**Grant agreement No. 101069852**

# MOVE2CCAM

## Methods and tools for comprehensive impact assessment of the CCAM solutions for passengers and goods

HORIZON-CL5-2021-D6-01

# **D3.4 -** Satellites' needs, impact analysis and mapping

Impact of self-driving vehicles on
citizens and organisations in Europe

Submission date: 31/07/2024

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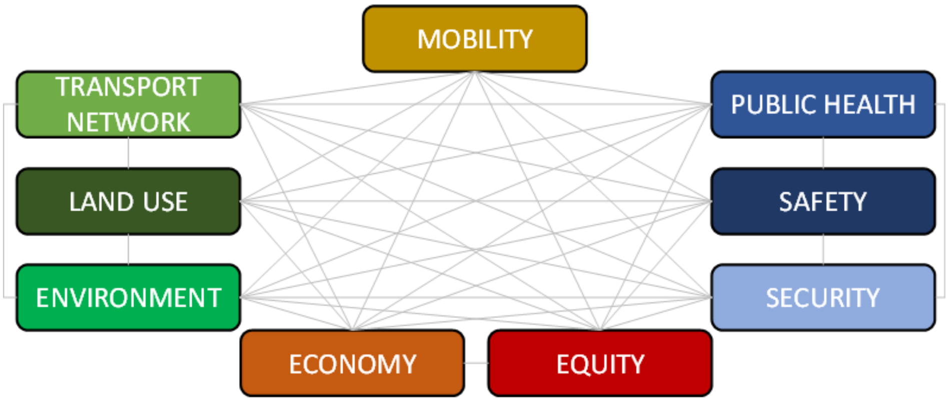
# Executive summary

This report analyses the perceptions of citizens and organisations in Europe about the impacts of self-driving vehicles, based on a series of activities implemented by Move2CCAM, a research project funded by the European Union. In these activities, citizens and organisations expressed their views about the impacts of self-driving passenger and freight vehicles on eight inter-related domains, as below. Some activities were conducted in all eight Move2CCAM countries: Cyprus, France, Germany, Greece, the Netherlands, Poland, Spain, and the United Kingdom. Others were conducted only in the three "prototypical regions" of the project: North Aegean region (Greece), Helmond (Netherlands), and Metropolis GZM (Poland).




## Part 1 – Impact of self-driving vehicles on citizens

### Chapter 2 - Qualitative assessment of impact - citizens

This chapter reports the results of online and face-to-face discussions and other group activities involving 232 citizens across the eight countries.

Citizens believed that self-driving vehicles could improve the mobility of those underserved by existing transport services, while also improving safety. Human assistants would still be needed, in case of emergencies, to help passengers with additional needs, and to solve situations such as anti-social behaviour (in public transport) and theft (in freight transport). Citizens were also cautious about technical issues such as lack of connectivity in rural areas, driving in bad weather or on uneven terrain, hardware or software failure, hacking, and handling of private data.

Congestion may decrease due to more efficient driving or increase due to a higher number of vehicles on the road. Shared services are unlikely to reduce private car ownership, due to their convenience. Congestion may also move elsewhere (e.g., the pavement for delivery bots, or the air for drones). Self-driving vehicles being electric could reduce air and noise pollution but could also create new environmental problems related to the manufacturing and disposal of batteries. There is also fear of job losses for delivery and public transport drivers, but also hope that more jobs and industries will be created. The net effect on jobs is uncertain. There were concerns about the exclusion of already marginalised groups.



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## Chapter 3 - Demonstration of self-driving vehicles - citizens

This chapter reports the results of a demonstration of three self-driving vehicles (a bus, a mini-shuttle, and a delivery robot) in Helmond (Netherlands), involving 35 citizens.

Participants reported mostly positive feelings about using the vehicles. Most said they felt safe and believed that the vehicles will also be safe for pedestrians and cyclists. Participants also liked that the self-driving vehicles were quiet, and that the ride was smooth. Self-driving vehicles are expected to be cheaper, less stressful, and more comfortable than human-driven ones. Participating in the demonstration increased intentions to use self-driving vehicles.

The main negative aspects were the perception that self-driving vehicles can be insecure in terms of exposure to crime and anti-social behaviour from other passengers, vandalism, and, in the case of the delivery robot, stolen goods. Participants who thought the mini-shuttle was less secure were also less likely to say they intend to use it. While safety perceptions improved after the demonstration, there were some remaining doubts about what happens in emergency situations or if the technology fails. The general view was that the vehicles were slow, although this was related to the design of the experiment, as the vehicles were programmed to travel at slow speeds. While the bus felt familiar, the mini-shuttle was thought to be too narrow, with not enough seating.

## Chapter 4 - Virtual reality experiments

This chapter reports the results of virtual reality experiments with 92 citizens in Helmond (Netherlands), Katowice (Poland), and Mytilene (Greece). Participants played a game where they chose between using a virtual self-driving car or bus. Electroencephalography (EGG) data was recorded. Participants also answered questionnaires and joined group discussions.

Participants had positive views about both vehicles and the experience of using them in virtual reality raised the intention of using them in the real world. The most common opinion was that self-driving vehicles will be cheaper, more comfortable, and safer than human-driven ones. The possibility to see the view was identified as a key element of trip quality in self-driving vehicles.

Personal security issues related to bus passenger number or behaviour were a concern, both in the participants' stated opinions and in reactions to specific situations inside the self-driving bus, as measured by EEG data. Participants noted that the lack of a human assistant in buses could reduce the accessibility of individuals with mobility restrictions. Women and older participants had more situations where EEG data indicated stress/arousal. Older participants were more likely to think that self-driving buses will be more insecure and less likely to think they will be safer than human-driven ones. There were also concerns about congestion, lack of space, and seat arrangement.

The experiment was successful as a method to study user reactions to self-driving vehicles. The scenarios were perceived to be realistic, and participants noticed most changes in the car and bus scenarios.

## Chapter 5 - Pan-European survey

This chapter reports the results of an online survey answered by 7,941 participants in the eight countries.



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Around one fifth of the individuals interviewed were not aware of self-driving vehicles. One fifth also thinks that these vehicles will never be implemented in their regions. Intentions to buy or use one are not very strong. Willingness to pay to use a self-driving vehicle is lower than what individuals currently spend on travel. The groups more likely to use self-driving vehicles are the 18-34 group, individuals without children, living in city centres, and who currently make more and longer trips, as well as those with high levels of technology adoption and awareness of self-driving vehicles.

Citizens expect that self-driving vehicles will increase their mobility (i.e. more and longer trips) but on average do not think that delivery orders, parking needs, or residence location will change much. Private car use may increase. Self-driving freight vehicles are expected to have a weaker impact on people's lives than passenger vehicles.

For their region as a whole, citizens expect some improvements in mobility without increasing congestion. However, self-driving vehicles could increase travel costs and will require the use of more resources such as electricity, parking space, and redesigned infrastructure. Most other perceived impacts are positive: increase in accessibility and economic activity and reduction in environmental harms and safety problems. Possible detrimental impacts are the increase in cyber attacks, vehicle breakdown, obesity, dependence on technology, and legal issues. Opinions about impacts on jobs or travel stress are split.

**Chapter 6 - Survey on impact of self-driving freight vehicles**

This chapter reports the results of a survey on the impact of self-driving freight vehicles in the United Kingdom, involving 700 participants.

The survey found that while there is interest towards deliveries made with self-driving vehicles, conventional vans remain the preferred choice, as citizens are familiar with them and value human interaction. Citizens prefer conventional vans to self-driving freight vehicles, after accounting for differences in cost, time, and other delivery characteristics. This preference increases with age. Citizens would only use self-driving freight vehicles if they were cheaper or faster. Some participants were also concerned with the reliability of these vehicles in face of unexpected situations or security issues. Others thought that deliveries with self-driving vehicles can be faster, reliable (in terms of punctuality), and more convenient.

Road users also expressed a variety of concerns about sharing roads with self-driving delivery vehicles, related to road safety, congestion, and privacy.

**Chapter 7 - Conclusions of Part 1 – Impact on citizens**

A common conclusion of all chapters in Part 1 is that self-driving vehicles can enhance people's mobility. Some of the project activities with citizens concluded that travel will be cheaper, others that travel will be more expensive. However, there was consensus that travel will be more comfortable and allow for productive or leisure uses of time. The number of trips that people make will probably increase, especially by private modes, which will increase road traffic levels but not necessarily congestion, as self-driving vehicles will be more reliable in dealing with unexpected events and bottlenecks. The effect on parking is uncertain. The perceived impacts on safety were consistent across activities: travel will be safer, but there are remaining concerns about emergency situations that self-driving vehicles may not be able to handle.



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The main concern about self-driving vehicles is security. Travelling in public transport without a human driver or assistant increases fear of crime and harassment. Freight deliveries will also be vulnerable to theft. Vehicles can be hacked, and citizen data can be misused.

Emissions and noise will probably decrease. However, citizens expressed concern in some activities about the implications of relying on electric vehicles, as demand for electricity will increase, and battery disposal may become a problem.

The impacts on public health were consistent across activities: air quality will improve but the impact on travel stress is uncertain. Perceived effects on jobs were also consistent: there will be both job creation and destruction, with an uncertain net effect. Finally, the perceived effects on equity were also consistent. Accessibility may increase in areas currently not served by public transport, but self-driving vehicles may not meet the needs of people with disabilities and may create price-related exclusion.

# Part 2 – Impact of self-driving vehicles on organisations

## Chapter 8 - Qualitative assessment of impacts - organisations

This chapter reports the results of online and face-to-face discussions and other group activities with 87 individuals representing organisations in the eight countries.

Organisations thought that self-driving vehicles can improve travel reliability and increase the accessibility of people with mobility issues or living in isolated areas, while also facilitating night-time trips and deliveries. However, security was a core concern, including theft of goods from driverless vehicles, dangerous or hazardous cargo being unsupervised, and issues around cybersecurity. Multiple safeguards and regulations are needed.

Other concerns were the ability to drive in bad weather, uneven terrains, and areas of poor connectivity, and the environmental impacts of battery manufacturing and particulate pollution, as well as increased noise and visual pollution. Infrastructure also needs to be adapted. This would have high costs that could be passed onto users. There are also risks to businesses if the technology were to malfunction and lose public trust.

There are also several uncertainties, such as whether there would be more vehicles on the road, which could increase congestion, collisions, pollution, and urban space use. Organisations are also undecided about the impact on jobs. Potential job losses for delivery and public transport drivers are a concern, but at the same time, more jobs, industries, and investment will be created.

## Chapter 9 - Demonstration of self-driving vehicles - organisations

This chapter reports the results of a demonstration of a self-driving mini-bus in Katowice (Poland), an event joined by 20 representatives of organisations related to the transport sector.

On average, organisations thought that self-driving mini-buses are a useful innovation and are safe both for their users and for pedestrians and cyclists, although not necessarily safer than human-driven ones. Safety remained a concern even after the demonstration. Organisations also thought that self-driving mini-buses will be worse than human-driven vehicles in aspects such as speed, security in terms of crime, and travel stress. There was also some concern about the cost of using these vehicles.



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Overall, organisations showed slightly less enthusiasm for self-driving vehicles than citizens did in the demonstration in the Netherlands reported in Chapter 3. However, organisations expressed a positive intention to use the self-driving mini-bus in the future.

## Chapter 10 - Case studies of organisations

Detailed case studies were conducted with representatives from 11 organisations in all countries except France, including transport providers, large institutions using transport, and the self-driving vehicle industry. The case studies were based on semi-structured interviews.

The organisations expressed their views on the costs and benefits of different types of self-driving vehicles. Self-driving buses were seen to have a large potential for providing additional bus services, covering unmet demand in rural areas or at night-time. Drones could also provide useful services. Both are safe and reliable and can reduce costs but require large investments. Organisations expressed their intention to use self-driving vehicles. Passenger transport providers may even be forced to use them, due to increased problems in recruiting drivers. However, many technical, financial, regulatory, infrastructural, safety, and labour issues need to be addressed before the organisations start using self-driving vehicles in their daily operations

Organisations thought that self-driving vehicles are expensive but may increase revenue and decrease costs, albeit only in the long term. They will also improve operational aspects but will require changes in the workforce.

Organisations also gave their views of the broader impact of self-driving vehicles in their regions. Mobility will increase but this will cost. Travel will be more reliable but may fail to meet the needs of people with disabilities. Some large facilities may be moved away from the centre, but parking spaces will not. Jobs will be created and destroyed. Travel will be safer, but less secure, due to increased risk of crime in public transport and freight vehicles, and hacking of vehicles.

## Chapter 11 - Conclusions of Part 2 – Impact on Organisations

A common conclusion of all chapters in Part 2 was that travel will be more reliable. Road traffic levels, especially of private vehicles, will increase but this will not necessarily increase congestion. Extensive changes to the infrastructure are needed.

The strongest concern, expressed in all activities, was personal security. Fear of crime may increase in public transport. Freight deliveries will also be vulnerable to theft. Vehicles can be hacked, and citizen data can be abused or stolen with malicious intent.

Organisations were consistent across activities that there will be both job creation and job destruction, with uncertainty on the net effect. There was also concern about customer resistance to new solutions, especially when they fail. Costs will also probably increase and be passed on to customers. There will also be a new industry developing self-driving vehicles and software. To adjust the economy to the new realities, large investments are needed.

Self-driving vehicles can improve accessibility of rural and suburban residents and night-shift workers, but there are also concerns about whether the new solutions can meet the needs of people with disabilities. They can also create digital and price exclusion. The self-driving vehicle industry is also dominated by younger males. Across all industries, older workers may feel excluded.



