventional to electric technology. There were strong concerns that a government preference for electric vehicles might restrict choice, with incentives for electric vehicles resulting in the penalisation of those driving petrol/diesel vehicles. For those with more limited financial means or who were currently driving cheaper second-hand cars, there was a fear that this could unfairly price them out of the market. There were also more general questions about how subsidies for electric vehicles would be paid for and whether lost fuel duties might be replaced by some kind of toll charge for using the roads.

Automated vehicles

Participants initially failed to see the technology as credible

Participants' top-of-mind associations with automated vehicle technology tended to be drawn from media reports on the development of the technology, including the 'Google car', and reports of accidents involving driver assist technology, such as Tesla. Although most participants were aware of drive assistance functions such as lane assist, and some were using these in their own vehicles, few people connected these with the idea of automated vehicles. Instead, there was a tendency to imagine automated vehicles as a completely new technology, representing a step-change in road travel. Furthermore, it was seen as very futuristic and still some way off from becoming a reality, with a somewhat alien feel. Given this image, whilst the idea of 'driverless cars' – as they tended to be called by participants - could generate some excitement, it challenged many strongly held assumptions about driving and answered no immediately obvious need.

> *"I saw in the news that loads of them had been crashing."*

> *"I've seen a couple on Top Gear though, they look pretty cool."*

For many participants, the most immediate concern when discussing automated vehicles was safety. Most participants intuitively felt human drivers to be more reliable and, even when presented with industry claims about the relative safety of the technology, many struggled to accept that machines could conduct a complex activity such as driving in a safe and trustworthy way. There was a sense that the technology was far from proven in real-life situations and was still very much in the early-stages of testing in laboratory-type conditions. Concerns ran across the audience but were particularly strong amongst nervous drivers and those less comfortable with technology.

'The human brain processes 230 million bits of information a second. How can a computer ever match that?!"

Alongside these practical concerns, the issue of safety was rooted in deeper fears about relinquishing control to technology. People questioned whether a machine could ever make the kind of complex moral decisions around what to do that are necessary in an emergency. Underlying these concerns were questions over responsibility and who would be liable for an accident in an automated vehicle. For participants, the relinquishing of driver control implied that the car itself could be found responsible, which was disquieting for some participants, shifting the very idea of what might be considered an accident and how to determine liability, as well as raising very practical questions about the implications for insurance. It could help to allay concerns somewhat when it was explained that fault could actually lie with the manufacturer or some other party responsible for building or maintaining the vehicle, although even then big questions remained about how this would work in practice.

"I just wouldn't feel safe because I wouldn't feel in control."

"I can feel nervous as a passenger with a driver in control, never mind if there's no driver!"

The idea of relinquishing control over the vehicle also raised broader concerns about the effect on the experience of driving. There were fears that ceding control of their vehicle to a computer would undermine the driver's ability to make their own decisions regarding routes or speed of travel and therefore diminish much of the sense of freedom currently associated with driving. The centralisation and computerisation of control also raised fears about systemic risk. In the light of a growing awareness of cyber-security and high-profile hacking events, participants worried about how the technology could open them up to new risks, undermining claims about safety.

"What if the technology goes wrong… we would have forgotten how to drive!"

Underlying these concerns, many participants also had deeper-seated questions about why the technology was being developed and what needs it was aimed at addressing. Most participants held a strong emotional connection to driving and for the most part actively enjoyed the feeling of control and active engagement that it offered them. They also tended to enjoy the sense of personal space and time that they encountered when driving, and had little spontaneous desire to be more 'productive' during their travel time, which in practice was often understood to mean either more work or more looking at screens. There was therefore little sense of benefit from automation. The technology was not seen to be answering any obvious problem for drivers.

In light of this, there was initially a high level of scepticism about automated vehicle technology. This operated on two levels. First, participants did not see the development of the technology by 2030 or even 2050 as a realistic prospect. It was seen as more of an idea than a nascent technology, and was still associated more with science fiction than with real life. Despite the claims of safety, participants' instinctive reaction was that they could not imagine handing over responsibility of such a central human activity over to machines. Second, participants did not see any immediate benefits from the technology, and instead tended to focus on what they may lose in terms of control and freedom.

A shift in credibility but still questions around benefits

As for electric vehicles, there was a clear shift in public attitudes across the course of the dialogue. However, in contrast to electric vehicles, this shift largely concerned the extent to which participants saw the development of the technology as a realistic prospect. This in turn drove some shifts in whether participants were able to see the technology as safe, although due to the absence of real-life testing some doubts remained for many. In terms of desirability, whilst participants did, to some extent, open up to the potential benefits of the technology for certain groups or in certain situations, scepticism remained strong about whether this was a technology that was really needed or indeed desirable.

"I'm still sceptical about AVs but interested to see how they develop. I think they'll make traffic slower and more frustrating because of increased levels of traffic and congestion. I'm less concerned with the safety of full automation than partial automation, but I don't want to have my control taken away. Will I still get the same joy from driving? Will I be able to speed in an emergency? I don't like the idea of total uniformity."

Again, much of the change in attitudes seems to have been driven by a process of familiarisation and sensitisation. Having been exposed to the technology in the early stages of the dialogue, many participants mentioned noticing media coverage about the technology, including details of actual trials of the technology in Greenwich and Milton Keynes, which suggested that the technology was at a more advanced stage than they had previously imagined. It is also noticeable that during the course of the dialogue, the Chancellor Philip Hammond announced financial support for automated vehicle technology and a change in the regulatory framework to allow testing on UK roads[5]. Exposure to these media reports – and to information about the technology throughout the workshops themselves - drove an increased awareness of how seriously both industry and the government were taking the technology, which in turn led to a greater belief in the credibility of it actually coming about. Whilst some doubts remained about the timeframe, and most struggled to picture automated vehicles by 2030, across the course of the dialogue the technology shifted from something associated largely with science-fiction to very much a real-life prospect.

"I think people just fear change. My mum wouldn't even get on a plane. We'll be the generation where everything feels scary, but as soon as it becomes widespread it'll just feel normal. AVs aren't that scary."

Alongside this, to some extent participants were also able to overcome some of their initial scepticism about the viability of the technology. The prospect that the technology was nearer than expected, details about testing of the technology on real roads and consideration of the fact that human error a factor in most accidents provided some reassurance around safety. Messages directly from industry itself could also feed into acceptance around the idea of safety. For example, in one workshop participants were more open to the idea of safety when informed by people working for Ford that safety was the key priority. The message that automated vehicles would not be perfect but would be safer than humans also seemed to have resonance with the public. However, whilst the participants shifted somewhat on the issue of credibility, a large number of concerns and questions still remained about quite how the technology might work in practice, particularly alongside conventional technology (discussed below).

With a growing acceptance of the credibility of the technology, participants also started to open up to some of the potential benefits. In particular they saw the technology as opening up mobility to groups who are currently excluded, especially older people or disabled people who are unable to drive, or to children, although this was often accompanied by questions of whether a chaperone would be necessary. They also saw the technology as offering wider advantages during certain situations: whilst few could imagine using automated technology for all journeys, many discussed how it could improve the experience of long journeys on the SRN, by allowing time to rest and cutting travel times by permitting smooth, un-interrupted journeys. Others discussed how the technology might allow them to use their car in situations when it would not currently be possible, such as after drinking alcohol. Here participants could begin to make connections with current automation and discuss how they could imagine getting used to the technology through a gradual process if able to choose when and where to deploy it.

"He may have a heart attack [due to over work] – but the car could drive him straight to A&E."

[5] https://www.gov.uk/government/speeches/autumn-budget-2017-philip-hammonds-speech

With consideration, some participants could also see benefits in the idea of being able to conduct other activities during journeys when necessary. It is necessary to point out that this did not apply to all participants or to all situations. As the majority of drivers actively enjoyed the experience of driving, the idea of losing this experience to engage in more of the same tasks or activities conducted at other times during the day was not necessarily attractive. However, some white collar workers discussed being able to conduct work during journeys, as long as this did not extend the hours in which they were expected to be working, which was a very real fear. Some others also talked about being able to use time in the car to spend better quality time with their children, again particularly during long journeys. One final benefit of the technology, which was popular across the audience, was the idea of automated valet parking, which was seen as highly convenient and addressed the common problem of trying to locate a parking space. Given these benefits, participants felt that they would be likely to travel the same amount or more often by car if they had access to an automated vehicle, particularly on the SRN, as it would take some of the hassle out of making long journeys or journeys to unfamiliar places.

> *"It would be great to be able to do a bit of last minute lesson planning on the way to work in the morning when you've not had the time to. But, I can tell that this would easily go from the one-off, to an everyday habit. I'm not sure I'd want that to eat into my non-work hours so much. I don't think increased productivity is always for the best."*

> *"I'm so optimistic about the future! This new tech is developing very fast and changes will happen so soon – I'm so excited about it! It will make driving around so much better – you'll be able to relax and chill – watch movies on journeys, not getting bored."*

Remaining concerns

Despite these changes in attitudes, public doubts remained around the technology. Most fundamentally, participants failed to see any sufficiently compelling personal benefits from the technology, beyond perhaps valet parking. Given the freedom and enjoyment derived from driving, most did not see the technology as answering any particular problem and instead feared that it would curtail their sense of control. The development of the technology was therefore largely interpreted as being driven by the other forces, particularly businesses who were seen to have most to gain through the increased productivity of people or services. Allied to this, it was also seen as being pushed by industry – and the government – onto people, rather being designed with people's needs in mind. Related to this, the technology raised concerns about potential job losses for drivers. As the government was seen to be supporting the development of the technology, this raised questions about what they may also be doing to assist those whose livelihoods may be affected.

> *"I really like the idea that industry and government are approaching the development of technology in unison. They are considering both the cost to the public and the extent to which infrastructure will need to be developed – which is both laudable and welcome. I understand that AVs are a case of when and not if, but the technology should only be deployed when safety is ensured and with necessary considerations about job losses."*

People also had serious concerns over quite how the technology would be implemented. Whilst most were able to imagine a somewhat distant future in which all vehicles were able to operate entirely independently, they were much less able to understand how the 'transition' period leading up to this might work. This concern operated on two levels. First, participants struggled to comprehend how lower levels of automation might work. A vehicle which can operate autonomously but requires a human 'driver' to take control in certain circumstances was considered to be dangerous. Second, participants were concerned about a future in which automated vehicles operated on the roads alongside conventional vehicles and questioned how the two might interact. Again, this was seen to potentially give rise to new dangers and some intuitively felt that

there would be a need for separate lanes for automated vehicles. Given these concerns, participants were still unclear at the end of the workshops how the shift to full automation might occur.

These issues also related to another strong fear about participants, that of the loss of control. As outlined above, this was seen to undermine the freedom inherent for many people in the act of driving, and as such was strongly resisted. Given this, some participants initially expressed a preference for a form of partial automation that allowed them to take control when they wanted, although this was then seen to largely negate the safety benefits of the technology. This tension between safety and control could diminish public faith in automated vehicles, by presenting a choice between either seriously curtailing control - against public wishes - or undermining the core justification for development of the technology.