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The impacts on safety were consistent across activities: travel will be safer, with fewer collisions, but there is a concern about emergency situations. Emissions will decrease, but new problems with be created such as battery disposal and visual pollution (due to increased number of vehicles). The impacts on public health are also mixed. Self-driving vehicles can solve emergency situations, but the impact on travel stress is uncertain.

## Part 3 – Further analysis, synthesis, and conclusions

### Chapter 12 - Joint qualitative assessment of impacts - citizens and organisations

This chapter reports the results of workshops where 44 citizens and 10 representatives of organisations exchanged views on the impacts of self-driving vehicles.

Participants found it difficult to judge whether people would be travelling more or less, if self-driving vehicles were available. Participants wanted the convenience of private cars to be preserved, especially for regional and leisure travel, but they were open to using shared vehicles. Participants believed that safety issues would be mostly resolved by 2050, which will cause public acceptance to automatically increase. Hacking was seen as a risk, but counter-measures were expected to keep up with more sophisticated attacks. Job losses could be absorbed, so as not to result in a net loss of jobs overall.

Participants believed in a mostly automated network by 2050. The more widespread the roll-out, the safer and more efficient the system would be. For self-driving vehicle services to gain public trust, they would need to be safer, more punctual, convenient in terms of frequency and routes, low cost, not increasing congestion, accessible to disabled people, and comfortable. Implementation depends Fon interventions from government and transport system operators and relies on investment and development of security provisions, the public transport system, and job transitions being managed well.

### Chapter 13 - Synthesis - comparison of impacts on citizens and organisations

This final chapter compares the conclusions derived from the activities with citizens and organisations.

Opinions of citizens and organisations were mostly consistent. Self-driving vehicles can enhance mobility and improve travel reliability, but this may come at the expense of increased costs. Traffic levels will increase but congestion may not. Parking needs may not decrease. Current environmental problems will be reduced, but new ones will be created. There will be both job creation and job destruction and the net effect is uncertain. Large investments are needed to adapt the economy. Customers may dislike freight delivery solutions based on self-driving vehicles. Accessibility of some groups may increase but self-driving vehicles may not meet the needs of people with disabilities and create price and digital exclusion. The impact on travel stress is uncertain. Safety will improve but collisions will not be eliminated. The strongest concern for both among citizens and organisations is the security of both passengers and freight.



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# Concepts

| | Definitions |
|---|---|
| Move2CCAM | An EU-funded project analysing the potential impacts of self-driving vehicles in Europe (https://move2ccam.eu). This report is one of the deliverables of this project. |
| CCAM | Cooperative, Connected, and Automated Mobility. Concept used in European research projects to denote technologies, products, or services to transport passenger and/or freight using self-driving vehicles. |
| Self-driving vehicles | Also known as autonomous vehicles. Vehicles for passenger or freight transport that are partially or fully operated by computer systems, without the need of a human driver. The vehicles are connected with other vehicles and with physical and digital infrastructure. This report focuses on fully self-driving vehicles only. |
| Use case | How a technology, product, or service could potentially be used. In this report, the concept applies to self-driving vehicles for passenger or freight transport. |
| "Satellites" | Group of citizens and organisations associated with the Move2CCAM project and invited to a sequence of project activities, including co-creation activities and activities where they express their views on potential impact of self-driving vehicles. |



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# 1. Introduction

Cooperative, Connected, and Automated Mobility (CCAM) is a new frontier for mobility. It allows vehicles to communicate with each other, the infrastructure, and other users of the transport network. Self-driving vehicles open new possibilities for both passenger and freight transport and could contribute to more efficient, equitable, and sustainable mobility systems. However, the potential impacts of this radical change are still not well understood. There is little knowledge on the many possible inter-relationships between the impacts of self-driving vehicles in different economic, social, and environmental domains.

The MOVE2CCAM project (https://move2ccam.eu) is exploring these inter-related impacts, aiming at delivering methods and tools for systems-wide assessments of self-driving vehicles. This exploration is done with input from the project "satellites", i.e., citizens and organisations in eight European countries (Cyprus, France, Germany, Greece, the Netherlands, Poland, Spain, and United Kingdom), who were invited to participate in a series of activities throughout the project.

Citizens represent diverse groups in society, while organisations represent a range of stakeholders with interest in self-driving vehicles. The engagement with the "satellites" ensures that the methods and tools developed in the project acknowledge the wide diversity of perceptions, needs, objectives across and within the eight countries in this project and are potentially transferable to the rest of Europe. Figure 1 is the structure of the "satellite" network, showing citizens and the range of different types of organisations in that network.

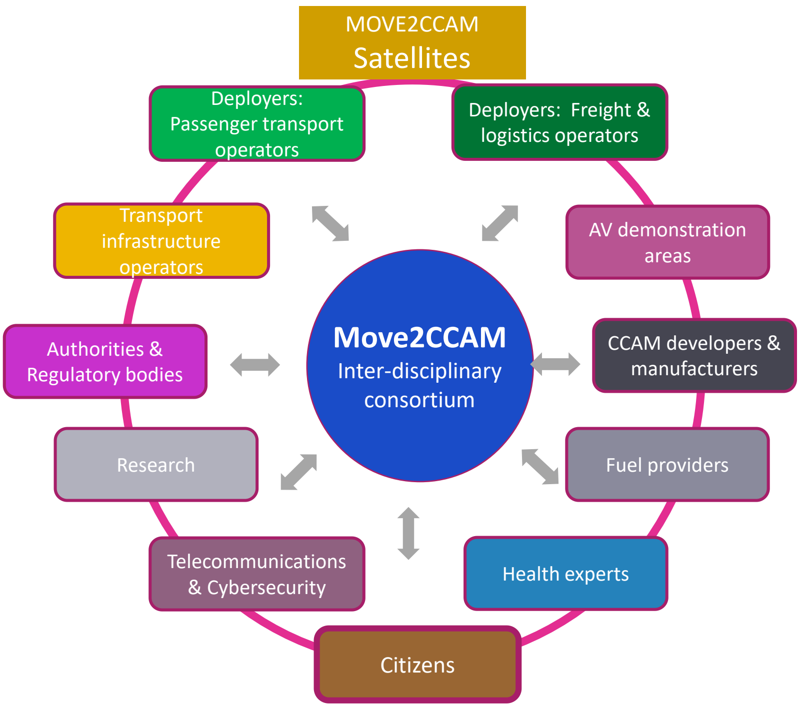


**Figure 1. The Move2CCAM project network of "satellites" (citizens and organisations)**

In the first part of the project (**Co-Creation**), citizens and organisations participated in activities to co-create use cases, scenarios, and business models for self-driving vehicles. The results of this



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part of the project were reported in Deliverable 1.2 (*CCAM use cases, business model, scenarios and Key Performance Indicators*).

In the second part of the project (**Impact**), reported in the present deliverable, citizens and organisations participated in activities where they expressed their views about the possible impact of self-driving vehicles on eight inter-related domains (Figure 2): mobility, transport network, land use, environment, economy, equity, public health, safety, and security.

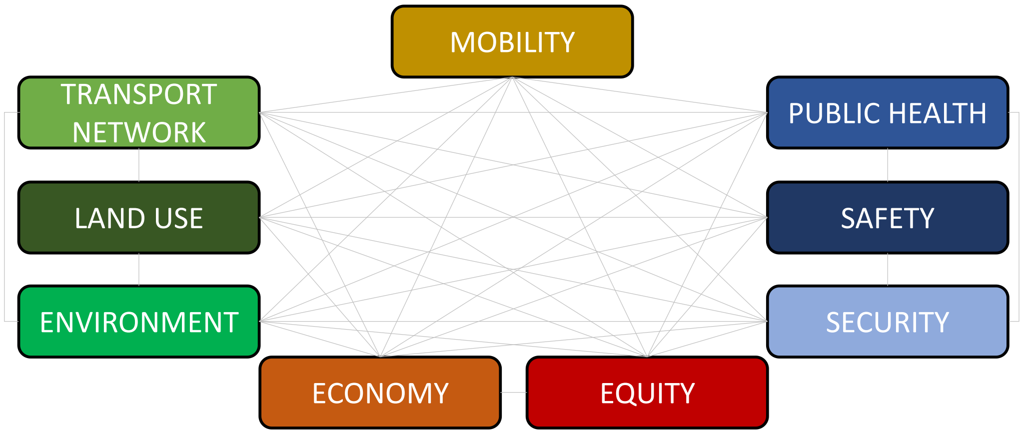


**Figure 2. The Move2CCAM self-driving vehicle impact dimensions**

This second part of the project used as input some of the outputs produced in the first part of the project, namely:

- Results from questionnaires answered by citizens and organisations when they were recruited to join the project's "satellite" network, i.e., before they joined the co-creation activities.
- A selection of use cases of self-driving passenger and freight transport vehicles, co-created by citizens and organisations. The concept of "**use case**" in this project is understood as a description of how a technology, product, or service could potentially be used – in this case how self-driving vehicles could be used to transport passengers and vehicles. A self-driving vehicle use case is characterised by several aspects: type of vehicles, possible origin and destinations of trips made by these vehicles, modes (private or public), and, in the case of public transport modes, characteristics of the service (e.g. frequency).

Previous project deliverables set the scene for the analysis of impact of self-driving vehicles reported in this deliverable:

- Deliverable 1.3 (*CCAM impact analysis roadmap*) presented a roadmap for assessing the impact of the self-driving vehicle use cases, including data to be collected, data collection methods, analysis methods, expected outcomes, participant recruitment strategy, and ethics consideration.
- Deliverable 3.3 (*Primary and secondary data and the MOVE2CCAM data warehouse*) presented the materials used to collect primary data during the activities to assess impact of self-driving vehicles. This included questionnaires, discussion guides, stimuli shown to activity participants, and documents related to research ethics, such as information sheets and consent forms.



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The present deliverable (3.4) presents the results of all activities where citizens and organisations provided input about the impact of passenger and freight self-driving vehicles. The deliverable is organised into three parts, and a total of 13 chapters.

All chapters can be accessed directly through hyperlinks from this introduction. There are also hyperlinks throughout the document to facilitate navigation within the document, given its length.

**Part 1** reports the results of activities involving citizens. Table 1 lists these activities, their location and timing, number of participants targeted (across all countries) as specified in the project's Grant Agreement (Part B, Table 10), achieved number of participants (i.e. individuals who actually participated in the activities, across all countries), and activity number (as defined in the Grant Agreement).

Chapters 2-6 report the results of each activity. This includes a qualitative assessment of impact, through online and face-to-face discussions (Chapter 2), citizens' feedback on a demonstration of passenger and freight self-driving vehicles in Helmond (Netherlands) (Chapter 3), results of virtual reality experiments in Helmond (Netherlands), Katowice (Poland), and Mytilene (Greece) (Chapter 4), results of an online pan-European survey, implemented in all regions of the eight Move2CCAM countries (Chapter 5), and results of a survey on the impact of self-driving freight vehicles, implemented in all regions of the United Kingdom (Chapter 6).

Chapter 7 then brings all these results together, providing an overview of citizens' opinions about the impact of self-driving vehicles.

**Table 1. Overview of activities - citizens**

| Chapter | Activity | Location | Timing | Number of participants | | Project activity number |
|---|---|---|---|---|---|---|
| | | | | Target | Achieved | |
| 2 | Qualitative assessment of impact of use cases | Netherlands, Poland, Greece | October 2023 | 400 | 232 | 5 |
| 3 | Demonstration of self-driving vehicles | Netherlands | January 2024 | 30 | 35 | 5 |
| 4 | Virtual reality experiments for self-driving vehicle use | Netherlands, Poland, Greece | December 2023-January 2024 | 96 | 91 | 5 |
| 5 | Pan-European survey of impact of use cases | Cyprus, France, Germany, Greece Netherlands, Poland, Spain, United Kingdom | January-May 2024 | 32 | 7,941 | 6 |
| 6 | Survey of impact of self-driving freight vehicles | United Kingdom | June 2024 | N/A | 700 | N/A |

**Part 2** of the deliverable reports the results of activities involving organisations. Table 2 lists these activities. Chapters 8-10 report the results of each activity. This includes a qualitative assessment of impact, through online and face-to-face discussions (Chapter 8), organisations' feedback on a



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demonstration of a self-driving passenger vehicles in Katowice (Poland) (Chapter 9), and detailed case studies, based on in-depth interviews, of the impact of self-driving vehicles on 11 organisations (Chapter 10).

Chapter 11 is an overview of organisations' opinions about the impact of self-driving vehicles.

Table 2. Overview of activities – organisations

| Chapter | Activity | Location | Timing | Number of participants | | Project activity number |
|---|---|---|---|---|---|---|
| | | | | Target | Achieved | |
| 8 | Qualitative assessment of impact of use cases | Netherlands, Poland, Greece | October-November 2023 | 240 | 87 | 4 |
| 9 | Demonstration of self-driving vehicle | Poland | June 2024 | N/A | 20 | N/A |
| 10 | Case studies (in-depth discussion of impact of use cases on selected organisations) | All Move2CCAM countries except France | March-April 2024 | 10 | 11 | Task 3.5 – point 2 |

**Part 3** of the deliverable provides the results of further analysis of impact from activities mixing citizens and organisations (Chapter 12). Table 3 gives the characteristics of these activities, which involved discussions and other group of activities. Chapter 13 then synthesises the results presented in all previous chapters, by comparing the impacts of self-driving vehicles on citizens and organisations.

Table 3. Overview of activities mixing citizens and organisations

| Chapter | Activity | Location | Timing | Number of participants | | Project activity number |
|---|---|---|---|---|---|---|
| | | | | Target | Achieved | |
| 12 | Further qualitative assessment of impact of use cases (citizens and organisation) | Netherlands, Poland, Greece | April-May 2024 | 240 | 59 | 7 |

A series of appendices collect further information. As mentioned, Deliverable 3.3 of this project compiled data collection materials and related ethics documents. However, the project organised extra activities that collected data, using new materials. In addition, some of the other materials were further refined since the submission of Deliverable 1.3 (e.g. the pan-European survey) or were customised to specific participants (e.g. the case study interview guides). As such, the present deliverable collects the new or revised materials used to collect the data analysed, as well as the unmodified materials, so that the deliverable is self-contained. These materials are collected in Appendices 1-11. Ethics documents are not included, but can be consulted in Deliverable 3.3

A final Appendix 12 includes the statistical models used in some of the analyses of the pan-European survey (since Chapter 5 describes only the main results of these models).

The table below lists all appendices and the chapters they are related to.



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**Table 4. Overview of appendices**

| Appendix | Contents | Related chapters |
|---|---|---|
| 1 | Questionnaire to collect citizens' demographic data | 2, 3, and 4 |
| 2 | Pre-events questionnaire - citizens | 2, 3, and 4 |
| 3 | Qualitative assessment of impact – activity guide | 2 and 8 |
| 4 | Self-driving vehicle demonstration – post-event questionnaire | 3 and 9 |
| 5 | Virtual reality experiments - post-event questionnaire | 4 |
| 6 | Virtual reality experiments - post-activity discussion guide | 4 |
| 7 | Pan-European survey on impact on impact on citizens – questionnaire | 5 |
| 8 | Impact of self-driving freight vehicles – questionnaire | 6 |
| 9 | Pre-events questionnaire – organisations | 8 |
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| 11 | Further qualitative assessment of impact – activity guide | 12 |
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# PART 1

# IMPACT OF SELF-DRIVING VEHICLES ON CITIZENS



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# Part 1 - IMPACT OF SELF-DRIVING VEHICLES ON CITIZENS

Part 1 reports the results of analyses of European citizens' perceived impacts of passenger and freight transport self-driving vehicles on their lives and on their regions where they live.

Chapter 2: Qualitative assessment of impact, through discussions and other group activities involving citizens.

Chapter 3: Citizens' feedback on a demonstration of passenger and freight self-driving vehicles in Helmond, the Netherlands.

Chapter 4: Results of virtual reality experiments in Helmond (Netherlands), Katowice (Poland) and Mytilene (Greece).

Chapter 5: Results of the online pan-European survey applied in eight European countries (Cyprus, France, Germany, Greece, The Netherlands, Poland, Spain, and United Kingdom).

Chapter 6: Results of a survey on the impact of self-driving freight vehicles in all regions of the United Kingdom.

Chapter 7: Conclusions of the analyses above.



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# 2. Qualitative assessment of impact - citizens

## 2.1 Overview

The qualitative impact assessment explored citizens' perceptions of the potential impacts of the self-driving vehicle use cases co-created with citizens and organisations in earlier project activities.

In all eight countries (Cyprus, France, Germany, Greece, the Netherlands, Poland, Spain, United Kingdom), participants joined a week-long online engagement platform, followed by an online or in-person workshop. In-person workshops were held in Greece, Netherlands, and Poland, focusing on the project's three "prototypical regions" (North Aegean Region, Helmond, and Metropolis GZM).

In each region, four self-driving use cases were examined in detail, aiming to understand perceptions of impact across the eight MOVE2CCAM domains: mobility, transport network, land use, environment, economy, public health, safety, and security. Use cases in each region were selected according to relevance, based on the results of earlier activities with the same participants.

The objectives of the online platform and workshop discussions were to understand:

- How citizens view the potential role of the selected use cases in their everyday lives and under what circumstances they might benefit from these use cases (or not)
- What positive and negative impacts citizens imagine might arise from the proposed use cases and which impacts are most important to them
- How certain they are about the range of impacts discussed, when they think use cases might be rolled out, and where they agree and disagree with one another.

A main output from these sessions was a set of causal effect diagrams, co-created with citizens for each use case. These diagrams have formed the basis of causal-loop diagrams used in another work package of the project to develop an impact assessment tool.

This chapter is organised as follows:

- Section 2.2 describes the methods used to assess perceived impacts of use cases across domains
- Section 2.3 describes the sample make-up and characteristics
- Section 2.4 reports the results of the engagement activities
- Section 2.5 draws conclusions.

## 2.2 Methods

### 2.2.1 Research design

The research was carried out in two stages: an online platform (Recollective), where citizens across all regions joined a week-long online engagement with tasks designed to familiarise them with the use cases and domains, followed by the workshop sessions, where most of the time was dedicated to developing the causal effect diagrams.



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For most of the engagement of the platform, citizens were asked to imagine that it is the year 2035, before commenting on a number of scenarios related to the use cases they had helped to co-create in earlier project activities.

For each use case, citizens answered questions on three of the eight MOVE2CCAM domains, giving in-depth data across the whole sample, while keeping the online engagement activity short enough to retain participant interest.

For each domain, participants were asked whether they thought the use case scenario would improve or worsen conditions. For example, if they thought the use case would have a positive or negative impact on the environment (e.g., in terms of air quality, pollution, climate change, or noise). Different domains were allocated across the sample to achieve coverage without overwhelming participants:

- All participants answered questions on mobility – as it is the domain where individual behaviour is most influential.
- All participants answered questions on one of these three domains: safety; economy; and environment – as previous sessions suggested citizens had the most developed views with regards to these domains.
- All participants answered questions on one of these four domains: public health, transport network, land use, and equity.

Figure 3 and Figure 4 show two aspects of the online platform.


**Figure 3: Online citizens engagement platform – welcome page**



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**Figure 4: Online citizens engagement platform – example of exercise**

After the online engagement was completed, citizens in the UK, Spain, Germany, France, and Cyprus participated in 2-hour online workshops, using the Zoom platform.

The workshops were designed to understand:

- What positive and negative impacts citizens imagine will arise from the use cases proposed, and which impacts are the most important to them.
- What they see as the potential effects or consequences of identified impacts.
- Citizens' views on the timeline for deployment of each use case in the next few years (see example in Figure 5).

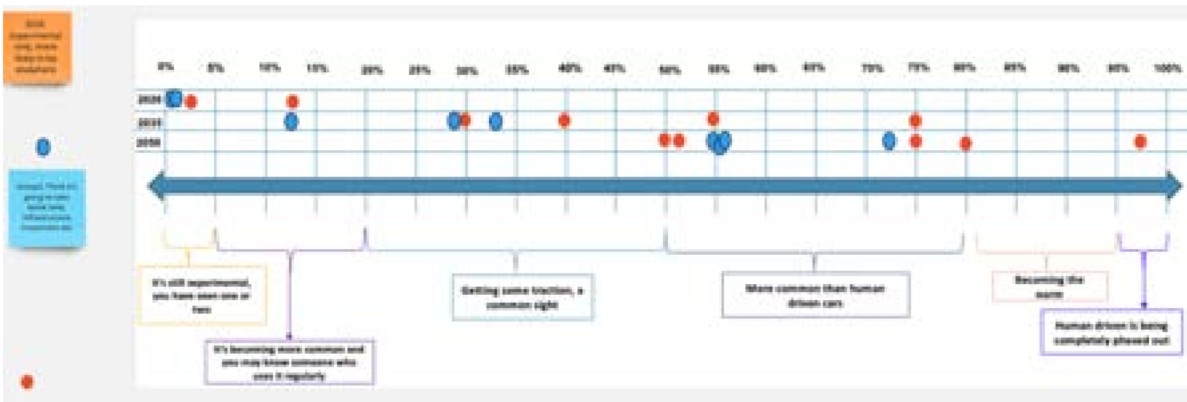

**Figure 5: Online citizen workshop exercises – timeline exercise**

Citizens were split into smaller groups within each workshop. Each group focused on two to three use cases in detail and worked together with the moderator to develop causal effect diagrams (see definition below) for each use case (including findings from the online engagement platform).

A causal effect diagram is a way of visualising how one thing (the introduction of a particular type of self-driving vehicle) affects another (the amount of traffic congestion in a city). There may be many steps between the two things, and each step involves a positive or negative change (more trips, or less, for example) at a given scale (e.g. 10 more, or 100 more). Figure 6 is an example.



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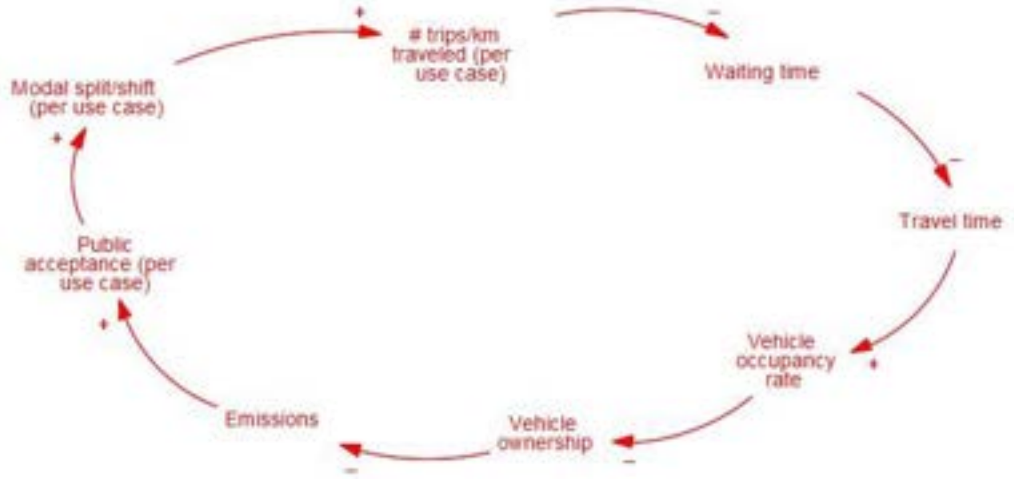


**Figure 6: Example of causal feedback diagram**

Examples of the types of causal effect chains that make up the diagrams include:

- Self-driving long-distance trucks could lead to reduced air pollution (compared to conventional trucks), which could lead to improved public health, leading to a more positive perception of self-driving vehicles overall.
- Self-driving long-distance trucks are at risk of data or connection interruptions, leaving them stranded or going the wrong way, leading to reduced uptake of the vehicles and reduced public trust in self-driving vehicles overall.

In order to make the idea of the causal feedback diagram more accessible to citizens, we developed a simpler diagram, with the eight domains as quadrants of a circle. For each domain the research team identified a few impacts, from the literature, to illustrate the concept. Citizens first discussed these impacts, adding or changing impacts based on their perceptions. Facilitators then asked participants to consider what the secondary or knock-on impacts might be for each domain, these were captured in the next layer of the circle, as shown in figure 6 below. Where participants described connections between impacts these were captured with arrows, and where they felt impacts were circular (e.g. that once a particular impact increased there would be a feedback loop) these were marked with a star. In this way citizens were able to generate their own causal feedback loops in a simplified way, based on their perceptions.

Each group's draft diagram was then presented to another group, allowing a higher number of participants to review and input into each causal effect diagram. This process highlighted a number of areas of uncertainty where citizens within or between groups were usure about how impacts would interrelate. These uncertainties were explored further in other activities of the project (see Chapter 12). Figure 7 shows an example of a diagram.



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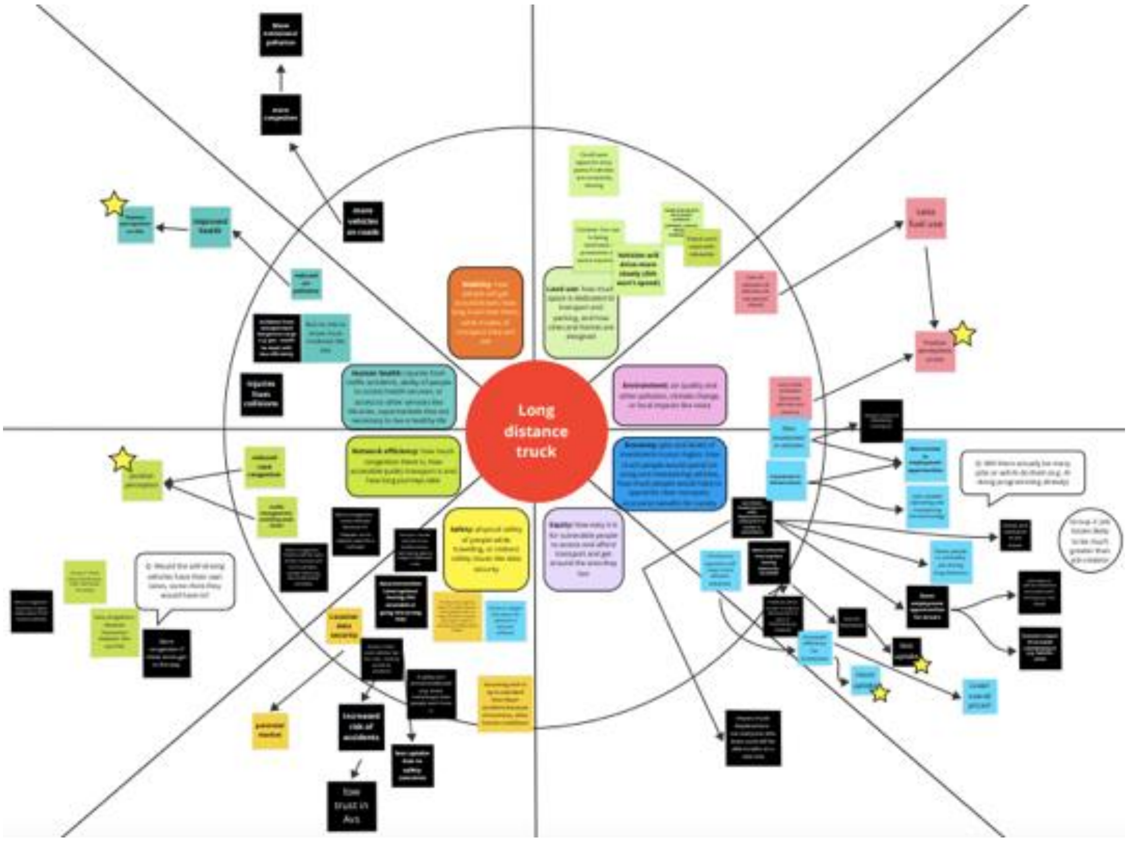


**Figure 7: Online citizen workshop exercises – impact diagrams**

After taking part in the online engagement platform, citizens in the Netherlands, Poland and Greece took part in 2-hour face-to-face workshops, which followed the exact same format as the online workshops but using materials in printed form. Figure 8 shows two aspects of the workshop in Poland.