Another concern, also related to the issue of control, was whether there would be legislation preventing people from using non-automated or 'manual' vehicles. In other words, if automated vehicles did come into the mainstream, then would human drivers be considered unsafe and unfit for the roads? There was an expectation that vehicles using the technology would be expensive, creating concerns for some that ownership would be restricted to the wealthy, increasing societal divisions. This was particularly the case for those currently driving second-hand cars, who felt that they could be priced out of the market even if new vehicles with the technology did not significantly go up in cost compared to today.

One final issue raised by some participants was whether the widespread adoption of automated vehicles might lead to an increase in congestion, due to a combination of an increase in road travel amongst current road users, the broadening of accessibility to groups currently unable to drive themselves and the possibility of empty cars using the roads.

Connected vehicles and real-time Information

As part of understanding the impact of automated vehicles, we also explored reactions to the idea of increased vehicle connectivity and real-time information (RTI) provision, The majority of participants, excluding the most elderly, were already using forms of RTI (ranging from satnavs, to navigation apps like Waze and Google, to apps that help them plan where to park or buy fuel). As such people's awareness of RTI – at least for the purposes of creating efficiencies to their individual journeys - was relatively high.

With a minority of exceptions people were positive about RTI and felt there had been massive strides in the development of services that supported journey planning and travel. Accuracy had greatly improved and value was placed on services that highlighted accidents, speed cameras or police presence, enabling people to adjust their route or behaviour as required. There was a general sense that RTI was already commonplace and people initially struggled to anticipate what further information could support more effective travel. Only a small minority of (typically older) participants reflected that they had not adopted these new services as it took some of the pleasure away from the simplicity of driving and preferred to use hard copy maps instead.

When presented with information on how RTI might develop in the future, people were broadly positive about the potential for greater accuracy in RTI to support more efficient journeys. At the same time, they were generally underwhelmed with this as an area for innovation as the benefits of future technological development were largely seen as providing potential benefit to the wider system rather than to them personally. While there was a degree of acceptance that - through the central management of traffic - congestion overall could be reduced and journey times improved, people were still reluctant to cede control over the route that they took. While recommendations on the best routes were welcomed, participants often felt that their 'local knowledge' was superior and wanted the option of choosing which route to take. As such, they wanted RTI to remain 'for information only' as opposed to actually controlling the movement of the vehicle itself, particularly in relation to automated vehicle technology. People wanted to retain control.

There was recognition among a minority of participants that enhanced RTI would require greater information to be provided by vehicles – to some form of central system - as well as being provided to drivers to inform their journey decisions. The concept of data privacy did not surface during discussions and people were not immediately cognisant of how their personal data might be used. On prompting there were some concerns raised around how this information could be used to monitor people's adherence to the rules of the road (e.g. automatic speeding fines), to monitor the quality of people's driving (with implications for licence renewals or insurance) or to charge people for their road usage (e.g. based on distance travelled). This in turn caused questions to be raised about who would control or have access to their data, and mixed feelings about the government sharing data with private companies and vice versa.

Current RTI services were already felt by some participants to provide too much information for them to manage effectively while driving, and there was a fear that enhanced RTI would lead to information overload, as well as an even greater volume of targeted advertising. An allied fear was that data security breaches could lead to criminals or terrorists creating havoc with the transport network through hacking into the systems that control the information provided to drivers.

> "It's alright as long as you have the option to turn it off."

In theory, the ability of vehicles to communicate the state of the road infrastructure to relevant authorities was responded to positively, however the value of such a service was undermined by perceived historic under-investment, particularly in local roads. Participant's struggled to believe that more information on the condition of roads (or supporting infrastructure) would lead to more effective maintenance and repair.

Platooning

During discussions of automated and connected vehicles, we also explored reactions to the idea of truck-to-truck platooning, which utilises both forms of technology. The majority of participants had heard of platooning of freight on the news (there had been recent media coverage of trials to take place in the UK), but, given that trials on UK roads had not yet begun at the time of the dialogue, none had been exposed to the service directly. As such awareness was limited to a basic understanding of the principle that a convoy of freight lorries would travel closely together, though whether this was controlled by a driver or completely automated was less well understood except by a small minority of people that had read the news articles more extensively.

> "They've tried this already haven't they? It didn't work. Surprise, surprise."

Platooning of freight was still seen to be a very new technology, and bound up in the development of automated vehicles and artificial intelligence which, as discussed, was a technology that raised a number of safety concerns. As such people were very sceptical about the safety of freight platoons, and harboured further doubts about the feasibility of employing platoons on UK roads. Even on the main motorways participants did not see platooning as being a practical solution as they envisaged that lorries would need to be decoupled and manned every time that they needed to exit the SRN, reducing the value of the service. A comparison was made across all locations with the rail network, which was seen to offer a more practical and existing solution to the movement of large volumes of goods. While freight platooning was seen to make sense in larger countries (like the US or Australia) with suitable infrastructure, within the UK context people did not believe it made sense. Finally, participants saw platooning as having one primary benefit – that of reducing costs for businesses by removing the need for drivers. There was little understanding that any savings would be passed onto the public and, as such, little interest in platooning as a technology area to prioritise.

When presented with information about platooning technology developments, participants still struggled to engage with it as a service in the future as they failed to see any immediate benefit to themselves. Instead the benefit would be to large commercial companies with the likelihood of greater rather than less congestion

as entire lanes of the SRN were taken up by platooning freight. Alongside this, participants identified a range of concerns, allied to those raised for AVs and enhanced RTI that negated interest in this technology in 2030 or beyond. Fundamentally people lacked an understanding of what it meant to be a ‘connected’ vehicle. People do not currently see their vehicles as ‘connected’ to a system or one another. There was therefore a degree of fear around what this this means in practice and how safe freight platoons would be.

In all, UK roads were not perceived as appropriately set-up to accommodate freight platoons and a risk that Government investment in supporting the technology could be perceived as primarily of benefit to big businesses.

5. Response to new mobility services and shared service models

This section provides specific details on participant responses to a range of automated shared service areas, including a digital platform providing an integrated service across different modes…

There was little spontaneous understanding of how vehicle automation might significantly change the way that people travel or lead to the development of new forms of mobility services. Experience of existing new driving service models was low. Whilst most had heard of Uber or similar services, there was little experience of use outside London. There was low awareness and use of UberPOOL or other shared options.

When prompted with a range of services – including a private automated car service, a shared automated car service and automated bus and minibus services - participants tended to assess them in reference to existing alternatives to car travel – specifically taxi services or public transport. As such, people tended to imagine using new services in similar situations to at present. Those currently travelling by means other than their own car could see benefits in terms of both cost and convenience. However, for the majority a personal automated vehicle was still seen to offer superior comfort, convenience and privacy compared to alternatives and remained the preference unless prohibitively expensive. Automated driving services were seen as a supplement rather than a replacement to ownership and few felt a proliferation of services would affect their attitudes to travel.

There was particular resistance to sharing, especially in smaller vehicles, where close proximity to other passengers was seen as a risk to personal comfort and safety. Accommodating other people's needs was also seen to compromise convenience and most felt that they would only share with people that they knew through some kind of social connection. Participants were more open to the idea of sharing in larger vehicles, which they tended to compare to current mass transit options and could imagine using for specific purposes if offered by an organisation or as an improved form of public transport.

The idea of an integrated platform providing information and seamless payment across a range of different mobility options generated excitement and felt like a natural progression of apps like CityMapper and Google Maps. People valued the idea of a personalised and transparent service enabling a more rational consideration of which option may best suit them for a journey, rather than defaulting to habit. At best, some could see how such services might encourage them to reduce household ownership from two cars to one car if other options seemed affordable, although most didn't want to relinquish ownership altogether.

New mobility options and services

As part of our discussion, we explored a range of potential automated mobility service options, the majority of which included some element of sharing (see Figure 5.1 below for details). Participants were asked to trade off the benefits of various options, including their own personal automated vehicle, for a range of journeys across a number of different criteria, including cost, speed, convenience, comfort and privacy.

Across the three locations in which the dialogue was conducted experiences of existing shared services was low. Whilst most participants had heard of Uber or similar services and some, particularly in London, were making use of these, there was low awareness and virtually no use of UberPOOL or other shared options. There was also very limited experience of current shared ownership models, such as ZipCar. As such, the public generally struggled to imagine how the services presented to them throughout the course of the research would work or might impact on their lives. They also failed to see how the introduction of automated vehicles would affect the kind of services available, except for maybe a slight reduction in cost, or significantly impact the way that they wished to travel. Given this lack of experience and understanding, people tended to view the services presented to them through the lens of familiar forms of non-personal transport – either taxi services, shuttle services or public transport. In particular, participants found it hard to imagine how automation might enable entirely new forms of vehicle. This had important implications for how services were understood overall and the degree to which people were open to the idea of sharing within any given service model.

Responses to the trade-off exercise therefore varied somewhat depending on current experiences. People who were currently making less frequent use of their car or who were travelling more using public transport were generally more open to continuing this behaviour and sharing with others in new service models. This represented a minority of the sample overall, but was more common in London where, for some, public transport options were already seen as more convenient than car travel for many journeys, including commuting. For the rest of the audience, who were using their car more frequently and making little or no use of public transport, there was typically quite strong resistance to the idea of sharing. This was to some extent based on practical reasoning, with taxi-type services seen as less convenient than driving in one's own car. Importantly though, this aversion to sharing also had an important emotional component for many, in that people felt discomfort at the idea of sharing, with some displaying an almost visceral aversion to having to travel in close quarters with 'unknown' others.

Figure 5.1 Responses to the new mobility options and shared services

RESPONSE TO NEW MOBILITY OPTIONS AND SERVICES

A self-driving car you own

A personally owned vehicle with full automated capabilities, able to drive completely independently of human input but with the option to also be controlled by the driver if preferred

Even in the context of automation, travelling in your own car was seen to set the standard for convenience, comfort, privacy, speed and flexibility for most journeys for most drivers, particularly those living and working outside of London and without accessible public transport options. For those used to car ownership, relying on other unproven shared services was seen to represent a fall in the standard of living and most wanted to maintain ownership as long as it remained broadly affordable on a per journey basis.

Private self-driving service

A service that allows users to summon a private self-driving vehicle on demand for short journeys or longer periods, with automatic pickup from home or any other location

Although most drivers did not want to give up their own-vehicle completely, most could see a role for private self-driving services for both short-term and long-term use, which they related to current experiences with taxis or hire cars. The privacy offered of the service was valued highly and created a sharp distinction with shared services. Most could imagine using in some occasions in situations in which they could not or did not want to use their own car.

Shared self-driving service

An automated ride-sharing service for a small number of passengers travelling in similar directions, reducing everyone's fare

Participants tended to reject the idea of a shared automated car service, except in some situations if it could offer a significant price reduction compared to a private service, equivalent to splitting the fare. Many displayed high levels of resistance to sharing with 'strangers', which was felt to be uncomfortable and potentially a risk to safety. Compared to sharing with many people on public transport, people could only imagine sharing the relative confines of a small vehicle with people that they already knew personally or through wider social networks.