**Figure 8: Images from face-to-face citizen workshops**

After the workshops, project partners in each country shared notes and co-created diagrams. Data from all workshops and countries were then drawn together to refine and expand the causal effect diagrams by looking at the potential positives and negatives from across the sample. They



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were further refined using data from the co-creation activities with organisations, to capture views expressed across different audiences.

### 2.2.2 Sample overview

The table below shows the number of participants in each country. A total of 232 citizens were involved, across eight countries. Table 6 show the sample composition.

**Table 5: Qualitative assessment (citizens) – sample sizes by country**

| **All** | **232** |
|---|---|
| United Kingdom | 34 |
| Germany | 28 |
| France | 11 |
| Netherlands | 33 |
| Spain | 29 |
| Poland | 40 |
| Greece | 40 |
| Cyprus | 17 |

**Table 6: Qualitative assessment (citizens) – sample composition**

| | | **Netherlands*, Poland, Greece** | **Other*** |
|---|---|---|---|
| Age | 18-34 | 16 | 26 |
| | 35-64 | 33 | 41 |
| | 65+ | 32 | 15 |
| Gender | Man | 43 | 49 |
| | Woman | 37 | 56 |
| Working status | Works full-time | 39 | 22 |
| | Works part-time | 7 | 13 |
| | Student | 5 | 9 |
| | Seeking work | 1 | 2 |
| | Homemaker | 6 | 2 |
| | Retired | 8 | 7 |
| Household composition | Single | 21 | 9 |
| | Shared home | 2 | 3 |
| | Lives with parents/family | 6 | 7 |
| | Single parent with children | 1 | 0 |
| | Lives with partner | 24 | 22 |
| | Lives with partner and children | 16 | 32 |
| Residence location | City centre | 16 | 15 |
| | City, not in the centre | 18 | 19 |
| | Small city | 0 | 0 |
| | Small town | 6 | 26 |
| | Village | 28 | 11 |
| Driving attitude* | Enjoys driving | 43 | 19 |
| | Would prefer to do something else | 13 | 13 |



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| | | | |
|---|---|---|---|
| Disability | Has a disability impacting mobility | 2 | 4 |

**Note**: *: some data is missing

### 2.2.3 Allocation of use cases

A total of ten use cases were introduced across the sample (Table 5). Each use case was a self-driving electric vehicle. Each country explored a set of four use cases, with two use cases (consolidated delivery bot and self-driving e-hailing) common across all countries because they emerged in previous co-creation activities as the most common, suggested in all locations. A further two use cases were selected based on services that had gained greater levels of interest or been identified as more relevant during previous activities held in each country.

**Table 7: Use case allocation by country**

| | | Greece | Poland | Netherlands | United Kingdom | Germany | Spain | Cyprus |
|---|---|---|---|---|---|---|---|---|
| Passenger | P1. Self-driving e-hailing (shared) | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | P2. Self-driving car (private) | ■ | | | | | | ■ |
| | P3. Self-driving bus service | | | ■ | ■ | | ■ | |
| | P4. Mobility bus on demand | | | ■ | | | | |
| | P5. Emergency transportation | | ■ | | | ■ | | |
| Freight | F1. Consolidated delivery bot | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | F2. Delivery drone | | | | | | | ■ |
| | F3. Long-distance truck | | | | ■ | ■ | | |
| | F4. Single-supplier delivery bot | ■ | | | | | | |
| | F5. Medical delivery drone | | ■ | | | | ■ | |

## 2.3 Results by use case: passenger services

### 2.3.1 Self-driving e-hailing

**Table 8: Self-driving e-hailing use case (citizens)**

| | |
|---|---|
| **Description** | The self-driving e-hailing service is a platform that uses self-driving vehicles to provide on-demand rides to passengers. It allows passengers to go to any location within a 10km radius in the city/area, similar to e-hailing services now but without a driver. |
| **Countries tested** | Cyprus, Germany, Greece, Netherlands, Poland, Spain, United Kingdom |

Across all regions, there was debate about whether self-driving e-hailing would improve the transport network efficiency, for example by reducing the need for private vehicles. Most agreed that this could be a positive outcome, easing congestion and therefore emissions, leading to a positive perception of self-driving vehicles. However, there was scepticism that e-hailing would genuinely lead to reduced private car ownership.



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Safety was also salient for all countries and audiences. Citizens recognised that self-driving e-hailing vehicles could significantly reduce road traffic accidents by removing human error and limiting speeds, but they were concerned about passenger safety in the event of a software or hardware malfunction. Participants felt that a driver can provide a sense of security, as well as assistance when needed, thus contributing to passenger safety, despite the risk of human error. In addition, participants were concerned about the risks associated with increased data sharing.

Equity proved to be another key domain across countries. Most participants felt that self-driving e-hailing services would allow greater accessibility to car use, particularly for those who cannot drive, for example due to mobility impairments. However, citizens in the Netherlands and UK thought the service could be too expensive for some to use regularly.

**Table 9: Self-driving e-hailing use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Citizens in Poland assumed that this service would improve mobility by shortening waiting times compared to public transport services. They also felt it could encourage car sharing, thereby reducing the demand for private vehicles.<br>• However, participants in Greece felt that the service could increase travel times for people choosing it over a private car.<br>• Participants in Germany also stressed the importance of a quick, responsive service if it were to replace private car use. See also Equity. |
| **Public health** | • For citizens across countries, the impact of reduced emissions was a frequent theme, and seen as a positive influence on public health and therefore perceptions of self-driving vehicles.<br>• However, there was some concern from Germany about potential impacts on mental health, contributing to social isolation in situations where taxi rides are a key social interaction in a passenger's day-to-day life. |
| **Land use** | • Land use was a key theme for citizens who identified that a reduction in private vehicles could reduce congestion. In Germany, however, citizens questioned whether there would in fact be a reduction in the number of private vehicles – some felt there could be an increase instead (see Environment).<br>• Participants also thought that an e-hailing service could reduce the need for private car ownership and, therefore, parking spaces, which could lead to more room for green spaces or electric charging stations. |
| **Safety** | • Safety was the most commonly expressed concern across citizens in all countries.<br>• Most participants recognised that self-driving vehicles might be safer on the roads by reducing human error and sticking more closely to speed limits. However, all countries mentioned concern for the physical safety of passengers in the event of a technology malfunction that affects the control of the vehicle.<br>• More specifically, there were concerns from Cyprus and the UK about the safety of vulnerable passengers without a driver acting as a safeguard.<br>• In addition, there were concerns about the security of passengers' personal data that the service might hold, and how secure this would be against theft; this was found to be significantly off-putting in most countries. |
| **Transport network** | • Citizens from all countries saw the potential for reduced private vehicle use to reduce congestion. However, some were cautious about the level of uptake needed to make a tangible difference in this space. This is true of citizens in Germany, who feared that the introduction of additional vehicles into the network might simply increase congestion. |
| **Environment** | • There was widespread agreement among citizens that self-driving e-hailing has the potential to reduce emissions through reduced private car use.<br>• However, views differed on the certainty of this outcome. For example, there was a strong expectation of this for citizens in Poland and the Netherlands, |



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| | |
|---|---|
| | while others, particularly in Germany, questioned whether e-hailing services would significantly reduce personal car use. These citizens feared that the introduction of more vehicles might instead increase congestion, and therefore pollution, overall.<br>• Elsewhere, citizens in Cyprus expressed concern over battery manufacturing and its environmental cost. |
| **Economy** | • There was considerable variation in discussions of this domain across countries.<br>• Spanish citizens highlighted that a positive impact might be felt from increased investment in infrastructure<br>• The UK and Poland felt there could be negative impacts on private business if new self-driving vehicles were unreliable.<br>• Meanwhile, citizens in Germany and Spain expressed concerns for the job security of current taxi drivers. |
| **Equity** | • Most participants felt that self-driving e-hailing services would allow greater accessibility to car use, particularly for those who cannot drive, for example due to mobility impairments.<br>• However, citizens in the Netherlands and UK thought the service could be too expensive for some to use regularly. |
| **Timeline** | • Citizens' ideas for when this technology would be operational varied considerably between countries.<br>• Most felt that there would be at least some degree of rollout by 2026 (typically between 3-5%, but as high as 50% in Cyprus), and many were optimistic of a 50-70% rollout by 2050.<br>• Those in the UK compared this to the rollout of Uber which received considerable backlash but still penetrated (and came close to dominating) the market.<br>• In Germany, citizens' estimates were based on the pace of technological, regulatory, and social factors.<br>• Polish citizens also saw regulation as a considerable hurdle for a service that they felt was technologically ready. |

### 2.3.2 Self-driving car

**Table 10: Self-driving car use case (citizens)**

| | |
|---|---|
| **Description** | This car is completely self-driving. The owners can use it to go anywhere at any time, just like a private car today but without the need for a driver. |
| **Countries tested** | Greece, Cyprus |

Safety was the most salient topic for citizens across both Greece and Cyprus. Participants envisioned a reduction in road traffic accidents due to lack of human error but felt concerned about the likelihood of technological malfunctions, such as signal loss, which could put passengers in danger.

With regards to land use, participants could see the technology leading to large infrastructure improvements to accommodate self-driving vehicles. Some thought this could bring about new industries and employment opportunities.

Participants could also see positive impacts in equity, through the potential to increase mobility for citizens with impairments, as well as in public health, through reduced air pollution from electric vehicles.



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**Table 11: Self-driving car use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • There was debate among citizens in Cyprus about whether this use case would lead to more or less congestion on roads. On the one hand, participants pointed to a greater number of privately owned vehicles being in circulation; on the other, self-driving cars could have a positive impact on congestion due to better and more efficient driving.<br>• There was also a lack of consensus in Greece, where some citizens felt that this technology would reduce congestion if manually driven cars were phased out, as the price of a self-driving private car is likely to be too high for most people. Others thought it would increase congestion as more people would be able to use it, such as those who cannot drive. |
| **Public health** | • Consistent across both countries, benefits to health were often described as a secondary – albeit positive – impact of better air quality from electric technology (see Environment).<br>• Citizens in Greece also thought this use case could lead to fewer accidents due to less human error and self-driving cars more closely following speed limits. |
| **Land use** | • Citizens in both countries felt that the impacts on land use could be positive, expecting improvements to infrastructure to come along with the new technology.<br>• Some citizens in Greece, however, viewed a possible reduction in parking spaces (due to decreased private vehicle ownership) as a negative.<br>• In Cyprus, citizens could also see this use case leading to less availability of parking spaces but due to an uptake in private ownership, rather than a reduction. |
| **Safety** | • As with other use cases, safety was one of the most important themes.<br>• Citizens felt that automated vehicles would lead to increased safety standards on the roads, for example by reducing the rate of accidents.<br>• However, particularly in Greece, others were concerned that issues like signal loss and poor reaction times could decrease safety for the passenger.<br>• Greek participants also highlighted the importance of regulation and data security before the vehicles come to market due to worries about the unauthorised use of personal data. |
| **Transport network** | • Not discussed |
| **Environment** | • Citizens considered the reduction in air pollution from using electric technology to be a key positive of self-driving cars; they felt this would encourage uptake among the public.<br>• Citizens in Greece mentioned the reduction of visible air pollution specifically. |
| **Economy** | • Economy was a key theme for citizens in Cyprus. Overall, they expected investment to come with the updates to infrastructure needed for this technology to take hold, and they believed that this could open up a whole new industry and offer new employment opportunities.<br>• There was however a concern that this might not happen and that the labour market would not be prepared for the skills shift. |
| **Equity** | • Citizens in Cyprus had concerned that self-driving cars would be expensive and therefore inaccessible for people on low incomes. More positively, however, they believed that the technology could increase mobility for disabled passengers, since it takes away the need to be physically able to drive.<br>• For citizens in Greece, there were concerns that citizens in rural areas would not be able to use these vehicles due to narrow roads and lack of network coverage. |



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| | |
|---|---|
| **Timeline** | • Citizens across both countries were not hopeful of any kind of penetration of fully self-driving cars by 2026.<br>• Participants anticipated on average a 35% penetration level by 2050 but acknowledged that they would be more willing to use services as time goes on so these numbers may change. |

### 2.3.3 Emergency shuttle pod

**Table 12: Emergency shuttle pod use case (citizens)**

| | |
|---|---|
| **Description** | The Emergency shuttle pod is a dedicated service that is able to pick people up in medical emergencies and take them to the nearest hospital. It is a bit like an ambulance but with no driver or medical professional on board. |
| **Countries tested** | Germany, Poland |

There were significant concerns in both Germany and Poland about safety and public health in this use case. This most notably related to the lack of staff on board the pods. Citizens in each country felt that this would put patients at risk of unnecessary harm and would not be appropriate for emergency situations.

In terms of land use and transport network efficiency, both countries also felt that significant improvements would have to be made to infrastructure before this use case would be viable and safe. They were not convinced of the pod's ability to navigate complex urban environments in emergency situations.

Under mobility, German citizens did feel that there was potential for this technology to reach areas that would be hard for traditional ambulances to reach.

However, Poland was more sceptical on these pods increasing overall access from the perspective of equity. While existing ambulances in Poland are free at point of use, some citizens were concerned that the vehicles in this use case might have a cost to use them, and therefore only benefit those who can afford them.

**Table 13: Emergency shuttle pod use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Citizen groups in Germany felt that this use case could increase access to medical services, for example by expanding service to hard-to-reach rural areas, as well as to those who can not drive or those with limited mobility who might find it difficult to get to a doctor. They also thought that the service might help people with medical anxieties, as it could feel like a less intimidating form of transport. The service was primarily seen as an addition to the ambulance service, rather than a replacement. Participants imagined a central control room that could allocate the pods to emergency situations or those who need help getting to appointments.<br>• Polish groups felt that this use case would be ineffective compared to a self-driving taxi that could provide the same service. They also raised concerns about limited range hindering a pod's reach to isolated areas. |
| **Public health** | • Citizens in Poland had many concerns with this use case relating to public health, including the potential for misdiagnosis and incorrect handling of certain<br>• conditions such as head traumas.<br>• Citizens in Germany had a more positive perspective, but assumed the pod would only be used for minor injuries, potentially as a shuttle service to the hospital or in the same capacity as an individual paramedic, to triage before hospital. |



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| | |
|---|---|
| | • Both countries' participants also noted the possible risk of immunocompromised patients picking up viruses from the vehicles, possibly under the assumption that the pods would be cleaned less frequently compared to traditional ambulances. |
| **Land use** | • Polish citizens were concerned about limited range hindering a pod's reach to isolated areas.<br>• Meanwhile, German citizens noted that the pods might require less parking space at the hospital compared to ambulances and private vehicles, leading to more room for green space around the hospital.<br>• Participants in both countries raised the point that without improvements in infrastructure these pods would only add to congestion on roads. |
| **Safety** | • Citizen groups in Poland and Germany were very concerned about passenger safety in this use case, for example the (lack of) stability of the pods affecting passengers with significant injuries.<br>• Polish citizens were particularly keen to point out that if patients could not be adequately assessed, then transport in the pod may do more harm than good.<br>• Both countries were also concerned about digital safety, particularly the misuse of location and/or medical data. However, there was recognition in both countries that this use case might reduce the chance of safety crews being exposed to dangerous situations. |
| **Transport network** | • Citizens felt that infrastructure is not currently adequate for this use case to take full effect, due to reservations around the technology's ability to navigate complex urban environments under emergency conditions.<br>• They did however think that the use case would lead to increased access to medical services in rural areas and faster and more targeted care overall, due to the added capacity across the service.<br>• To Polish groups, this use case felt like an unnecessary alternative to automated taxis that could provide the same service, and there was a concern that limited battery range could hinder reach into isolated areas. |
| **Environment** | • Citizens in both Germany and Poland agreed that if this use case were to lead to a reduction in private vehicle use, and in turn a reduction in air pollution, then it would increase positive perceptions of self-driving vehicles.<br>• Additionally, Polish groups thought that there would be a reduction in noise pollution, because the vehicles in the use case would be electric. |
| **Economy** | • Participants in Germany suggested that this use case could lead to increased efficiency in the medical industry due to fewer staff being needed in emergency transport, while increasing the number of patients served, and that supporting the medical profession in this way would increase the positive perception of self-driving vehicles.<br>• They also suggested that this use case could lead to increased investment in infrastructure, which could provide jobs.<br>• However, there were concerns about the large upfront cost to both the transport and health systems that this use case might require. |
| **Equity** | • Existing ambulances in Poland are free at the point of use. Therefore, Polish citizens felt that this use case could negatively impact the acceptance of self-driving vehicles if the service was costly, i.e., only available to those who can afford it.<br>• Meanwhile, German groups felt that a control centre would be essential to ensure pods were sent to the most appropriate cases. |
| **Timeline** | • Polish citizen groups did not think the service would ever be an appropriate use of the technology.<br>• Some German citizens felt that early adoption could happen within the next 5-10 years, but others anticipated operational challenges that would mean adoption would be much further away. |



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### 2.3.4 Mobility bus on demand

**Table 14: Mobility bus on demand use case (citizens)**

| | |
|---|---|
| **Description** | This vehicle will transport passengers to their destination with onboarding and security features that will ensure a controlled ride for everyone. |
| **Countries tested** | Netherlands |

Citizens considered this use case to have the potential to encourage much needed transport infrastructure development. They saw benefits in the domains of land use and economy, such as better-quality road networks and a potential reduction in the cost of running public transport. However, they also agreed that there are concerns about the safety of the use case, regarding the potential misuse of location data and the assistance of vulnerable passengers once on board.

Citizens debated across mobility, land use and transport network efficiency how much the service is likely to lead to a decrease in private car ownership and therefore congestion. They also debated the credentials of the use case in relation to the environment and public health; some felt a reduction in fossil fuel use could be beneficial to air quality, while others felt this would be offset by particulate matter from wear and tear of the vehicles.

**Table 15: Mobility bus on demand use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Citizens were keen to point out that for this use case to work there must be consolidation with other users, so the service is open to everyone, potentially by having different vehicle types (see also Equity).<br>• They felt that a service for only a certain group of people, such as those with mobility impairments, does not maximise the potential of the technology.<br>• Some were concerned that the service could lead to pavement congestion from people waiting to board and questioned whether it would actually reduce private car use and free up road space (see also Land use). |
| **Public health** | • Citizens debated whether the use case would lead to better air quality.<br>• Some participants felt that reduced fossil fuel consumption would improve air quality, but others felt that particulate waste matter from brakes and tyres would counteract this positive impact.<br>• Citizens did agree however that benefits to public health might be seen through reduced traffic accidents, but there was disagreement as to the extent of these benefits. |
| **Land use** | • There was debate in the groups about the type of roads suitable for this service, and where, if at all, new lanes would be required.<br>• Some also questioned how the vehicle would navigate interactions with emergency vehicles.<br>• However, there was positivity towards the use case being accompanied by infrastructure redevelopment, with secondary impacts such as better road capacity and more navigable cities. |
| **Safety** | • Citizens were concerned about the potential misuse of location data of vulnerable people, and the lack of a driver to assist those who might need it, particularly when boarding and disembarking the vehicle. |
| **Transport network** | • As with other use cases, citizens cited the potential for reduced road congestion through decreased private vehicle use.<br>• Some also noted that there may need to be a maximum number of stops per trip to ensure efficiency. This was in response to a concern of uptake exceeding capacity, i.e., should the service be taken by too many passengers, it would become difficult to use, for example by facilitating too many stops or minimising entering and exiting times for passengers. |



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| **Environment** | • Citizens highlighted environment as a key area where there could be positive perception of self-driving buses, if they were to lead to a reduction in private vehicle use, congestion, and air pollution.<br>• However, some were concerned that because of the increased weight of the vehicle, particulate matter from tyre wear and brakes would be an issue. |
| **Economy** | • There was widespread agreement between citizens that investment in infrastructure would be beneficial for the economy, and that the service had the potential to reduce transport costs for users, presumably as a result of decreased staffing costs.<br>• They also felt that there would be less cost associated with repairs, due to fewer accidents. |
| **Equity** | • Citizens felt that this use case could lead to a safe travel option for people with disabilities, but that to be truly equitable, the service should be available to everyone by providing a variety of vehicle types tailored to different groups and locations.<br>• They also felt that efforts should be made to support people on lower incomes to access the service, implying that uptake and acceptance rely on efforts being made around accessibility. |
| **Timeline** | • Participants thought that the public would need time to adjust to this technology and did not envision this service being available at all by 2026.<br>• However, they felt that rollout could be between 15% and 20% by 2035, jumping to 50% to 65% by 2050, suggesting slow initial uptake but trust eventually building in the service. |

### 2.3.5 Self-driving bus service

**Table 16: Self-driving bus service use case (citizens)**

| | |
|---|---|
| **Description** | This self-driving bus service provides passengers with connection between local towns and villages at specific times from designated spots, much like a regular bus service but without a driver. |
| **Countries tested** | Netherlands, Spain, United Kingdom |

The theme of safety was a salient topic across countries, but specific concerns varied. They ranged from a concern for the safety of passengers without a driver present, particularly those considered vulnerable such as elderly people or those with disabilities, as well as how adept a self-driving bus would be in navigating pedestrians and other road users. There was also concern about the potential for a loss of connectivity resulting in buses being unable to operate.

The necessary updates to infrastructure were also a key topic of discussion in relation to economy across all countries. There was broad concern that infrastructure updates will be expensive if vehicles cannot use the current road network as it is, but also a view that this service would be a good opportunity to invest in improved infrastructure, which would demonstrate commitment to the technology, and provide jobs.

Across the board, citizens had positive views on the theme of environment, emphasising the improvement in air quality, if the potential of the use case could be fully realised by encouraging less private car use and individual travel.

This use case was seen as one of the most “realistic” ones and expected penetration sooner rather than later.



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**Table 17: Self-driving bus service use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Citizens in the UK felt this service had the potential to increase accessibility for people with mobility impairments, if the service could be designed to specifically cater to any additional needs.<br>• Participants in the Netherlands felt similar, adding that this service could lead to increased flexibility for disabled people, as bespoke transport services currently need to be booked 24 hours before. |
| **Public health** | • Across citizen groups, every country identified a potential reduction in air pollution from reduced private vehicle use that could positively impact public health, leading to a more positive perception of self-driving vehicles.<br>• However, in the UK there was concern that quieter vehicles could pose a traffic safety risk which needs to be considered. |
| **Land use** | • Most citizen groups assumed that self-driving buses would replace traditional buses and that this could be a more comprehensive service, reaching places where current buses can not go and running later without a driver to consider.<br>• In Spain, this was seen to be a potential solution to the societal problem of depopulation in rural areas. In other words, this use case could deliver mobility to – often older – citizens in isolated villages, therefore making it more feasible and attractive to live in such places.<br>• In the Netherlands, groups assumed that these buses would be more frequent as the technology could allow them to respond to where customers are in real time or create a timetable that reflects better knowledge of demand.<br>• Across all countries, some citizens felt that this could lead to decreased private vehicle use leading to a reduced need for parking spaces in urban centres, and less space needed for bus infrastructure.<br>• However, others felt it would have no impact on private car use. |
| **Safety** | • The safety of automated buses was a big concern for citizens across countries.<br>• In the UK, participants were concerned about cyber security issues such as the 'hackability' of these vehicles and passenger safety in the event of a hacking incident.<br>• Participants in the Netherlands meanwhile were concerned about what would happen in the event of a crash without a driver to alert emergency services. They were also concerned for pedestrian and cyclist safety, suggesting that robust testing – and possibly separate lanes – would be needed for these vehicles before they could be rolled out.<br>• Concerns were also raised in the UK and the Netherlands that the bus is currently a safe place for vulnerable passengers and without a driver that may no longer be the case. |
| **Transport network** | • Participants in the Netherlands felt that if buses were reliable, they would be the most efficient use of the network and should be encouraged over private electric vehicle use. They felt they could be used as shuttle buses for specific events or for specific routes from rural to urban areas.<br>• Groups in Spain meanwhile thought that significant uptake would reduce individual transport use, in turn reducing congestion. |
| **Environment** | • For citizens across all countries, there was a generalised sense that self-driving buses would increase the efficiency of public transport, improving the service, and therefore reducing private vehicle use and the negative environmental impacts associated with that, including air pollution. |
| **Economy** | • Economy was a salient theme for citizens across countries. Job losses of drivers were a particular concern, however there was also an acknowledgment that this could be more efficient and cost effective for the public transport network.<br>• For many, job losses would only be acceptable if significant improvements were made to public transport.<br>• There was also concern from UK citizens that 'bad signal' stopping the bus |



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| | from working could lead to a bad reputation for businesses and a loss of income. |
| **Equity** | • For citizens in the UK and Netherlands, the lack of a driver to help vulnerable passengers was a concern (see also Safety).<br>• Additionally, with the lack of driver, citizens in the Netherlands highlighted the need to keep the payment system simple and in line with the current system. |
| **Timeline** | • Some citizens in Spain felt that deployment in the near future is realistic. However, most across the countries felt that the technology has a long way to go before it is viable in everyday life.<br>• Citizens in the Netherlands and the UK expected penetration of 0-5% by 2026, but potentially as high as 70% by 2050; these estimates came with the caveat that this use case must become more popular than driving or travelling individually to encourage uptake. |

## 2.4 Results by use case: freight services

### 2.4.1 Consolidated delivery bot

**Table 18: Consolidated delivery bot use case (citizens)**

| | |
|---|---|
| **Description** | A consolidated delivery bot transports packages like products or food items from several companies to people in their homes, much like a private courier service, e.g., DPD Courier. |
| **Countries tested** | Cyprus, Germany, Greece, Netherlands, Poland, Spain, United Kingdom |

In the domain of transport network efficiency, there was consensus across all countries that the current pavement infrastructure would not be suitable to accommodate these bots. Under mobility and safety, many worried about space being taken away from pedestrians and the risk of collisions causing injury. There was also concern that there would be an increase in theft without a human present. More positively, on the environment, most agreed that there is potential to improve air quality through electric technology and reducing the number of larger delivery trucks.

In terms of safety, data privacy was an area of debate among UK citizens, who expressed concern about the potential misuse of personal data. Another area of disagreement related to the efficiency and value of the service. Participants in the Netherlands, for example, struggled to understand how this service would be better than what is currently available.