Shared self-driving minibus

An automated service that is shared with a number of other users - or may be offered by different organisations such as schools, work places or businesses

Some participants saw automated minibus options as highly relevant for certain situations and felt they could expand the capabilities of the kinds of services already offering shuttles, such as schools, social services or employers. Minibus-style services were seen to offer a more personalised and convenient service than public transport and a greater level of anonymity than a smaller shared vehicle and if affordable then could appeal both as a supplement to current public transport or as part of wider service offerings.

Public self-driving bus

An automated public service that follows a fixed timetable along a fixed route – much like current public transport

Even in the context of new automated services, many participants could still see the value in fixed schedule buses, especially in busy urban centres. If able to offer a reliable and timely service then they were in some ways seen as a convenient option, requiring no input from the user except turning up at the bus stop.

Integrated transport service

An online service that is accessed via a user's personal digital assistant and automatically suggests the best travel option from across a range of public and private alternatives, with payment taken directly from the user's digital wallet

Received more positively than the other non-ownership-based new mobility models, addressing a number of the barriers that participants currently saw to public transport use and helping road-users to imagine journeying by means other than their own car. Participants valued the idea of a convenient joined-up door-to-door service, offering transparent and tailored information about costs and journey-times for a range of options. Some could see how such services might encourage them to reduce car ownership in their family if other options seemed affordable, although most didn't want to relinquish ownership altogether.

"I don't like sharing with people – would rather get the train than share a car with somebody."

Across the audience then, the introduction of new forms of shared services did little to shift participants away from their existing attitudes and behaviours around how they would choose to travel. Most still expressed a preference for using their own vehicles where possible, as it was seen to offer the greatest convenience, flexibility, privacy and comfort. One factor that may have been expected to push people towards an increased use of shared services was cost. However, as noted in Section 2, the majority of participants considered ownership of their own vehicle a necessity and so any comparisons of cost were on a per journey basis. Indeed, the sunk costs of ownership could be seen to act as an incentive for car use, as greater use represented greater value from the purchase. As such, on the whole alternative services were only really seen as attractive if they could offer a more convenient service than driving, such as greater speed during the commute, the avoidance of high parking fees or service at times when driving is not currently suitable, such as after drinking alcohol.

"The shared service would have to be SO MUCH cheaper for it to make up for the fact that she wouldn't have her own car. I wouldn't do it unless this was the case. It'd be a nightmare having to have your kids in a shared car – what would you do with all their stuff? What if they made a mess – who is going to clean that up?"

Situations in which participants were open to using alternative services therefore tended to be substituting those where they might currently use taxis or public transport. The adoption of new mobility services could therefore reduce demand for public transport, raising questions about the impact of adoption on congestion. Furthermore, there was little indication that, for those habituated to owning their own vehicles, these services offered a satisfactory alternative to ownership in terms of convenience, flexibility, personalisation or status. For the majority of participants then, shared services were seen as a supplement to ownership, and to potentially offer a more convenient alternative to public transport at a more affordable price than current taxi services. There was also a clear preference expressed for private self-driving services in most situations, as it was considered worthwhile paying a premium in order to avoid the inconvenience and discomfort of having to share routes and personal space. Many also speculated that the reduced cost would make mobility more accessible to those who could not currently drive themselves, such as the disabled or elderly. This suggests a risk that road traffic could increase with the introduction of more affordable self-driving services, as users switch from public transport to private automated car services.

Whilst the idea of an affordable self-driving service could create interest, there was much more resistance to the idea of ride sharing, especially within small personal vehicles such as taxis. Whilst some could imagine

sharing in certain circumstances - e.g. if they were catching a taxi from a station and the other people in the queue were heading the same way – the majority associated taxis with trips made for quite individual purposes, often during the evening when concerns about safety could be at the fore. Emotionally, the idea of sharing in a small vehicle with a small number of other passengers created strong negative reactions of discomfort, lacking the relative anonymity and established etiquette around sharing on public transport. This often included fears for personal safety related to sharing space with an unknown stranger, accentuated by the lack of any driver to act as a concierge. Most therefore felt that they would only be open to sharing with individuals that they already knew, such as friends or colleagues, or could at least identify through some kind of pre-existing connection, such as working on the same industrial estate or a social media connection.

Practically, there were also reservations about the benefits of the service. Driving services were seen to lack the flexibility to accommodate complex individual driving needs or trip chains - such as dropping the children at school, heading to the shops, then finally to work - or to adapt swiftly to changing needs. The need to pick up and accommodate the routes of others was seen as a considerable inconvenience, with each stop creating the potential for additional delays or waiting times. Importantly, there was a sense that sharing could affect not only the overall journey time but also predictability, reducing passenger control and handing it over to the service and the needs of the other passengers. Given this, even in cases in which individuals were open to the service, they felt that it would need to be substantially cheaper than regular services to represent value, for example little more than the price of a private service split evenly between the number of passengers.

Participants were more open to the idea of ride sharing in larger vehicles, which they tended to reference against vehicles that were currently offering some kind of shared services. For example, self-driving shuttle services were often related to current minibus or coach services, such as holiday shuttles, school buses or dial-a-ride mobility services. People could imagine using these services for specific purposes if they were offered by an organisation, although struggled to see how such services would be significantly different from those offered at present. At other times, people could imagine shuttle services more a more personalised form of public transport and could welcome the improvements created by more dynamic routing. However, the larger number of passengers and stops was inevitably seen as less convenient than ownership and most didn't therefore see it affecting the way they were currently making decisions about how to travel. With the introduction of more personalised shuttle-type services, public self-driving buses could be seen as less important, although some regular commuters still appreciated the idea of a fixed timetable and route to cover their everyday journeys, especially if cheaper.

Mobility as a Service

Participants were also presented with the idea of a 'Mobility as a Service'-type digital platform providing integrated information and seamless payment across a range of different mobility options, including new shared service models and public transport. This received considerable positive reaction and could create high levels of excitement amongst participants. People were easily able to imagine using the service and many compared it to apps that they were currently using, such as Google Maps or CityMapper, seeing it as a welcome progression of these, offering a series of benefits that were appealing on their own and also made the idea of using public transport or shared services a more attractive prospect because the service could increase the convenience of travelling by means other than one's own car. It was envisaged as being quick and easy to use, removing the need to micromanage journeys or coordinate across different providers. Here the integration of private shared services alongside public transport options was seen as a particular benefit, particularly as it helped to enable full end-to-end journeys. Allied to this, payment through the service was also seen as highly beneficial, making the whole process seamless and easy-to-manage, creating the feeling that users are making use of just one service. The integration of a full suite of options within one easy-to-use

service was seen to take the hassle out of planning and helped to improve the sense of accessibility of travelling by a means other than personal car.

Participants were positive about the personalised nature of the service, which they felt allowed them to stay in control of the options offered to them, in terms of how they prioritised travel in general or their needs for a particular journey. The service was seen to offer the best option ‘for me as an individual’ rather than some generic idea of what is best or what is best in terms of the network. Some of the journey aspects that people discussed in relation to this were price range, journey time and preference for specific modes of transport, such as more private forms of shared service but also walking.

For those currently making less use of public transport, the service was seen as best suited for longer or more unfamiliar journeys, where it could be a useful tool in sorting through a large range of dispersed options for multi-stage journeys and help to connect to disparate services. For those commuting by public transport, especially in London, the service could also be seen as a useful everyday tool, to help respond to unexpected delays or service alterations.

In all, by comparing journey times and prices from across a broad range of different options, the service was seen to bring transparency to the process of choosing how to travel, especially if it were able to compare costs alongside the cost of travelling within a privately owned vehicle. By tying together public and other shared modes of transport in one convenient service, people felt that it offered the means for them to make a more rational consideration of which option may best suit them for a journey, rather than defaulting to using their own car.

Participants could see the service as a prompt to using alternatives to car travel then, although it didn’t shift the ways in which people were willing to share, with most still opposed to the idea of sharing with strangers in small vehicles. As such, many outside of London felt that public transport offers would need to improve considerably for this to be a realistic option. Those in more rural areas in particular, could doubt whether the services would be available for this to be a realistic option for them.

6. Reactions among the public to policy options and resulting considerations

This section summarises participant expectations for the government role in relation to the new technologies, and pulls out some implications of this for potential policy responses…

Participants typically expected the government to be responsible for implementing the infrastructure necessary to support electric and automated vehicles, with little recognition of the role of industry. This led to some concerns about whether there was the money, capacity or capability for the infrastructure to be implemented as quickly or effectively as was being predicted and discussed within the workshops.

The government's role in relation to transportation was perceived to be one of maintaining an effective transport system that moved people from place to place safely and efficiently. As such, only a small minority of participants recognised and praised the government for investing in roads technologies from the perspective of supporting industry and the economy. There appeared to be little grasp that government is a multifaceted entity working towards multiple objectives and interests - at least when considering transportation policy. Indeed, perceptions that the government were playing a role in directly or indirectly promoting the adoption of new technologies and services could lead to concerns that vehicle owners or drivers of 'conventional' vehicles would be penalised in future, restricting their choice and potentially forcing them into the adoption of unproven technologies.

Congestion was considered a problem by many, but it was also an issue that people had become accustomed to and tolerated as it was largely predictable. Overall, the convenience and relatively low cost offered by road travel outweighed frustrations. People rarely reflected on their own role in contributing to congestion and more often saw it as a result of poor traffic management. On reflection participants could recognise the role of individual choices in congestion, and were highly positive about the benefits that reduced congestion and car ownership would provide (e.g. in terms of the physical environment and air quality), these were not sufficient to encourage people to change their behaviour.

Participants were presented with a range of initial ideas for policy aimed at encouraging people to travel less by car. When considering these, participants expressed a strong preference for incentives over taxes or charges. Many participants were unwilling to support the idea of raising taxes even for heavier road users, though participants in London were more open to charging for certain roads or at certain times, perhaps due to familiarity with the congestion charging zone. Incentives such as discounts, promotions or loyalty schemes for using sharing schemes were more popular and could encourage people to trial them, although this did not counter underlying concerns about the relative inconvenience of sharing vehicles compared to travelling in one's own car. Despite widespread concerns about congestion, the idea of building more roads or widening existing roads was generally not seen to be a viable long term solution, neither was the introduction of car-sharing lanes as they were seen as likely to cause congestion for the majority of drivers and leave sections of the road empty much of the time.

Changing the behaviour of drivers and the paradigm of car ownership will require attractive, safe, reliable and affordable alternatives to ownership. Alongside this, it will also require significant input from government and industry in helping people to live in ways that reduce the need to use the roads so uniformly, in promoting the benefits of sharing vehicles and in helping to establish a new framework of social norms about the individual's role in helping to manage congestion (e.g. via behaviour change initiatives and campaigns).

Views on the role of government in supporting the technologies

Even though it was explained to participants that the development of new road technologies would largely be driven by private enterprises, it was evident that they still anticipated that government, or at the very least some public authority, would have a key role in managing and implementing the infrastructural changes necessary for any future roll-out of electric and automated vehicles. This was particularly clear in relation to electric vehicles. People perceived the government to be playing an active role in 'promoting' the technology via incentive schemes but tended to extend this to include the idea that government would also be the provider of the charging infrastructure necessary to support it. Throughout the course of the dialogue participants also came to see the government as playing a role in promoting automated vehicle technology, influenced to some extent by the content of the research itself but also by media reports about government support for the technology. There was an assumption that accommodating automated vehicles on the roads, especially alongside conventional vehicles, would also require high levels of infrastructure investment.

> *"Government needs to support, facilitate, and incentivise people to transition over to the newer forms of technology"*

The idea that government was key to driving these new technologies had some influence on how people envisioned it developing. Across the audience, and especially outside of London, there was a view that 'government' was not effectively maintaining the current road infrastructure, by repairing potholes for example, or in the deliverability of large public sector initiatives (with HS2 and the NHS raised as examples). There were therefore doubts about the ability of the government to oversee the development of new infrastructure, often accompanied by questions about the legitimacy of doing so if the current, seemingly more basic, infrastructure is not being maintained.

> *"Look at how long it has taken for them to get HS2 up and running, how are they going to handle all of this?"*

It is worth noting that a very small number of participants did take a positive view of government involvement, praising the attempt to plan for the future, to address issues of congestion and pollution, and to create new

economic opportunities. It is interesting that most participants had a relatively weak grasp that government is a multifaceted entity. Alongside the maintenance of roads, the key role that people saw for the government in relation to transport was in ensuring the effective provision of public transport. Perceptions of the rationale for the development and investment in transport technologies was seen to sit almost entirely within transport policy, with scant awareness of the role of industry, industrial-economic policy or benefits to economic development. This is potentially an angle that government may wish to emphasise alongside the personal benefits – a dual approach - in supporting communications around any future investment of public funds in roads infrastructure.

Misunderstandings about the role of government in supporting new technologies - in relation to the role that is played by private companies - could also raise questions about the motivations driving development, such as why the government was 'investing' in developing automated technologies rather than making improvements to public transport. In relation to shared services in particular, this could raise questions about access to the fore. Given that automated driving services were seen to be of particular use to those with mobility issues, some raised questions about how government will ensure that commercial companies are providing services that are both accessible and affordable to these groups, by for example providing subsidies for use.

"So they'll be in cahoots then? The government will just sell it off to businesses."

Perhaps most fundamentally, the idea that government was actively involved in promoting the new technologies raised concerns that users of conventional vehicles could be penalised in future. Many participants were strongly opposed to the idea that their future choice of how to travel would be restricted and that they would be forced into adopting electric and automated vehicle technology. This was felt to be an unwelcome incursion on their freedom to choose, with negative perceptions reinforced by a lack of clarity on the personal benefits of the technology. This was particularly the case for automation, where the benefits of the technology were felt to accrue primarily to businesses. Here some participants raised questions about whether the government was thinking about the wider effects of the technology and making plans to deal with second order effects, such as the potential impact on the job market, which was seen as a more central domain for government.

The role of policy in reducing congestion

Congestion was a consistent concern for participants throughout the course of the dialogue. However, underneath these surface concerns, public views towards congestion were complex. People generally had positive images of how the areas in which they lived and worked might look and feel if congestion were reduced and to a large extent saw it as the responsibility of government to manage congestion. When forced to consider their own role in contributing to congestion though, they generally acknowledged that they were in part responsible and that, despite positive imagery of a world with fewer vehicles on the road, they were too wedded to the freedom and convenience offered to them by ownership to voluntarily curb their own driving habits.

When asked to imagine a world in which congestion had been reduced, participants often had quite utopian visions of what this would look like. Many described more parks, greenery and open 'European-style' terrace cafes and restaurants. City centres were pictured as being generally cleaner, healthier and more pleasant to be in. Accompanying this for many there was a sense of strengthened community – with more public spaces and greater opportunities for children to play outside. However, these positive visions were almost always accompanied by a strong sense of cynicism about this actually happening. On one level, this was driven by a surface expectation that government should be reducing congestion or providing wider transport solutions and an accompanying lack of faith in them to do so. Alongside this though, many participants also acknowledged wider societal barriers. Their visions of a more communal world in which people interacted more with the communities around them was seen to be at odds with the individualistic way that people

currently lived, including the ways in which they travel e.g. private cars. Even those who were most positive about the idea of reducing the number of cars on the roads felt that it would require a shift in public attitudes and behaviour that they could not envision happening spontaneously, even in relation to their own behaviour.

Towards the end of the research, participants were asked to consider how some outline policy option ideas aimed at reducing congestion. When exploring these, some clear patterns in responses emerged, particularly a preference for incentives over taxes or anything that could be construed as punitive towards motorists. The cost of motoring, considering road tax, fuel duty and insurance costs, was already perceived to be a major household expense, and the idea of taxing further was strongly resisted on the grounds that it was unfair to penalise those that need to use a car to conduct their daily activities. Taxes were generally perceived to be likely to hit poor people hardest and many participants were unwilling to support the idea of raising taxes even for heavier road users, as they may be more in need of using the roads. Rather than target individuals, there was a feeling that businesses using the roads should be paying a greater share. In London, where people were already used to the congestion charging zone, people could be more open to the idea of charging to use certain roads or during certain hours. Elsewhere, even though taxes were strongly resisted, there was recognition that taxes would be likely to impact travel decisions if they made driving less financially viable.

When they were understood, incentives to share vehicles or to drive less were, perhaps somewhat unsurprisingly, much more appealing. This carrot versus stick approach was considered much more palatable but did raise some questions as to how it would work in practice. Some suggested discounts, promotions or loyalty schemes for using sharing schemes, such as the ability to collect tokens for sharing that could then be redeemed against future travel costs. However, this would involve the cooperation of the private companies running the services, who will anyway be attempting to make services attractive to potential users. Others talked about how government could subsidise specific journeys, particularly for those with specific mobility needs, in order to ensure accessibility, although this would necessarily only affect the behaviour of a minority of individuals. Although incentives were a far more popular option, some also raised doubts about whether they would alter their current behaviour given the convenience they felt was offered by their car. Reactions then suggest that a positive framing and approaches to encourage use of shared mobility are less likely to be met with resistance by the public, but there is still no obvious prospect of significant behaviour change given the visceral current response to sharing.

Despite widespread concerns about congestion, the idea of building more or even widening roads was generally not seen as the answer, with responses driven by a mixture of concerns about feasibility and cynicism about the impact. For some, the idea was just not realistic, given the lack of space in areas where congestion was at its worst. The idea was also understood to carry a high cost and there were questions about affordability. Perhaps most importantly, people's responses were shaped by their experience of road works at present. There was little desire to face the short to medium-term disruption caused by work to widen roads and a sense that improvements would have little lasting impact on congestion anyway.

The idea of introducing car-sharing lanes was also opposed by most motorists, largely based on negative impressions of existing bus-lanes, which were seen to cause congestion for the majority and leave sections of the road empty much of the time. There were also concerns about the extensions to infrastructure that would be necessary to support this and felt that the only realistic option would be for shared vehicles to use current bus-lanes, but wondered even then how this would be policed.

The need for a holistic long-term approach?

Participants could be quite aware of the tensions in their views: on the one hand they wished to see congestion reduced and were positive about the idea of reducing the number of cars in their lived environments, on the other they felt unable and unwilling to change their own travel behaviour. When

reflecting on this, a number of suggestions emerged across the sessions about what might shift their own ingrained behaviour.

A number of participants raised the idea that, given the central role currently played by personal car ownership in their lives, changes in attitudes towards travel would only occur over a long time-period and via a process of constant reinforcement. Some compared this to the way that attitudes had changed around wearing personal seatbelts and drink-driving. In this light, government was seen to have a role to play in promoting the benefits of sharing vehicles and helping to establish a new framework of social norms about the individual's role in helping to manage congestion. This suggests an important role for behaviour change initiatives and campaigns, in the same way that the Think campaign has been used to shape norms around road safety. Crucially, this approach would rely on the existence of convenient alternatives to personal ownership, whether from public transport or commercial shared service providers. Also, whilst government can play a role in helping to seed and promote new social norms, ultimately people's behaviour will most be shaped by those around them. As a critical mass of people start to use shared services, driven by pragmatic factors such as cost and convenience as much as social principles, then the idea is likely to build in acceptability amongst larger sections of the public. This suggests a crucial role for younger people (particularly those in urban centres) who may be growing up without cars or who are not acquiring driving licenses at as young an age as has been the case in the past. The younger generation may not yet by as habituated to ownership and are therefore making a different set of calculations about the relative costs of different travel options. It is therefore possible that adoption will be subject to inter-generational effects, with new behaviour amongst younger generations potentially laddering up and creating new social norms amongst older generations. For this to be facilitated it will still require a fundamental change in material conditions for mobility, and/or wider social values; if it remains comparatively cost effective and more convenient to own your own vehicle then the behaviour will be harder to change even among the young.

In reaction to fears about penalising motorists, participant responses also suggested that a more positive approach to selling the benefits of reducing congestion could be effective. Prior to the workshops, participants had not seriously considered how reducing car use could change the way that they engaged with their cities and, whilst there was cynicism about how this could happen, visions of how life could be improved by a reduction in car use could be motivating. Here many participants talked about the positive benefits of pedestrianisation of certain widely-used areas as one way of engaging the public with this idea, perhaps supported by effective park and ride schemes. Others suggested a more active role for government in promoting and improving public transport services, both as a way to create more viable alternatives to car travel but also to signal real support for alternatives to car travel.

Finally, people felt that using their cars was currently a necessity given the way that their lives are structured. Whilst they could imagine shifting working patterns, particularly higher levels of flexible working, changing the extent to which they needed to use their cars in future, they also saw an important role for government in helping people to shape their lives in ways that reduce the need to use the roads, particularly at busy times. Here people suggested ideas such as greater localisation of services, staggered start times for school and businesses and policies promoting flexible working. People's travel patterns are intimately tied to the structure of their broader lives, suggesting the need for a joined-up cross-departmental approach to tackle some of the underlying causes of congestion.

7. Implications: Likely public responses to future technologies and services

This section considers public responses across the dialogue to draw out and highlight the likely barriers and enablers to adoption of the different technology service areas…

Behavioural thinking provides a means of interpreting public responses and exploring implications. System 1 and System 2 are two distinct modes of decision making. System 1 is automatic and influenced by habits, heuristics (mental shortcuts) and the context in which decisions are taken. System 2 is more reflective and influenced by the conscious assessment of legitimacy, efficacy and cost/benefits.

Immediate participant reactions to the transport technologies and services can be seen to driven by System 1. For example beliefs or assumptions that electric vehicles are slow, unreliable and unaffordable; that current infrastructure is not designed in a way that could permit automated technologies to operate as safely as a human being; that Real Time Information is attractive because it builds on services that people are habitualised to (such as Google Maps); and that shared services are an unfamiliar hybrid between private and public transportation, with neither the safety of public transport nor the convenience of a private vehicle.

When presented with additional information and asked to reflect on their likely future behaviour, participants adopted a more rational (System 2) approach to assessing options. Assessments were made around the perceived viability of a service/technology, whether it added value, and whether it compromised or enhanced the control/flexibility people had over journeys. From this more considered view, the rationale and benefits of electric vehicles became more apparent, but significant concerns remained for both automated vehicles (in relation to loss of control/enjoyment and safety) and shared services (in relation to convenience and safety).