Lastly, some citizens were concerned about the accessibility of the bots themselves and the difficulty some people may face in retrieving packages without a driver to help.

**Table 19: Consolidated delivery bot use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Citizens felt that this use case might reduce road congestion, but simply offset this by further crowding pavements (see Transport network).<br>• The potential of reduced mobility for pedestrians was identified as a negative impact which participants felt would lead to negative perceptions of self-driving vehicles (see also Equity). These concerns were raised by participants across all countries, but notably in Greece. |
| **Public health** | • Citizens in all countries expected that the bots would improve public health via improved air quality, due to their electric power and as a consequence of fewer large delivery vehicles in populated areas (see also Environment). |
| **Land use** | • Land use was a particularly important theme for citizens across all countries.<br>• Most were concerned that their regions do not have the necessary |



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| | infrastructure to support this use case, particularly in relation to giving up space on pedestrian pavements, as well as the practical considerations of where to locate supporting infrastructure such as charging stations and storage units.<br>• For citizens in Spain, there was general unease about private companies using technology that takes up additional space in places that are intended for use by pedestrians. |
| **Safety** | • Much like the concerns discussed under the themes of mobility and land use, citizens in all countries were concerned about the possibility of pedestrian and/or cyclist-related accidents on pavements, which would very negatively impact public perceptions of this technology.<br>• Dutch participants in particular highlighted an intolerance to self-driving vehicles causing injuries, as the technology feels too new for there to be the necessary levels of public trust.<br>• There was also concern for the theft of goods across all countries, demonstrating less trust in this technology than in human couriers.<br>• Citizens in the UK also voiced concerns over misuse of personal data.<br>• However, groups in Spain felt more confident that data and privacy issues would be manageable and did not see this as a barrier to uptake. |
| **Transport network** | • Citizens in all countries broadly agreed that any perceived benefit to reducing traffic congestion in this use case would be negated by increased congestion on pavements, inconveniencing the public and negatively affecting the uptake of self-driving vehicles.<br>• In the Netherlands, citizens felt that this technology would be less efficient than delivery and courier networks already in place, which could negatively affect perceptions and uptake further.<br>• Citizens also emphasised that if goods are not safe, or if there are no guarantees of responsibility from the manufacturer/retailer then uptake would be limited (see also Safety). |
| **Environment** | • Citizens across all countries highlighted the environmental impact as a positive aspect of this use case, due to the reduction of delivery vehicles on the road. If this led to less congestion and therefore less air pollution, they felt it would positively influence the uptake of this technology. |
| **Economy** | • There was significant concern across all countries regarding job losses for drivers.<br>• However, citizens in Spain felt that the negative impact of this may be overstated provided that other jobs were created in the process.<br>• Participants from Greece and the Netherlands saw economic incentives in the form of new businesses and business models which would take advantage of the presumed convenience and direct-to-consumer relationship this use case could provide. |
| **Equity** | • Citizens across countries expressed significant concern for vulnerable and less mobile groups.<br>• The UK, Germany, and Poland all stressed the importance of a human to support people with restricted mobility to retrieve parcels or use the service at all. A lack of human there could lead to negative perceptions of the use case and self-driving vehicles more generally.<br>• Similarly, citizens in Greece and Cyprus emphasised that it would also be difficult for digitally excluded groups to benefit from this technology. |



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| **Timeline** | • Although estimated uptake varied between 50% and 90% by 2050, most countries agreed that this technology was likely to be adopted soon and exist in a lengthy experimental phase.<br>• Germany's participants anticipated legal and regulatory hurdles but saw this use case being introduced in tech-friendly cities, while groups in the Netherlands felt it would initially only be introduced in closed, controlled areas such as warehouses, harbours, or airports. |

### 2.4.2 Single-supplier delivery bot

**Table 20: Single-supplier delivery bot use case (citizens)**

| | |
|---|---|
| **Description** | The single supplier delivery service replaces a retailer's previous fleet of delivery vans and drivers. Depending on the retailer, the delivery service can operate nationwide. |
| **Countries tested** | Greece |

Across multiple domains, citizens debated whether this use case would reduce the amount of traffic on roads. For those who thought it could, positive benefits like reduced congestion and air pollution followed.

Similarly, most citizens were concerned that current infrastructure is unsuitable for this use case, however some felt optimistic that infrastructure improvements could bring about transport network efficiencies and economic benefits through a better managed traffic flow.

There was a general concern regarding the risks to safety for pedestrians on pavements, and the need for regulation about where the bots would operate, to mitigate those risks. Theft of unsupervised deliveries and vulnerability to data leaks also raised concern.

Under Equity, participants were particularly concerned about people who are digitally excluded or in rural areas where bots might struggle to navigate the terrain.

**Table 21: Single-supplier delivery bot use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Participants thought that control centres would be needed for the roll out of this use case. However, should rollout be successful, some felt that this use case could reduce congestion on roads, and therefore support better mobility and increase positive perceptions of self-driving vehicles. |
| **Public health** | • Citizens felt that the self-driving vehicles being electric could have a positive effect on public health from reduced air pollution, and that advanced traffic management from self-driving vehicle technology could also support this goal through more efficient driving.<br>• They also felt that there would be a reduction in accidents caused by human error. |
| **Land use** | • Citizens were concerned that current infrastructure is unsuitable for this use case, with congested roads and narrow pavements likely leading to accidents and low trust in the bots.<br>• They felt that considerable investments to local infrastructure would need to be made to make this technology feasible. |
| **Safety** | • Although citizens felt that this use case could reduce traffic accidents on roads, they worried about increased accidents involving pedestrians on pavements.<br>• They were also concerned about how goods on board would be protected from theft, as well as how sensitive personal data would be handled and protected; there was appetite for regulation around the latter issue to build trust and facilitate uptake. |



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| | • Participants also anticipated legal issues relating to responsibility in the event a package is lost or stolen, and what would happen in the case of lost signal. |
| **Transport network** | • For some citizens, the potential to reduce road traffic and present opportunities for advanced traffic management could have a positive effect on transport network efficiency.<br>• However, others felt that current capacity and infrastructure is already inadequate, and so the introduction of this use case would only create congestion for pedestrians and reduce overall transport network efficiency. |
| **Environment** | • Many citizens felt there was potential for the bots to reduce the number of vehicles on the road, leading to less fuel use and less noise and air pollution, and resulting in positive perceptions of self-driving vehicles.<br>• However, others concerned that renewable energy sources might not provide enough power and that the necessary charging infrastructure would not be available, leaving bots stranded. |
| **Economy** | • Most citizens felt that this use case could result in job losses for couriers and delivery people, and fewer employment opportunities overall<br>• However, some foresaw new opportunities in manufacturing from investment in new vehicles. |
| **Equity** | • While citizens said that this technology could be used by elderly and vulnerable groups, they also felt that these are the groups that might struggle to access it most due to a lack of driver to help them.<br>• They were particularly concerned for those who are digitally excluded or those in rural areas where bots might struggle to navigate the terrain. |
| **Timeline** | • All citizens felt there would be very limited uptake in the near future but were more varied in their estimates for the longer-term; most settled on 30% by 2050, while others were more optimistic with figures between 65% and 70%. |

### 2.4.3 Medical delivery drone

**Table 22: Medical delivery drone use case (citizens)**

| | |
|---|---|
| **Description** | Self-driving delivery drones designed to transport medicines and healthcare products to people with reduced mobility. |
| **Countries tested** | Poland, Spain |

Across both countries citizens saw various applications of the use case that could have positive outcomes. For example, they saw a wide range of possible applications across Mobility and Public health for the use case beyond individual deliveries, such as deliveries in emergency situations (e.g. flooded areas or war zones), as well as quick deliveries of essentials (such as blood) to hospitals.

Both countries could see positive impacts in transport network efficiency such as reduced traffic congestion, particularly in urban areas. However, some were concerned about the potential for increased noise and visual pollution.

Both countries also raised concerns about safety, seeing medicines at an increased risk of theft in unsupervised drones. Other concerns around not being able to operate in bad weather or areas with poor connectivity, as well as limited capacity for charging, also remained.

**Table 23: Medical delivery drone use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Citizens in Poland saw this use case as having more applications than deliveries to individuals. They felt it could be used to transport medicines and medical equipment between pharmacies, but that it would have to be fully integrated with the current transport network to work efficiently. They stressed |



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| | that this service should not be seen as a substitute for pharmacy visits. Participants also saw the opportunity for deliveries at night (due to them being self-driving) as a positive, however there was concern that they would not be able to operate in bad weather.<br>• Citizens in both Spain and Poland felt there was potential for the use case to ease traffic congestion on the roads, particularly from delivery vans but that this might be offset by increased air congestion causing visual pollution. |
| **Public health** | • Citizens in Poland saw many applications for the use case resulting in positive impacts on public health, for example a service that could reduce exposure to viruses through the lack of human contact or facilitate a wider and more efficient distribution of medicines, supporting those who cannot leave their homes. They felt it could be useful for delivery of medicines in flooded areas or war zones, as well as offering new opportunities for research. However, if the drones in this use case failed to deliver, for example through an accident or lost connection, this could result in poorer health outcomes.<br>• Citizens in both Spain and Poland agreed that this use case may not be suitable for unstable medications, such as those that need to be stored at a particular temperature, and Spanish citizens worried about the impact of collisions causing injuries. |
| **Land use** | • Citizens in Spain felt that drones would not require significant infrastructure development, which was seen as a positive, although they were unsure of how drones would be stored when not in use.<br>• Polish citizens however saw a need for a network of vertiports, including on private land, which they felt could complicate their management. |
| **Safety** | • Citizens in both Poland and Spain were concerned about the security of personal data being used by the drones and its vulnerability to misuse and hacking. They felt this could lead to distrust from users, affecting perceptions of the technology. They also questioned how reliable the technology would be, seeing drones as at increased risk of accidents and theft compared to traditional deliveries.<br>• However, some in Spain felt that concerns about personal data and accidents were overstated and expected the technology to have developed enough to offset this negative impact. |
| **Transport network** | • Citizens in both countries were positive about the use case for services such as blood delivery and felt it could improve efficiency of health services.<br>• Some citizens in Spain expressed concern about drones flying in high density areas and the potential disruption this could cause but saw a potential reduction in road traffic as a positive impact.<br>• Citizens in Poland felt this use case would have limited coverage due to charging capacity and limited charging infrastructure and have limited utility in bad weather. They could not see applications beyond individual deliveries such as transfers between hospitals, as currently hospitals do not communicate with each other. They did however think that the use case could lead to less road congestion and increased potential for night deliveries but foresaw problems with returns. |
| **Environment** | • Citizens in both countries had concerns about the pollution associated with battery production and disposal, despite the potential for reduced local air pollution. They were also both concerned about increased noise pollution.<br>• Citizens in Poland were concerned that the drones would increase visual pollution and collisions with birds. |
| **Economy** | • Polish citizens were concerned the use case would incur large costs to the healthcare service. They did see potential for job creation and innovation with private investment, but worried that this initial outlay could increase the cost of medicines to users.<br>• Citizens in Spain also felt there is potential for job creation, but only with a |



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| | significant amount of upskilling. |
| **Equity** | • Spanish citizens expressed concern about unnecessary technification making services harder to access for digitally excluded people but felt this could be overcome with training and the right support. They also foresaw access issues for people who are unable to leave their homes to retrieve packages.<br>• Citizens in Poland felt that charging stations would end up being concentrated in urban environments leaving rural locations with poorer service. |
| **Timeline** | • Citizens in Poland felt that this technology is likely already available but requires regulation before it can be introduced properly.<br>• Citizens in Spain estimated that the penetration rate of this technology could be anywhere between 50%-100% by 2050. |

### 2.4.4 Long-distance truck

**Table 24: Long-distance truck use case (citizens)**

| | |
|---|---|
| **Description** | This long-distance truck transports goods efficiently and safely, eliminating the need for drivers. The truck navigates routes, delivers cargo, and optimises supply chains, ensuring timely and reliable freight transportation. |
| **Countries tested** | Germany, United Kingdom |

Both countries' participants agreed that there is currently a lack of appropriate infrastructure to support this use case. However, if changes could be made, such as dedicated lanes for the vehicles, this could lead to higher transport network efficiency and lower congestion, as well as potentially repurposing land use currently dedicated to rest stops and parking.

Citizens in both countries were concerned about the safety of the vehicles, particularly around the likelihood of more accidents, loss of connection, theft of goods and the oversight of dangerous cargo. They felt that these aspects could affect perceptions of the technology and decrease uptake.