As new services and transport options become more viable, adoption will depend on people feeling able to judge the benefits as outweighing the costs. This judgement incorporates financial calculations but also a range of other costs and benefits relating to personal and social circumstances (e.g. relative values placed on time, convenience, comfort, safety and privacy; perceived opportunity costs; level of risk aversion etc.).

Discussions of expected future behavior was framed within the context of an existing paradigm of convenient and affordable vehicle ownership that typically gets them from A to B within an expected timeframe, supported by a wider system of public transportation that is largely fit for purpose. Clarity will be required around many issues (e.g. home charging infrastructure; how partial automation can operate safely; what the automated vehicle ‘experience’ would feel like; the future tax or regulatory situation etc.) for people to assess both the legitimacy and costs/benefits of the proposed technologies/services, and therefore to judge their own behaviour. In the absence of this, the reaction to new technologies or services seeking to alter the existing paradigm typically involved scepticism if not outright dismissal.

That said, a range of factors emerged likely to influence adoption for the key technologies. Across the technologies, the general public were more likely to be motivated by options which personally benefit them by making their lives easier in some way or that reflect social norms, than they are by rational macro-level benefits around congestion or reductions in pollution.

Electric vehicle adoption is likely to be influenced by:

- the relative supply, availability and affordability of both electric and petrol/diesel vehicles
- electric vehicle performance
- access and convenience of supporting infrastructure (both for electric and petrol/diesel)
- financial incentives and regulation which influences attractiveness of owning petrol/diesel vehicles

Increased electric vehicle adoption has the potential to significantly reduce the cost of road travel, which could at the margin increase road usage amongst those concerned with costs. However, if this results in increased congestion the likely impact will be that people turn to other forms of transportation (e.g. public transport or shared services).

Automated vehicle adoption will be influenced by:

- the relative availability, affordability and safety of automated technologies
- the performance and experience of using automated vehicles as compared to conventional vehicles and/or public transport
- the effectiveness of communications which convey the safety and benefits (convenience, reliability, comfort and cost effectiveness) of the technology
- the speed and efficacy of the transition between driver assistance technology (Level 1 and 2) and true self-driving automation (Level 3, 4 and 5)

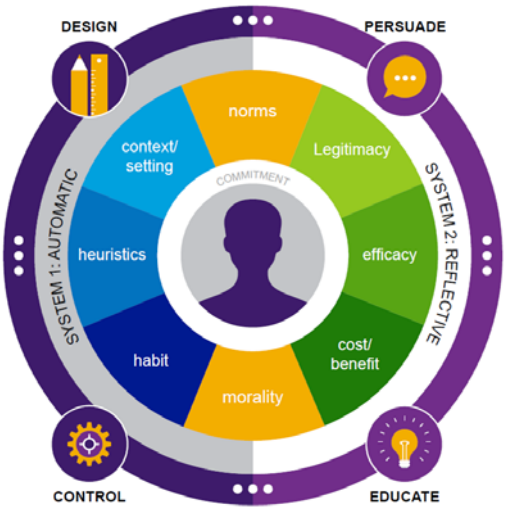
Increased automated vehicle adoption would increase the range (and potentially volume) of people who use the road network, and could lead to increases in the volume and length of car journeys as long car journeys become more attractive due to the increased capacity to carry out other activities (e.g. sleep or work). This in turn may influence where people choose to live, with people moving from urban centres or commuter towns.

The adoption of shared services will be influenced by:

- Legislation or regulation that reduces the attractiveness or convenience of private vehicle ownership
- The relative costs of private vehicle ownership
- Shared services being demonstrated to be reliable and safe forms of transportation, comparable to the efficiency of public transport and/or convenience of private vehicles
- Shared services increasing their personalization of offer (e.g. different types of vehicle or service) and geographic coverage
- Shared services being fully integrated within Mobility as a Service
- The prevalence of people that have the capabilities (and licences) to drive

Shared services are seen to be neither public nor private transport – an offer which is currently largely undefined and un-experienced by most people. Sharing is a compromise which people are reluctant to make outside of public transport options where it feels normalised. With increased automation, it is likely that norms will be challenged, providing an opportunity for greater sharing. However, at present there is limited evidence to suggest sharing in private services will become normalised without a significant push from both government and industry.

Understanding the behavioural levers underpinning participant responses



The preceding sections provide detail of the responses gathered from members of the public during the workshops. To understand the implications of these for actual behaviour and demand on the road network, we have drawn on the Kantar Public behaviour web (see right), a model that summarises what we know (from a combination of academic work and practical research experience) are the key generic influences on people's behaviours. This is useful in helping to understand what is driving participants' current responses to the technologies and service areas, and what might influence their future behaviours.

The immediate reaction to most technologies and services was influenced by more automatic (System 1) factors such as existing transport habits; heuristics, like availability (ease of imagining), affect (emotional feeling generated by concepts), loss aversion biases (higher weight given to potential losses than gains); and a context/setting in which current infrastructure is not seen to be supportive of the adoption of new technologies like electric vehicles. It was also influenced by how legitimate participants felt the technology/service was in terms of whether it was addressing an identified need and whether people could envisage it being implemented. Relevant System 1 influences that could be seen within this research included:

- Perceptions among participants that electric vehicles are perceived to be slow, with poor range and expensive relative to conventional vehicles. Drivers of electric vehicles are expected to be older people (with the wealth to meet the higher purchase price and less performance demands) or people with environmental concerns. There is a perceived lack of electric vehicle charging infrastructure and issues exist around home charging feasibility for many people in urban centres, in the suburbs and in some rural locations.
- Perceptions among participants that automated vehicles can't work as the technology just isn't as good or safe as a human being. How can Level 2 or Level 3 automation possibly be safe if people are expected to take control? They may lose the skills necessary to drive or not be in a position to retake control in certain circumstances. Furthermore, how can automated vehicles operate effectively in a context in which there are automated and non-automated vehicles sharing a road yet which cannot 'communicate' with one another?
- Real Time Information is a familiar concept, building on people's experiences of journey planning apps like Waze, smart motorways and variable speed limits. It is therefore not a stretch of the imagination to see this becoming more integrated into how people plan and support their travel.
- Public transport was seen by people to have the benefit of being cheaper and (often) quicker than travel by car within urban centres so, while less comfortable and private, it can be a sensible option for regular journeys that are serviced effectively. Perceptions among participants that shared services are a compromise on convenience, comfort, privacy and safety – though it is not a public service per se which is confusing - therefore the immediate reaction is negative where private vehicle ownership is still an affordable option. However, it is intuitively appealing to those who currently may not drive and have limited alternative options.

Anticipated behaviour in relation to certain transport technologies was seen to change relatively rapidly through raising people's awareness of where the technologies were currently at (or will be in the future) and in providing reassurance around the safety, efficiency and effectiveness of the technologies. The more considered (System 2) reaction to technologies and services was influenced by more reflective components such as whether the proposed technology or service was seen to be viable (e.g. within anticipated

technological capabilities or the socio-economic and environmental context), whether it added value in such a way that people would change their behaviour (e.g. moving from car ownership to car sharing because of the cost savings), and whether it compromised or enhanced the control/flexibility people had over their journeys. Relevant System 2 influences that could be seen within this research included:

- An acceptance among participants, further to review of the evidence, that the performance of electric vehicles will soon hit parity with conventional vehicles, private companies will develop and implement suitable charging infrastructure, and the running costs will be significantly cheaper than petrol/diesel equivalent. In addition, the move to electric will help to improve air quality and the environment. This increases the appeal of the technology and between 2030 and 2050 participants can largely see electric vehicles becoming the norm. However, there are still some individuals who remain sceptical and will delay adoption until the technology is more mainstream and the supporting infrastructure is seen to be present.
- In principle, fully automated vehicles sound like an attractive proposition to people. They have the potential to free people up to do other things when in transit and, in Greenwich, Ford stakeholders quickly overcame safety fears through assurances around the level of performance that would be expected of automated vehicles. However, there was a high degree of scepticism around how and when this potential would be realised, and the demand was not being generated by public consumers. Fully automated vehicles were seen to likely be very expensive as compared to vehicles with lower levels of autonomy; prohibitively expensive for most people. Furthermore, there is still a lack of clarity around how automated vehicles will operate alongside non-automated vehicles and what the journey to full automation will look like. There were also wider concerns about the degradation of driving skills that will result from the introduction of higher levels of automation and the employment impacts on those currently working in transportation as drivers. While these second order effects had less influence on people's anticipated behaviour they did serve to reinforce primary concerns.
- Beyond public transport there was little in the way of normative experience for shared services except for UberPool (which was only familiar to a small number of participants, and largely in London), and comparatively little in the way of information on how these services may operate. As such, people's reactions to shared services were influenced more by more automatic System 1 factors than they were the more reflective System 2 influences. However, it was clear that *if* shared services were a convenient alternative to public transport, *if* they could be demonstrated to be a safe mode transport, and *if* they were more cost effective to car ownership, then they may become a viable option for people who currently own a car. At present the cost differential between a private taxi and a shared service (e.g. via UberPool) were not sufficiently different for most people to accept the inconvenience of sharing when not driving their own vehicle. For non-drivers, shared services are more of an appealing service as it offers the potential for higher levels of convenience and independence than reliance on public transport, friends or family.

These more reflective factors will become increasingly important in influencing behaviour in relation to transport choices as the technologies and services under consideration become more available and normalised within society. As behaviours change and adoption increases this will help generate a swing in attitudes that will in turn further increase adoption.

The implication, should government and industry be interested in encouraging greater take-up of electric vehicles, automated vehicles and/or shared services, is to first concentrate on tackling System 1 barriers (those automatic responses to propositions) before then focusing on System 2 barriers (the more reflective and considered responses). For System 1 it will be important to raise people's awareness of the technologies and services, their development pathway, performance and safety benefits. Key in tackling this is to recognise the influence that heuristics are playing in peoples' reactions to the technologies and services

(e.g. I am a better driver than a machine would be; ownership as a paradigm) and forcing people to question and re-evaluate these (through communications, education or legislation). Given the financial implications of vehicle purchase decisions, there is also inevitably a need to address System 2 barriers once people engage more deliberately with the technology/service options (e.g. electric vehicles are slow and have low range; automation is less safe than human control). Here there would be an importance in raising awareness and educating people through communications from trusted influencers (most likely to be the media and industry).

Impact of new technologies on publics' road demands

DfT commissioned this research in part to understand how people are likely to react to new transport technologies and services to help inform investment, policy and communications strategy. One interest is whether new technologies and services will increase or decrease the demand placed on roads infrastructure in the next 15-30 years. The challenge in answering this question is that participant's immediate responses are framed by their lived experience as of 2017/18 where there is an overarching paradigm of vehicle ownership which provides a private, convenient and affordable means of transportation for most people that typically gets them from A to B within an expected timeframe. This is supported by a wider system of public transportation that is largely felt to work in the current context, though not sufficiently extensive to meet all people's needs in terms of coverage or speed. As such, the reaction to new technologies or services that seek to alter the paradigm (particularly automated vehicles or shared services), typically involves scepticism if not outright dismissal.

When encouraged to reflect on the new technologies and services, and to consider anticipated behaviours in a future context, people engage in a more rational assessment which ultimately centres on the perceived costs and benefits. Fundamentally people will only adopt new technologies, and demand allied services, if the cost/benefit judgement stacks up. This is a judgement that not only incorporates financial costs but also the wider costs and benefits that relate to personal and social circumstances (e.g. the relative values placed on time and convenience, comfort, safety and privacy; perceived opportunity costs; level of risk aversion; current financial circumstances etc.). If the new technologies and services are more expensive or less convenient there is less of an incentive to alter behaviour. Similarly if these technologies or services are seen to offer greater efficiencies for people (in terms of speed of journey time or increased reliability) or wider benefits such as greater freedom of movement or increased free time this will increase their perceived efficacy and therefore attractiveness.

As it stands there is still clarity required around a host of unresolved issues (e.g. home charging infrastructure for electric vehicles; how partial automation can operate safely; what the automated vehicle 'experience' would feel like; the relative cost of an automated shared service compared to ownership; the future tax or regulatory situation for car owners) which is necessary for people to assess both the legitimacy and costs/benefits of the proposed technologies/services, and therefore to gauge likely reaction. What is clear is that the general public are unlikely to adopt technologies based on rational macro-level benefits as DfT or Government may see them (e.g. congestion / reductions in pollution). Instead, people are far more likely to be motivated by making decisions which personally benefit them, that make their lives easier in some way or that reflect social norms – with reduction in congestion or pollution levels being a secondary consideration in the uptake of new technologies or services.

As with technology adoption in the past, as it becomes more commonplace the norms alter (e.g. in relation to what is environmentally acceptable, vehicle ownership, what a vehicle constitutes) and people will feel more comfortable adopting new behaviours. As both technologies and norms can change very quickly (e.g. attitudes toward smoking, drink driving) this makes it challenging for people to predict their future behaviour accurately but also shows the potential for largescale and rapid behaviour change. Nonetheless, based on this research, it is possible to consider what the influencing factors will be on peoples' decisions in relation to

hypothetical scenarios involving the core technologies and services under consideration. Figure 7.1 (below) details those factors identified influencing electric vehicle adoption[6].

Figure 7.1: Factors that facilitate or act as barriers to electric vehicle adoption

ELECTRIC VEHICLES

Factors that will increase the adoption of electric vehicles over the next 15-30 years:

- Car manufacturers reduce/cease their supply of new petrol/diesel vehicles, as currently planned for 2040
- The purchase price of electric vehicles reduces to become more on par with conventional petrol/diesel models offering comparable performance
- There is a reasonable supply of second-hand vehicles to enable lower income households to transition over to electric vehicles, without necessarily compromising on performance quality
- The performance (range and speed) of electric vehicles improves, again offering comparability to petrol/diesel vehicles
- Investment is made in the charging infrastructure to enable home charging and sufficient public charging points, or technologies develop that support charging on the move
- The charge time for electric vehicles improves to allow for fast charging when not at home
- Legislation or schemes comes into place which increase the tax on petrol/diesel vehicles, or ban them from certain areas (e.g. urban centres)
- The availability of petrol/diesel within filling stations reduces, making it more inconvenient and potentially less socially desirable to own a conventional petrol/diesel vehicle

Conversely, the adoption of electric vehicles will be hindered where:

- The perceptions of the relative performance and cost remain
- Charging supply infrastructure does not meet the convenience demands/expectations of people
- There continues to be an easily accessible and affordable supply of petrol/diesel vehicles, and refuelling options

The barriers identified in Figure 7.1 will confine uptake to early adopters that will necessarily be wealthier individuals able to afford the luxury of an electric vehicle, possibly still in addition to ownership of a conventional vehicle. Should adoption of electric vehicles increase, such that they form a substantial proportion of the vehicles in use by 2050, it will be necessary for the government to ensure that suitable charging infrastructure is established to facilitate convenient charging. Given how much cheaper it is to run an electric vehicle as compared to a conventional vehicle there is a risk that should electric vehicles increase considerably, this could lead to heightened demand on the roads. This in turn has the potential to increase congestion though, in response to this, people are likely to seek alternatives to ensure time is used most effectively, thus still presenting government with the challenge of how to recoup lost revenue from petrol/diesel.

[6] Note that these are not exhaustive, nor necessarily articulated directly by participants, but represent the range of factors likely to have influence on behaviour based on our analysis of the workshop discussions

Automated features within vehicles will start to become more commonplace over the next 15-30 years, which will help to normalise the relinquishing of control from the driver to the vehicle itself. On the assumption that fully self-driving technology is introduced in the near future, the factors detailed in Figure 7.2 will influence adoption rates[7]:

Figure 7.2: Factors that facilitate or act as barriers to automated vehicle adoption

AUTOMATED VEHICLES

Factors that will increase the adoption of automated vehicles over the next 15-30 years:

- The purchase price of self-driving cars reaches a level which is affordable, or lease options are provided that make the technology available to the general public, otherwise this technology will remain the domain of wealthier early adopters in the short-medium term
- Experiencing the technology firsthand and how it interfaces with both the roads infrastructure and other road users/pedestrians, either through seeing private vehicles on the roads or through riding on automated public transport (buses or mini-buses)
- Advertising of autonomous vehicles conveys the safety of the technology and the benefits to users (i.e. the features which support work/leisure activity while in transit); this would need to account for benefits to convenience, reliability, comfort and cost effectiveness
- Advertising or incentives should take advantage of people's bias against loss aversion. People are motivated to minimise feelings of loss based on a previous reference point, so advertising could take advantage of this in positioning automated vehicles offers against conventional vehicles (e.g. in relation to depreciation or vehicle tax)
- The transition between driver assistance technology (Level 1 and 2) and true self-driving (level 4 and 5) is relatively swift; at present there is a high degree of concern around the safety of Level 3 – or conditional automation – where drivers may be required to retake control of a vehicle at short notice
- There are few high-profile accidents or shortcomings in the performance of the technology during the short-medium term
- Car manufacturers reduce their supply of non-autonomous vehicles and automated functions such as valet parking become activated as the default factory settings
- Reassurance is provided from the government or the 'system controllers' around the safety and security of the overarching connected network infrastructure (i.e. around personal data and anti-hacking)
- The extent to which autonomous vehicles, which still retain the ability for manual driving, pass information on to authorities or insurance companies around driving behaviour
- The speed and connectedness of the wider public transport system

Conversely, the adoption of automated vehicles will be hindered where:

- The added value of the technology is unclear in terms of the relative benefits it will bring
- There are significant ongoing safety concerns – the availability heuristic shows that automated vehicle accidents will be significantly more memorable than will road accidents involving conventional vehicles

At present people can struggle to see how automated vehicles will benefit them as individuals or society more broadly, and there are significant concerns about Level 3 or 4 autonomy where control (and safety) moves between the responsibility of the user and the car. Unless car manufacturers make the benefits of this

[7] Note that these are not exhaustive, nor necessarily articulated directly by participants, but represent the range of factors likely to have influence on behaviour based on our analysis of the workshop discussions

technology tangible for people, and provide access to the technology for people to try it for themselves, then uptake of self-driving vehicles will likely be confined to a small proportion of individuals that are wealthy and/or technology enthusiasts. Given the way in which technology trickles down vehicle model ranges it is likely that more and more people will be exposed to the underlying technology, though possibly without consciously associating it with automation. Businesses on the other hand may be earlier adopters due to the commercial advantages that automated vehicles provide for transporting goods or people.

When Level 4 or 5 self-driving technology becomes mainstream (i.e. when it is both affordable and safe) there will likely be a relatively high level of adoption (either via private ownership if vehicles were comparatively affordable, through leasing, or through shared services) due to the range of benefits this will provide for people in terms of how time in transit can be spent. It would also enable a much wider range of people to be using the road than is currently possible (e.g. children, the elderly or those with disabilities that currently prevent driving). This would have the potential to lead to increases in the volume and length of car journeys as - assuming that car travel remains relatively cost effective as compared to public transport options - using an automated vehicle for commuting would become more viable (particularly if the vehicle can drop people off and independently park). This in turn may influence where people choose to live, with people moving out from commuter towns. However, if congestion increases substantially people will be unlikely to accept longer journey times assuming that faster journeys can be achieved by public transport options.

Shared services are likely to take advantage of both electric and automated vehicle technologies, building on and diversifying from current services like Uber Pool. The factors detailed in Figure 7.3 will influence adoption rates[8]:

Figure 7.3: Factors that facilitate or act as barriers to increasing use of shared services

Factors that will increase the use of shared services or Mobility as a Service over the next 15-30 years:

- Legislation comes into place which increases the tax on private vehicles, bans them from certain areas (e.g. urban centres – building on the Clean Air Zone legislation now put in place by many cities) or prevents/penalises ownership within certain residential areas
- The purchase price, or running costs, of owning a private vehicle rise substantially relative to salaries, or other living costs (mortgages, rent, food etc.) increase substantially, reducing the income that can be spent on purchasing or maintaining a vehicle
- The cost of using a shared service is significantly lower (c. 20-25%) than the running (and parking) costs of a private vehicle
- Shared services can be demonstrated to be reliable and safe forms of transportation, comparable to the efficiency of public transport and/or convenience of private vehicles
- Congestion on the roads does not significantly increase, in which case people will switch to faster forms of (public) transport
- Shared services provide a diverse offer to allow consumers choice over the type of vehicle they travel in, who they travel with, the level of privacy desired, the in-car experience, and the level of assistance required
- Shared services increase their coverage such that they become more normalised outside of the major urban centres
- The coordination of MaaS (e.g. via apps) seamlessly integrates shared services with other forms of public transport, walking and cycling
- Greater numbers of people do not apply for driving licences due to the phased introduction of self-driving technologies

Conversely, the use of shared services will be slower to materialise where

- Alternative, private options are still financially viable
- Where shared services prove themselves to be less safe, more unreliable or more inconvenient than other alternatives.

It will be important for shared services to have a clear service offer for people so that they are able to set their expectations accordingly. The danger is that they are seen to offer an option that is neither public nor private transport – an offer which is currently largely undefined and un-experienced by most people. Sharing is a compromise which, at least at present, people are reluctant to make outside of public transport options where it feels safer (due to larger numbers of passengers and greater physical space) and more normalised. This suggests that, in the short term at least, it is likely to be younger males (and those in urban areas) that are more likely to utilise shared services.

As fully automated vehicle technologies develop there will likely be a significant shift in the concept of what a vehicle looks and feels like to travel in. This change will alter the norms around transportation, and will likely open the way for shared services to be more seriously considered. Currently shared services hold limited appeal as the price differentiation is not sufficiently compelling to pull people away from the options currently used. However, going forward, should automated shared services provide both a more cost effective and convenient service than would either car ownership or public transport, it is likely that their use will increase. Assuming that vehicle ownership becomes less affordable – due to purchase prices of automated vehicles or taxes/running costs - then there is a strong possibility that people will use shared services in their place, particularly for shorter journeys with more predictable journey times. This may also reduce the volume of passengers on public transport (most obviously within urban centres) though should public transport continue to offer faster and cheaper travel, especially across larger distances, the impact would likely be limited (especially given the predicted population increases).