**Table 25: Long-distance truck use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Mobility was a low salience issue across countries and audiences.<br>• However, citizens in the UK felt that this use case could lead to more trucks on the road, due to numbers not being restricted by available drivers; they thought that this could lead to more congestion.<br>• German citizens, meanwhile, felt the lack of need for rest periods could lead to faster, more efficient deliveries, as well as fewer traffic jams due to more efficient autonomous driving. |
| **Public health** | • UK citizens had mixed views around public health. They had concerns about injuries resulting from collisions but felt there was an opportunity to reduce pollution leading to better air quality and therefore health. There were also concerns about how dangerous cargo might be overseen without a driver.<br>• German citizens shared this optimism for better air quality and a concern for dangerous cargo, as well as the safety and stability of hydrogen as a fuel (see also Safety). |
| **Land use** | • UK citizens expressed concern that current infrastructure is not suitable for self-driving vehicles, which may in turn limit the uptake of this technology. They also felt that roads would need to be in better condition, for example free of potholes in case the technology can not cope with these obstacles. They did, however, think that self-driving trucks would save space through the reduced need for lorry parks and rest stops.<br>• German citizens shared this view of space saving and the need for development of road infrastructure and capacity, and they also wondered |



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| | whether this use case would lead to greater traffic at night. |
| **Safety** | • Citizens in both the UK and Germany raised concerns about how adaptive to obstacles and traffic hazards the vehicles would be, as well as what would happen in the event of a mechanical failure, and the ability of the technology to replicate a drivers' 'feeling' for safety and vehicle health.<br>• Despite this, German citizens saw opportunities to reduce accidents related to fatigue of drivers, while UK citizens felt that speed limits might offset any potential negative impacts; both wanted to assume the technology would be safe by the point of rollout.<br>• Some participants recalled previous examples such as smart motorways, which worked in theory but had to be scrapped.<br>• They also saw potential impacts for this use case on the policing of traffic accidents and border crossing.<br>• Some had concerns about the size of the vehicles, making them a hacking target to use as a weapon.<br>• Overall, UK citizens felt that the perceived dangers of these large vehicles on busy motorways may be a serious impediment to their uptake.<br>• Germany also expressed concern regarding theft of trucks as well as the oversight of dangerous cargo. |
| **Transport network** | • UK citizens were unsure if this use case would help congestion, for example through more efficient movement in dedicated lanes, or make it worse, likely through an overall increase in trucks on the road.<br>• German citizens saw potential for increased accidents and breakdowns to negatively impact transport network efficiency. They also took a more international view, citing the need for Europe-wide laws and regulations that would manage this technology; they were also concerned for the potential impact of increased human trafficking. |
| **Environment** | • Both UK and German citizens saw potential impacts of reduced emissions from hydrogen use which could lead to an increased positive perception of self-driving vehicles. German citizens also felt that savings in fuel could be made through autonomous driving, perceived to be more efficient that human driving. They also pointed out a reduction in noise pollution. |
| **Economy** | • UK citizens felt that job losses would be significant for drivers and associated service industries, potentially leading to strikes. However, with the trajectory of technological innovation and use of Artificial Intelligence, they recognised this as an inevitability to some extent, leading to only a limited effect on uptake.<br>• German citizens felt this use case could help with overcoming the shortage of lorry drivers, a job where interest is decreasing. However, they were concerned about data connection issues causing problems for businesses. They also saw an investment in infrastructure leading to a positive impact of new and different types of jobs. |
| **Equity** | • UK citizens were concerned about job displacement, noting that not everyone will be able to get a new job.<br>• German citizens were worried about impacts to smaller businesses that may be priced out of using this technology. |
| **Timeline** | • UK citizens generally agreed on a slow initial uptake but increasing to between 50% and 95% by 2050. This was seen to be dependent on factors such as cost, infrastructure upgrades, and feasibility of use for smaller companies.<br>• German citizens also felt that uptake would rely on infrastructure developments; they thought that the current road network in Germany needs a lot of work, and so full deployment across the country would be difficult. |



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### 2.4.5 Delivery drone

**Table 26: Delivery drone use case (citizens)**

| | |
|---|---|
| **Description** | The drone will pick up your package and navigate on its own, delivering it to a specified location within its area of coverage. It operates on-demand, and will transport products, goods, or food items. |
| **Countries tested** | Cyprus |

Under Equity, citizens identified the potential for greater delivery coverage for isolated and rural areas, which could also have a positive impact on public health. Most other pros to this use case, such as more space in urban areas, fewer road accidents and less air pollution, depended on the potential for this use case to reduce congestion on roads.

Other risks, for example around personal data and job losses, were raised as in other use cases.

**Table 27: Delivery drone use case: results of qualitative assessment (citizens)**

| | |
|---|---|
| **Mobility** | • Citizens felt that this use case would decrease the number of large delivery vehicles on the road, and their associated trips, reducing congestion and increasing positive perceptions of self-driving vehicles. |
| **Public health** | • Citizens felt that delivery drones could reduce the number of traffic-related accidents as a result of fewer large vehicles on the road (see also Mobility and Safety). |
| **Land use** | • Citizens felt that decreased road congestion could have a positive effect on the amount of land given over to green space, particularly in urban areas. |
| **Safety** | • There was a perception that less traffic congestion could lead to fewer accidents on roads.<br>• However, there was a general concern about the safety of personal data and vulnerability to cyber attacks that could negatively affect uptake. |
| **Transport network** | • Again, citizens think that this use case could lead to a significant reduction in congestion, improving driving conditions.<br>• However, there was a concern that they may increase air traffic congestion which would negatively affect perceptions of the technology. |
| **Environment** | • This theme was important to citizens. They felt that the reduction of congestion would lead to less air pollution and better air quality.<br>• However, the manufacturing of batteries to power this technology as well as increased noise pollution were mentioned as being significant concerns that could offset any perceived improvements to air quality. |
| **Economy** | • Citizens felt that this technology would lead to job losses for delivery drivers and couriers, though this negative impact would be offset by the new jobs and employment opportunities that would emerge with the new technology.<br>• Participants also identified risks to businesses if the technology were to malfunction and lose public trust. |
| **Equity** | • Citizens highlighted that this service could increase access to more remote areas, leading to more equal access to goods between rural and urban areas, and encouraging the uptake of this technology. |



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| | |
|---|---|
| **Timeline** | • Citizens felt that penetration rates for this use case would remain low in the short term at around 0-15% by 2026, but would be between 70-100% by 2050, indicating the belief that almost all small packages will eventually be delivered by drone. |

## 2.5 Conclusions

**The potential role and benefits of use cases**

Across use cases, citizens saw the biggest benefits to self-driving vehicles in improving mobility for those who are underserved by existing technologies and services. However, there were strong concerns about the user-friendliness (particularly for those with reduced digital capabilities), safety, and security of the technology – and to what extent they would be better, rather than just different, to what already exists.

They could see themselves making use of self-driving vehicles once they had become more established, particularly where they would be replacing existing services (such as manually driven buses).

**Positive and negative impacts**

On safety, citizens see fewer collisions on roads as a great positive, however the lack of driver is considered disconcerting at best, or dangerous at worst. For example, citizens see drivers as necessary both in emergencies and in helping passengers with additional needs; drivers are also seen to deter theft (in the cases of freight) and antisocial behaviour (in the cases of passenger vehicles).

Most feel that self-driving vehicles would be capable of driving well and safely at the point of rollout. However, some remain cautious about issues with lack of connectivity (particularly in rural areas), driving in bad weather or on uneven terrain, and passenger safety in cases of hardware or software failure. In multiple use cases, participants think the rollout of self-driving vehicles would only be possible with a central hub or control room to coordinate the vehicles.

Citizens tend to interpret 'safety' very broadly, and associate concerns about data and hacking with this domain. There are frequently raised concerns around the security of any personal data stored by the self-driving vehicles or their operating systems. Participants do not see many solutions to this other than regulation in this space. Larger freight or passenger vehicles being hacked and controlled remotely by bad actors is also a concern.

Currently, participants see a big challenge in the introduction of new legislation to manage instances such as road accidents or theft of goods. They assume that new regulation will be necessary to determine who is culpable in cases of collisions and/or theft of goods, which they feel could take time to establish.

**Certainty about impacts**

Citizens are unsure to what extent these solutions will change how we travel. For use cases that were seen to be similar to existing technology (e.g. private car, e-hailing, self-driving bus service), the self-driving aspect was not seen to fundamentally change how citizens might move around, except perhaps giving more autonomy to those who do not want to or are unable to drive.



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So far as these use cases can reduce the amount of private vehicle use (in passenger vehicles) or delivery journeys (for freight), participants see many benefits associated with reduced congestion on roads. However, whether this would indeed be the case is up for debate: firstly, in some use cases there is a question of whether this congestion would simply move elsewhere (e.g., the pavement for delivery bots, or the air for drones); secondly, there is a question of whether congestion would decrease due to more efficient driving from self-driving vehicles, or increase due to a higher total number of vehicles on the road (i.e., self-driving vehicles are adding to, not replacing, overall vehicle use and ownership). Many thought that shared services were unlikely to lead to a reduction in private car ownership, the convenience of which was seen as hard to beat.

In addition, infrastructure is currently not felt to be adequate to facilitate the rollout of these use cases. However, participants are fond of the possibility that the infrastructure improvements required to rollout self-driving vehicles might lead to more investment and improvements in transport more broadly. One large aspect of this is charging infrastructure, but also the improvement in electric vehicles themselves, which sceptics view as unreliable currently (i.e. lack of range and access to charging points).

There is a prominent fear of job losses for delivery and public transport drivers, but equally an acceptance that more jobs and industries may be created in the rollout of self-driving vehicles. Participants are not unanimous on which way this dial would swing.

Citizens do not want self-driving vehicle use cases to only benefit or be available to those who can afford it. There were also concerns about the exclusion of already marginalised groups and those who feel more vulnerable. While many felt that those with physical disabilities and mobility impairments may benefit from self-driving vehicles, those using mobility aids themselves were concerned about accessing the vehicles without human assistance.

There is uncertainty on the environmental and health impacts. Most participants think that self-driving vehicles being electric would mean reduced air and noise pollution, which they see as a good thing. The most frequently mentioned benefit to public health is better air quality, but this assumed that self-driving vehicles both reduced congestion and were indeed electrically powered. In addition, some citizens have environmental concerns about how batteries are manufactured and disposed of, as well as the particulate matter from tyre wear and brakes, which could result in air pollution. The potential number of collisions on roads and pavements also contributed to citizens perceptions of self-driving vehicles' impact on health, whether positively or negatively.

Timelines are difficult to estimate but use cases that are “closer” to what already exists feel possible. Self-driving bus services, e-hailing, and private cars are seen as most “realistic”, with penetration expected sooner rather than later. Meanwhile, use cases that would take us further away from current norms are seen to potentially face more hurdles before implementation.



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# 3. Demonstration of self-driving vehicles - citizens

## 3.1 Overview

A demonstration of self-driving vehicles was organised in Helmond, the Netherlands, involving 35 local citizens. Helmond is a city in the South of the Netherlands, with a population of 95,940. The demonstration had five objectives:

- To capture citizens' feelings and opinions about self-driving vehicles after using and observing them
- To compare feelings and opinions about several types of self-driving passenger and freight vehicles
- To assess whether using the vehicles change opinions and intentions, compared with those expressed before the event
- To assess how people compare self-driving and human-driven vehicles
- To assess whether feelings and opinions about self-driving vehicles are related to the characteristics of participants

A demonstration is a useful approach to gather data on opinions and intentions about self-driving vehicles, as most people have not yet experienced using these vehicles. Previous trials and demonstrations mainly featured a single vehicle. Our demonstration in Helmond adds to the literature by offering citizens the opportunity to try more than one type of self-driving passenger vehicle, as well as to observe a self-driving freight distribution vehicle. In addition, both passenger vehicles were for public transport, not private vehicles. This corresponds to the emphasis given in this project to use cases of shared use of vehicles. The inclusion of a distribution vehicle also brings value added, as few studies to date have reported how people perceive these vehicles, especially after experiencing them.

Overall, the demonstration was expected to produce insights on citizens' views about the range of vehicles that will be using the roads in the future, and how citizens perceive the possible impact of those vehicles on their lives and on the lives of others in their region.

The rest of this chapter is organised as follows

- Section 3.2 describes the **methods** used to organise the demonstration and in data collection and analysis, including ethics considerations
- Section 3.3 describe the **characteristics** of participants and their travel context and behaviour
- Section 3.4 report the **results** of the demonstration
- Section 3.5 synthesises the key **conclusions** of the demonstration

## 3.2 Methods

### 3.2.1 Design of the demonstration

The event was organised by the City of Helmond, with support from the Helmond Automotive Campus, Future Mobility Network, and University College London. Questionnaires were designed by University College London.



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The demonstration was held on 20 January 2024 in the Helmond Automotive Campus. This coincided with the virtual reality experiments reported in Chapter 4 of this report, which had the same participants. The day was divided into eight 2-hour slots. In each slot, there were two groups of four participants. In the first hour, one group engaged in the virtual reality experiment and the other one in the demonstration. In the second hour, the groups swapped. This means that across the whole day half of participants completed the virtual reality first and the other half completed the demonstration first. Differences in results for these groups are tested later in this chapter.

The demonstration included three self-driving vehicles: a bus, a mini-shuttle, and a delivery robot (Table 28).

**Table 28. Vehicles used in the demonstration in the Netherlands - specifications**

| | Bus | Mini-shuttle | Delivery robot |
|---|---|---|---|
| |  |  |  |
| **Name** | Karsan Autonomous e-Atak | Auvetech Iseauto | Macrostep Autonoom Delivery Robot |
| **Type** | Low-floor electric bus | Electric vehicle, 25km/h maximum speed | Electric vehicle with a container |
| **Size** | 8.3 x 3.2 x 1.7m | 3.5 x 1.5 x 2.4m | 2 x 1.1 x 1.7m |
| **Seats** | 18 seats | 8 seats | 0 seats |
| **Web** | https://www.karsan.com/en/autonomous-e-atak-highlights | https://auve.tech/products/iseauto | https://www.macrostep.eu/nl/?option=com_sppagebuilder&view=page&id=16 |

The vehicles circulated in the parking lots of the Helmond Automotive Campus. Barriers, barricade tapes, and traffic cones were installed to separate other users of the campus from the vehicle driving areas. Safety stewards were also present whenever a vehicle was moving. Safety drivers were in the passenger vehicles in case of possible emergencies requiring them to take over the vehicle.

Figure 9 is an overview of the demonstrations of the three vehicles. The event occupied with a length of around 600m, but separate spaces were used for each vehicle.