Given the current level of shared service use it is unlikely that sharing will become normalised in the foreseeable future, at least until the introduction of self-driving technology helps to reduce the costs to such a degree that these services become more compelling to consumers on a financial level. Even under this scenario however, it will require a significant push from both government and industry to encourage greater sharing of vehicles which, in turn, has the potential to lead to more manageable levels of road use given the predicted population increases.

Final thoughts

As we have seen countless times in the past, the adoption of new technologies can be rapid and the impact of this adoption hard to predict or plan for. The participants in this research were members of the general public, representing a wide spectrum of socio-demographics and driving behaviours. They struggled to anticipate what the future may hold in terms of how new technologies and services may influence their behaviours, particularly without clarity on how exactly the technology would operate, what their road-travel experience would be, the financial viability of the options under consideration, what the alternatives would be, and what the social and legislative context would look like.

Initial reactions were largely emotionally driven, which will influence the adoption of these new technologies and services, with electric vehicles most likely to see a relatively rapid increase in the medium term (i.e. within the 2030-2050 timeframe) assuming the performance concerns are addressed and supporting infrastructure is put in place. However, ultimately the adoption of these technologies and services will be driven by relatively rational decisions that are influenced by cost/benefit calculations. Price will be a key driver of choice, but cost/benefit also includes a number of other important factors that - including speed, convenience, comfort, privacy, safety – all of which will be weighed up when making decisions. Based on the views of the general public in the workshops conducted, while electric vehicles have the potential to increase substantially in the next 30 years, the use of shared services and automated vehicles will be relatively slower to take off. The benefits of both shared services and automated vehicles are not clear enough for people. While there will be significantly higher levels of automation on the roads in the next 5-10 years, will it be the self-driving (Level 4 or Level 5) automation that can truly revolutionise transport or more interim stages of automation that prompt more fear than excitement?

If Level 4 and 5 technologies and supporting (IT) infrastructure develop rapidly in the next 5-10 years, *if* further work is conducted to build a comprehensive understanding of how to influence behaviours around shared services, and *if* significant education and awareness raising is undertaken around these new technologies and services there is a possibility that technology/service adoption could be relatively swift and changes in travel patterns seen as early as 2030. Nonetheless, the equalising factor will always be congestion. If journey times on the road increase, people will look for alternative routes, modes or times to travel.

Appendix A: Levels of automation

Human driver monitors the driving environment			
0	No automation	Full-time performance by human driver	-
1	Driver assistance	The driving mode-specific execution of either steering or acceleration/deceleration using information about the driving environment but with the expectation that the human driver performs all other aspects of the dynamic driving task	e.g. Adaptive cruise control
2	Partial automation	The driving mode-specific execution of both steering and acceleration/deceleration using information about the driving environment but with the expectation that the human driver performs all other aspects of the dynamic driving task	e.g. Parking assistance
Automated driving system monitors the driving environment			
3	Conditional automation	The driving-mode specific performance by an automated driving system of the dynamic driving task, with the expectation that the human driver intervenes appropriately to requests to intervene	e.g. Highway chauffeur
4	High automation	The driving-mode specific performance by an automated driving system of all aspects of the dynamic driving task, within specific use cases, even if a human driver does not respond to requests to intervene	e.g. Parking garage pilot
5	Full automation	Full-time performance by an automated driving system of all aspects of the dynamic driving task, under all use cases (i.e. roadway and environmental conditions) that can be managed by a human driver	e.g. Robot taxi

The table above is based on the Society of Automotive Engineer standard J3016. This standard defines a useful means of understanding the different “levels” of vehicle automation, they are not formally recognised by the UK, or the UN bodies responsible for vehicle construction regulations and international road traffic rules”

Appendix B: Methodology and sample

Overview

Kantar Public employed a staged approach to this research, with two core data collection phases:

- Phase One - 30 depth interviews (12 general public and 18 businesses[9]) were undertaken between 30th August and 8th September 2017 to inform the development of the wider public dialogue, and to provide early findings about public and business responses to the four service areas. This Phase of work was reported on separately and where appropriate learnings from the public interviews have been subsumed into this report.,Findings from the business interviews are included separately in Appendix D
- Phase Two – deliberative workshops in three locations (Newcastle, Sutton Coldfield and Greenwich) with 33 members of the public invited to participate across three waves of reconvened workshops in each location.

Deliberative Dialogue

This research aimed to understand public views around the complex and still nascent topic area of emerging road technologies. To address this challenge, we employed a deliberative approach specifically designed to develop meaningful public dialogue around a subject area that the audience was likely to know little about, exploring public reactions to the technology and service areas across a series of reconvened workshops. The research followed an iterative process, with early sessions focused on the provision of information relating to the technology areas, allowing time and space for reflection, and deeper engagement, debate and prioritisation focused towards the end of the dialogue once participants were more informed. The sessions followed a stepped structure, with a shorter evening session for Wave 1 helping to ease people into the process and preparing the ground for full-day sessions during Waves 2 and 3. Workshops at each wave included a mixture of whole-group plenary sessions and smaller breakout group activities. In between each session, participants were tasked with completing a short take-home activity, keeping them engaged with the process and providing an additional source of individual data. Participants were also provided with a financial incentive of £150 in return for their attendance at all three workshops and to ensure that no-one was excluded from participation due to financial considerations.

Stakeholders were engaged in various ways, including via links provided by DfT and free-find approaches. Input was sought throughout the project, including during project and stimulus design, when a series of workshops was held with stakeholders on the four technology service areas. Stakeholders also participated in Waves 2 and 3 of the dialogue, responding to participant requests and helping to fill information gaps

[9] General public interviews included a mix of local, regional and national road users, mixed frequency of road use, with demographic spread (across age, gender, and SEG). Businesses included a mix of business size and sector (freight and personal use e.g. taxi companies), a mix of regional and national travel, and mix of frequency of SRN usage (biased towards frequent use). Interview locations included: Leeds, Nottingham, Birmingham, Exeter, Kent and Bristol.

when needs arose. Following the public dialogue, a final workshop was held with stakeholders to collect their responses to the workshops and to emerging findings.

Each wave of the dialogue focused on a distinct set of aims, which were sketched out at the start of the process and then refined throughout, incorporating learnings from previous waves. We adopted an iterative process, shaping the focus of each wave of workshops to account for people's views and the needs of DfT. As such there was a tightened focus on electric vehicles, automated vehicles and shared services over the course of the dialogue. The broad aims for each wave were as follows:

	Date / Time	Aims and Objectives
Wave 1	17th / 19th October 18:00-21:00	**Introduce group and process, establish existing understandings / behaviour and introduce technology areas…** • Identify participants' current driving attitudes, behaviour and technology use • Explore spontaneous public visions of the future (2050) including visions of transport • Introduce and collect initial responses to each service area in more detail
Wave 2	25th Nov / 2nd Dec 10:00-16:00	**Explore '2030' transition scenario, including acceptability of automated and electric vehicle technologies** • Respond to participant questions from Wave 1, using projective and immersive techniques to bring technology areas 'to life' and explore issues or acceptability • Explore potential reactions to travel decision-making in a near-future transition scenario, using personas to understand participant's preferences within the presented choice infrastructure • Identify potential barriers and opportunities arising from the scenario relating to safety, cost, privacy etc.
Wave 3	20th / 27th January 10:00-16:00	**Explore '2050' future scenarios, particularly reactions to a range of self-driving shared services** • Introduce and discuss 2050 scenario, including potential impact of growth of shared service model on transport conditions • Explore reactions to a series of 2050 travel options across a range of different journey types and personas, to draw out public priorities and trade offs • Establish public priorities and concerns for 2050 road use, drawing on user-generated mobility service ideas and reactions to potential policy options

To support participants to engage with the subject matter, Kantar Public developed a range of stimulus material bringing to life the various technologies and policy options under exploration. These were developed following an extensive literature review and incorporating findings from Phase 1 scoping interviews, in consultation with DfT, CTS and a range of external stakeholders. For Wave 1, participants were shown stimulus explaining the current state of each technology and some of the ways in which it may develop in future. For Waves 2 and 3 of the dialogue, stimulus materials revolved around the introduction of greater information on the different technologies, distinct future scenarios and a series of projective exercises that

presented participants with a series of defined choices. These scenarios were presented as potential examples of how the technologies could develop, not definitive predictions of the future. They were also accompanied by a clear explanation that the time frames presented were just illustrative and that in reality development of the technologies could happen more or less quickly. With these caveats in mind, the approach enabled participants to respond to an informed concrete expression of technological development and provided a means for them to project their own feelings into an unfamiliar future.

The two key scenarios presented to participants were:

- **Wave 2: The '2030' Transition scenario**
    - A near-future scenario in which improved electric vehicles had achieved 60% of new UK vehicles sales, automated technology had begun to enter the market, principally by business users and to a lesser extent within the consumer market, and a range of other in-car and connected technologies had also become mainstream. Importantly, these new products and services were all available alongside existing petrol / diesel technology.
    - Participants were introduced to a series of personas, representing a range of demographics and situations, and asked to respond to a series of different questions faced by each persona in relation to the new technologies.
- **Wave 3: The '2050' Future scenario**
    - A more fully-fledged future scenario in which electric and fully self-driving vehicles had entered the mainstream, largely replacing petrol / diesel technology and leading to the emergence of a range of new shared service mobility models, including an integrated digital platform offering a Mobility as a Service (MaaS)-type offer.
    - Participants were again introduced to a series of fictitious individuals living within this scenario, and asked to respond to a fixed choice between travel options for a specific journey.

To ensure ongoing dialogue throughout the research process, Waves 2 and 3 also involved the participation of a range of expert stakeholders. These stakeholders were encouraged to respond to questions and engage with participants during the break-out discussions held during the workshop, filling in information gaps and driving more informed conversations (see Appendix C for a list of stakeholders participating in the workshops). Wave 2 included a series of videos recorded by various staff working within DfT and related agencies in relation to the new technologies, responding to some of the concerns raised by participants during the first wave.

Workshop Sample

Workshop participants were all drivers or passengers and beyond that included a mix of: frequency of SRN use; levels of knowledge/use of transport technologies; and demographics. The sample was weighted towards regular and frequent SRN users but also included some infrequent users. In total, the sample was designed to include coverage of a full range of existing and potential road users to help inform our understanding of potential future travel behaviours and road demand, including a quota of car users with disabilities/health conditions who may stand to benefit from the new technologies. A full quota of 96 participants attended Wave 1 workshops and there was a small level of attrition due to personal factors, with a total of 88 participants attending all 3 waves. The sample table below covers the 88 participants who completed all three waves of the dialogue.

Criterion		TARGET	ACHIEVED
Extent of travel on SRN	Primarily local	Min 18	41
	Primarily regional	Min 18	28
	Primarily national	Min 18	19
Frequency of SRN usage	Typically frequent – driver	Min 18	33
	Typically frequent - passenger	Min 6	6
	Typically regular - driver	Min 24	26
	Typically regular - passenger	Min 6	7
	Infrequent or non-users (to include learner drivers and people that have stopped driving due to medical conditions)	Min 18	16
Technology adoption (e.g. smartphones, use of journey planners, intelligent personal assistants, ULEV)	Early adopters	Min 24	25
	Majority	Min 24	32
	Laggards	Min 18	31
SEG	ABC1	Min 36	48
	C2DE	Min 36	40
Age	18-24	Min 18	28
	25-34		
	35-44	Min 18	33
	45-54		
	55-64	Min 18	27
	65+		
Gender	Male	Min 36	44
	Female	Min 36	44
	TOTAL		**88**

Road User category	Commuters	Min 3	33
	Holidaymakers (perhaps with caravans/boats etc.)	Min 3	35
	Older motorists	Min 3	16
	Car users with disabilities/health conditions that might be particularly affected by delays e.g. need for regular toilet facilities	Min 3	17
	Parents	Min 3	14
	Motorcyclists	Min 3	3
	Cyclists	Min 3	4

Analysis

Analysis proceeded on an iterative basis: following each stage of the project brainstorms and analytical notes were used to prepare toplines and presentations to key stakeholders. Having completed all fieldwork,

more rigorous analysis was conducted involving creative discussion and brainstorming among the whole research team, with reference to fieldwork note and analysis of notes made by participants during the research process, including pre-task activities, self-completion forms, personifications and prioritisation games.

Our main analytical approach involved content analysis using a method known as ‘matrix mapping’. This involves developing an analytical framework comprising the themes of interest, and then mapping data from each group or – for self-completion work - individual to these themes, allowing conclusions about the prevalence of specific views to be made. Please note that due to the nature of discussions, which involved diverse groups of individuals in relation to demographics and driving behaviour, quotes throughout the report have not been attributed to specific individuals.

Appendix C: Participating stakeholders

The following individuals attended workshops during Waves 2 and/or 3 for the Public Dialogue (please note that there was wider involvement from stakeholders at the project design stage):

Darren Capes	City of York Council
Philip Andrews	Department for Transport
John Baverstock	Department for Transport
James Canton	Department for Transport
Michael Dnes	Department for Transport
Adam Jones	Department for Transport
Donald McDonald	Department for Transport
Emily Mills	Department for Transport
Lucy Yu	Five AI
David Skipp	Ford
Dennis Witt	Ford
Ray King	Newcastle City Council
Shuo Li	Newcastle University
Andrew Dorrian	North East Combined Authority
Rebecca Buckley	Office for Low Emission Vehicles
Stephanie Edwards	Office for Low Emission Vehicles
Kristen Hernandez	TRL
Simon Tong	TRL
Nikolas Thomopoulos	University of Greenwich
Sarah Sharples	University of Nottingham

Appendix D: Business responses

Background

Kantar Public conducted 18 hour-long depth interviews between 30th August - 8th September 2017 with businesses to provide early findings about potential responses to the dialogue. Specifically, the research explored:

- Businesses attitudes toward, and experiences of, four broad transport service areas: enhanced real-time information and interventions; electric vehicles; freight platooning on the SRN; and automated vehicles
- Expectations, hopes and fears about how these emerging services might be employed 15-30 years in the future, including concerns relating to safety, cost, privacy, data protection, and the environment.

Businesses included a mix of business size and sector (freight, logistics, bus operating companies and personal use e.g. taxi companies), a mix of regional and national travel, and mix of frequency of SRN usage (biased towards frequent use). Interview locations included Leeds, Nottingham, Birmingham, Exeter, Kent and Bristol.

In this appendix, we highlight the key points of differences in responses compared to the public audience.

Findings

Overview

Compared to the general public interviews**,** businesses' reactions to service areas were driven by cost and feasibility considerations rather than safety concerns. Concerns centred around whether a technology/service would increase or reduce costs; journey speed; whether changes would lead to more issues or congestion on driving routes and whether there would be job losses associated with technological advancement.

Whilst businesses were generally cost-focussed, some businesses had more of an environmental interest, either due to personal views or linked to the reputation of the business. Any businesses that drove in London on a regular basis also had fairly different responses to the service areas, and often struggled to see how certain features might work in a congested urban context.

Electric Vehicles

- In general businesses were interested in the potential cost-savings of using EVs, and were more likely to think about overall costs rather than just purchase costs. As a result, they were more concerned about reliability and maintenance costs, and how often they might need to repair or replace an EV. They also mentioned cost per mile, and any savings through tax benefits. There was interest in purchasing EVs if they could demonstrate cost-savings in the future, and if they were reassured about range and reliability concerns.

- Businesses were particularly concerned about range, as they expected range limitations would impede their ability to complete journeys quickly and cost-effectively. Stopping for long periods to charge vehicles was not seen as viable.
- Some businesses were concerned that electric vehicles would lack the requisite power to tow other vehicles or heavy loads.
- Whilst there were concerns about charge times, some freight businesses felt these could be mitigated by charging during requisite breaks.
- Environmental concerns varied across the audience – some businesses doubted the environmental benefits of EVs whereas others were motivated by the idea of cutting their business emissions and making their use of electric vehicles visible to customers.

Automated vehicles

- Those driving for a living, including taxi drivers, were concerned with full automation and the impact it could have on their work. However, at the same time some identified new service opportunities for jobs. For example, taxi businesses recognised that AVs would not be able to help people with luggage, or help people with mobility problems. Some thought that if AVs became more common, they would be able to focus on different aspects of the service (e.g. customer service, keeping people company, etc.) rather than driving.
- Businesses thought their staff time could be made more productive if they were able to concentrate on other things while travelling.

Connected vehicles and advanced real-time information

- Business participants were more likely to be slightly critical and hesitant about adoption of RTI than the general public, as they generally put more store into their personal knowledge of the best routes to take, linking this directly to business efficiency. They stressed the importance of the ability to 'opt out' of taking certain routes so that they were able to take the quickest/best route for their business rather than the flow of traffic as a whole. Some taxi drivers felt that their own knowledge of the roads would still serve them better than RTI information
- Some business participants voiced the concern that the technology could distract their drivers. These participants wanted the ability to curate and choose what information they received and when to ensure that their drivers were able to maintain safety,
- Some businesses felt that RTI would take them on longer and therefore more costly journeys. One taxi driver felt that he would then have to explain the choice to his customer before taking them on that route as this may have cost implications.
- Views were polarised about the potential impact on travel choices. Some businesses felt that they would need to do less planning prior to beginning their journey as they were more able to get real time, reliable information when needed. Others were very against the prioritising flow of traffic across the whole road network rather than their priority to get from A to B in the quickest time possible. This group of participants would want to select and tailor information in advance and interact more actively with the system so that they could personalise their own routes, for example.

Platooning

- Businesses envisaged there would need to be ‘platooning hubs’ at junctions and ends of motorways, where drivers would need to wait to take the freight off the motorways and onto smaller roads. They struggled to see the business “sense” of this – as they expected it would still require ferrying drivers around the country to be available at the ‘hubs’.
- Some businesses were worried that they might be expected to pay higher tax rates to pay for supporting road infrastructure, such as dedicated lanes. They were not convinced that the costs required were outweighed by benefits to them, or societal benefits. Platooning was seen to benefit only very large businesses with enough freight volume to use platoons. This was seen to create unfair advantage and to have an adverse effect on competition.
- Some business owners felt that a shift to platooning or other forms of automation would mean that the workforce would need to become more technical – i.e. able to fix software or vehicle issues rather than just driving. However as with AV, this was not a like-for-like swap and could cause marginalisation of low skilled workers.
- Business owners voiced concerns that the wireless networks could be hijacked in order to steal the goods they contain, through hacking or malware - and as with AVs, this was particularly worrying where drivers are not present in some cabs. They also raised concerns that platooning vehicles could be hacked into and used for terrorist attacks.
- Businesses that either imported/exported goods globally, or who could see how reduced transportation costs may in turn lower some of their operating costs, felt there would be a long term benefit to their business if these cost savings were significant.

Appendix E: A note on sub-groups

The deliberative approach used for this work focused on drawing out the major themes across a wide audience. Findings are qualitative – they are indicative rather than representative of the broader population, but have aimed to incorporate views from a broad cross-section of UK road-users in relation to demographics, comfort with technology, frequency and type of travel, and location (Greenwich, New Castle and Sutton Coldfield). This diversity and the communal nature of discussions mean that it is not within the scope of this research to make any strong conclusions about the views of particular sub-groups. However, in this note we highlight where findings suggest that there may be differences in views across different sections of the audience. Please note that any findings contained here should be considered suggestive and subject to further research to confirm their validity.

At the outset of the dialogue, there was a highly variable mix of feeling toward the future of driving in the UK, with a broadly equal proportion of people feeling excited, pessimistic, or a combination of both. Those who were most positive tended to largely undertake local journeys, have middling self-reported comfort with technology and fewer health issues. Those who were more negative undertook a mixture or local and regional journeys were mixed in their comfort with technology and were more likely to have some health issues. Finally, those who were excited but also apprehensive or concerned were also most likely to travel locally, have higher comfort with technology (possibly seeing both benefits and drawbacks) and a mix of health issues.

As the dialogue progressed, a number of factors were perhaps suggestive of potential interest in the technologies across the wider population.

Location was a key factor underlying views. Those outside of London tended to be more pessimistic about the ability of government to deliver the infrastructure they felt was needed to drive technological change in relation to both automated and electric vehicles. Those living outside of urban areas in particular were also more dependent on car use to maintain their lifestyles and therefore less reassured about the convenience of shared services.

Some of the technologies could also be ascribed with different value depending on **current car use and ownership**. The majority of our sample were drivers but there was broad agreement amongst those taking part in the dialogue, including amongst those using the roads as passengers, that automated vehicles and shared services would be of particular interest to those currently unable to drive. The small number of cyclists in the sample shared a common interest in the societal and environmental benefits of electric vehicles, as did those currently driving low-carbon vehicles. As cyclists were less wedded to car travel to maintain their lifestyles, there was comparatively less interest in or excitement about the prospect of automated vehicles.

The relevance of the different technologies was also perceived to vary somewhat according to **age and lifestage**. Although the audience generally expressed the view that young people growing up with new technologies would be more comfortable with adoption, this was not necessarily the case amongst our sample, perhaps due to the fact that automated vehicles and associated services were still widely seen as a nascent and unproven technology. Indeed, for younger people still living at home in particular car ownership could be strongly associated with freedom and independent living, and learning to drive could be considered a rite of passage to adulthood. At the other end of the spectrum, some older drivers expressed a particular

interest in automated vehicles as a way to maintain their independence in later life, although this could be tempered by concerns about affordability. There was also a general perception across the audience that older people would be less comfortable adapting to new behaviours such as utilising shared mobility services. Parents with children living at home generally seemed most wedded to ownership of their own vehicle due to the perceived uniqueness of their journey needs.

Finally, **socio-economic group** also seemed to have some effect on views, particularly in relation to affordability. There was less interest in the new technologies amongst those with less income, many of whom were currently driving older vehicles bought on the second-hand market. For these groups both automated vehicles and electric vehicles could feel unaffordable. Some individuals also expressed concerns about being priced off the roads if the new technologies were made mandatory.