Organisers guided participants through the various experiences. Participants first observed the delivery robot moving for 3 minutes. They then walked a short distance to the location of the mini-shuttle, where they used the vehicle for 1.5 minutes. They then used the bus for 3 minutes. The mini-shuttle brought participants back (another 1.5 minutes). Before each experience, participants gathered in tents, where they were briefed on what was going to happen (for about 2 minutes). At the end of each experience, participants had opportunities to ask questions (for 2-3 minutes). The whole event, for each group, took about 35 minutes. At the end of the last experience, participants were escorted to the main building, where they answered a questionnaire.



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Several events were programmed for the vehicle movement, to show participants how the vehicles handled specific situations. Pedestrians crossed the path of the self-driving bus twice. All three vehicles turned several times and demonstrated that agile manoeuvres were possible. The bus also did a U-turn and had acceleration and braking events. Figure 10 shows aspects of some of the paths of the vehicles. Figure 11 shows various aspects of the demonstration of the three vehicles.

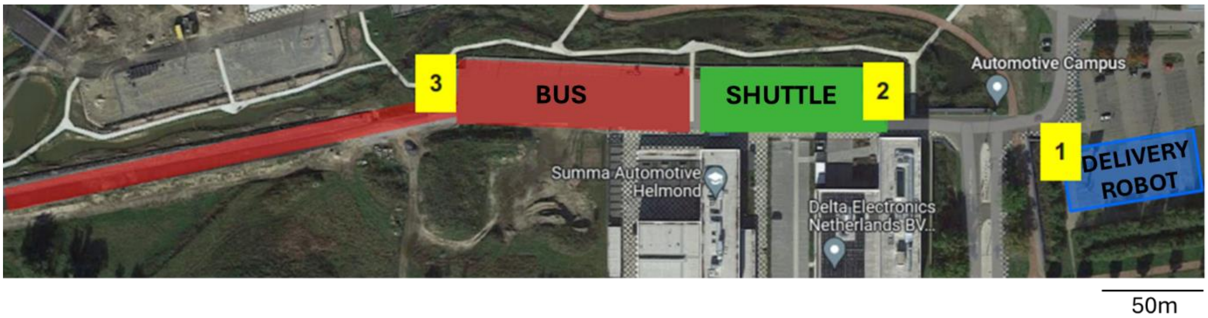


Figure 9. Overview of the three vehicle demonstrations

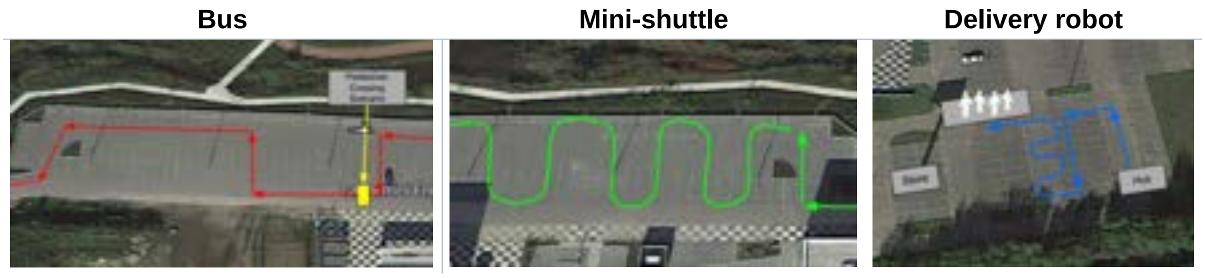


Figure 10. Examples of vehicle routes and events



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**Top left**: bus; **top right**: delivery robot; **bottom**: mini-shuttle

**Figure 11. Aspects of the demonstration in the Netherlands**

### 3.2.2 Participant recruitment

Participants were recruited from the Move2CCAM project network of "satellites", i.e. citizens who were invited to previous activities organised by the project. The aim was to recruit a balance of men and women, and proportions of participants in three age groups (18-34, 35-64, and 65+) that are aligned with the population of the City of Helmond.

### 3.2.3 Pre-event questionnaire

Participants answered a questionnaire before the event. This was done online, through the Qualtrics platform. Participants who had joined previous activities of the project filled this questionnaire before they joined their first activity, in 2023. Participants whose first activity was the demonstration filled this questionnaire in advance to the event. The questionnaire was in Dutch. Appendix 2 contains the English version of this questionnaire. It includes questions to capture the context in which the participants travel and their actual travel behaviour:

- Residential area characteristics, i.e., how far from the participant's home are four types of places (work/study place, shopping areas, health centre, and leisure places)
- Travel frequency and main mode used to travel to the four types of places listed above
- Health problem or disability affecting mobility
- How the participant feels about driving
- Use of travel time while using public transport

Another set of questions captures attitudes and intentions regarding self-driving vehicles:

- Awareness on self-driving vehicles



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- Three main concerns about self-driving vehicles
- Adoption of self-driving vehicles (if the participant would use, would pay to use, and would buy a self-driving vehicle)
- Use of travel time in self-driving vehicles

Finally, participants were asked about their demographic characteristics: age, gender, migration background, employment status, income, qualifications, educational background, and type of residence location (urban vs rural). These questions were included as appendix in a previous report of this project (Deliverable 3.3., Appendix 1).

### 3.2.4 Post-event questionnaire

A questionnaire was designed to capture the participants' views after the demonstration. This was a paper-based questionnaire in Dutch, answered by participants after experiencing the three vehicles. Appendix 4 contains the English version of the questionnaire.

The first section of the questionnaire asked for previous experience using or observing different types of self-driving vehicle.

The following two sections asked about the experience using the self-driving bus and mini shuttle. The two sections include a similar set of questions, covering:

- Overall feelings during the experience. Participants could choose all feelings that applied to them, from a list of 18 possibilities
- What they liked and disliked about the experience (open ended question)
- How safe they felt, on a 5-point scale during various parts of the trip: boarding, departing, moving forward, turning, pedestrian crossing the bus path (asked in the bus experience only), stopping, and getting off.
- How self-driving buses will compare with buses with a human driver: which trips will be more interesting, faster, cheaper, more stressful, more comfortable, more dangerous (in terms of accidents), and more insecure (in terms of crime).
- Three main concerns about using a self-driving bus/mini-shuttle
- Intention to use self-driving buses/mini shuttles in the future.

The last two questions above are similar to questions asked in the pre-event questionnaire described in the previous section. This was to assess whether people's perceptions and intentions changed after the demonstration.

The section about the bus experience included two extra questions, answered only by participants who had joined the virtual reality experiment held on the same day in the same location (Chapter 4 of this report). Half of the participants experienced the virtual reality experiment first and the other half experienced the real vehicles first. The questions asked whether there was anything participants liked in the real bus that they had previously disliked in the virtual bus, or the opposite.

The final section of the questionnaire asked about the experience observing the delivery robot:

- What participants liked and disliked about the vehicle
- How deliveries made by this type of vehicles will compare with deliveries made by vehicles driven by humans (e.g., vans): which deliveries will be faster, cheaper, more dangerous, and more insecure (in terms of stolen deliveries)
- Intention to order goods delivered with this type of vehicles in the future



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- Three main concerns about ordering goods delivered by these vehicles

### 3.2.5 Ethics

The event received ethical approval from the Bartlett School of Environment, Energy and Resources at University College of London (ID: 20231120_EI_ST_ETH_ Move2CCAM). The City of Helmond was also informed by the event organisers of the various activities planned and the safety measures applied. A formal permit from the municipality was not required since all participants were pre-registered, the number of participants was below the city's threshold of 250 for a permit, the activities were within closed sections of the Automotive Campus, and safety measures were put in place.

The demonstration involved participants interacting with a technology they may not be familiar with. This raised several ethical issues. The safety of participants and organisers (e.g. risk of collision of the vehicle) was addressed by having safety drivers prepared to take over the vehicles in case something went wrong. Participants were also informed, before riding the vehicles, that this type of vehicles have been tested widely in multiple contexts around the world and are considered safe. They were also informed about the duration of the ride, route, and other details, and reassured that they could opt-out of the ride if they felt unsafe.

Before the event, participants were provided with an information sheet and an informed consent form, which they filled before joining the event or when they arrived in the site. The information sheet contained details about the event, funder and organisers, use of personal data, capture of photos and video recordings of the event, reporting, and other ethics-related information. Participants gave they consent by confirming (by ticking a box) that they understood what the research involved and what was expected of them. The information sheet and consent form were included as appendices in a previous report of this project (Deliverable 3.3., Appendix 19).

The pre- and post- event questionnaires did not capture any information that could identify individuals. Participants were identified through an ID number. The data was analysed by University College London researchers, who did not have access to the file matching ID numbers with participant contact details. Only the event organiser (City of Helmond) had access to this file.

## 3.3 Participant characteristics

### 3.3.1 Demographic and socio-economic characteristics

Figure 12 shows the key demographic characteristics of the sample, as reported in the pre-event questionnaire. The 35-64 age group included 19 individuals, i.e. 56% of all participants, a considerably high number compared with the 18-34 group (6 individuals, i.e., 18%) and 65+ (9 individuals, i.e. 26%). However, these proportions are reasonably aligned with those in the Helmond adult population (27%, 50%, and 22% in the 18-34, 35-64, and 65+ groups, respectively)[1]. The gender distribution is also roughly balanced (20 men, 14 women, i.e. a 59-41% split).

Six participants (i.e., 18%) reported that one or more of their parents were not born in the Netherlands. The majority is currently working. All income groups were represented, with a slight

[1] https://helmond.incijfers.nl/mosaic/gemeente-informatie/bevolking



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predominance of higher-income ones (for reference, the average household income in Helmond is €48,900/year). The majority had a university degree or a higher degree (e.g. Master's, PhD). The same number lived in a city but not in the centre. 23 (68%) lived with their partner, with or without children.

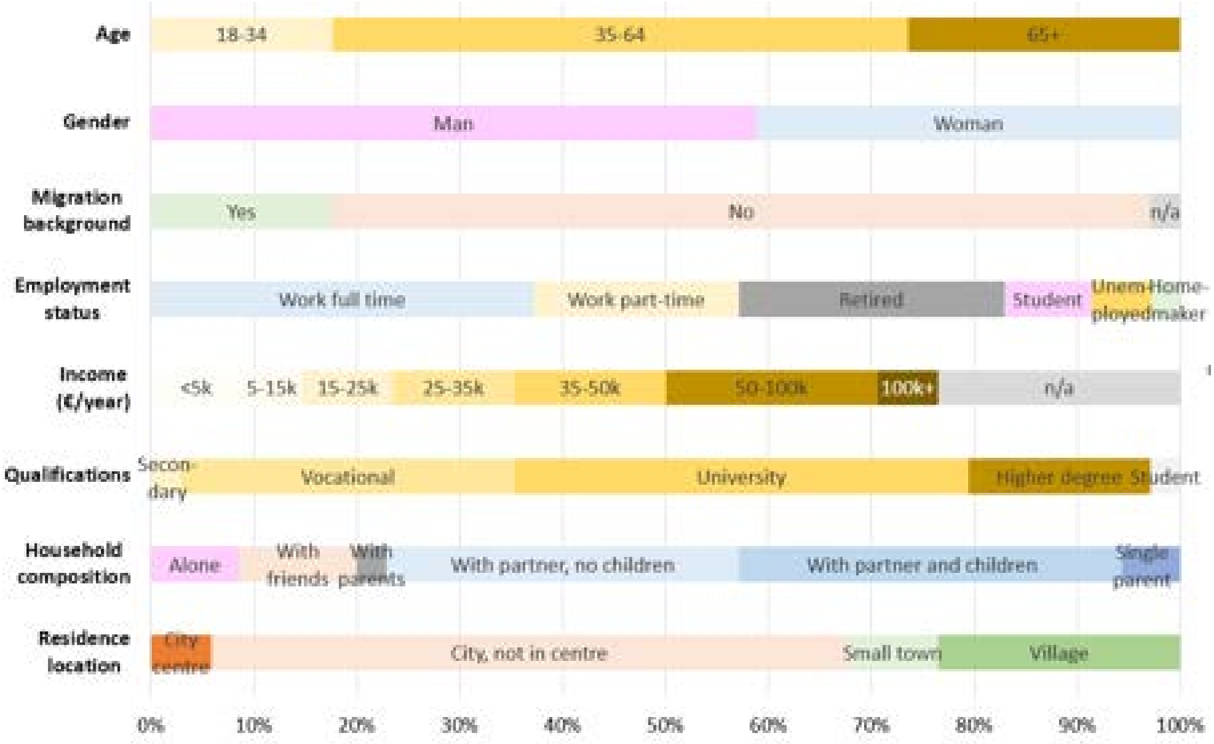


Figure 12. Demonstration of self-driving vehicles – participant characteristics

While the sample is consistent with the population in terms of age and gender, it differs from the population in terms of migration background (18% in the sample, 32% in population), workers (59% vs. 73%), and university graduates (62% vs. 24%).

### 3.3.2 Current travel context and behaviour

Figure 13 shows several characteristics of the participants' current travel context and behaviour, as reported in the pre-event questionnaire. 17% reported a health issue affecting their mobility. 85% have a driving licence and can drive. Only 3 participants (9%) have a licence but no car and only one does not have a licence. About half drives and enjoys driving, 21% drive but would rather use the time to do something else, and 29% does not drive. 40% travels to work four or more days a week. Most participants travel for shopping or leisure 1-3 times a week.

Figure 14 shows the travel modes that participants use for at least one of four possible purposes (work, shopping, leisure, or go to health centre). The results reveal the context of a typical mid-sized city in the Netherlands. 31 of the 35 participants (i.e. 89%) cycle, the most common travel mode among the sample. 69% drive alone. Using bus or tram is uncommon - only two of the 35 participants (6%) uses these modes. This is an important statistic to keep in mind in the analysis that follows, as the demonstration of passenger vehicles featured both a public bus and a mini-shuttle intended to be used as public transport.



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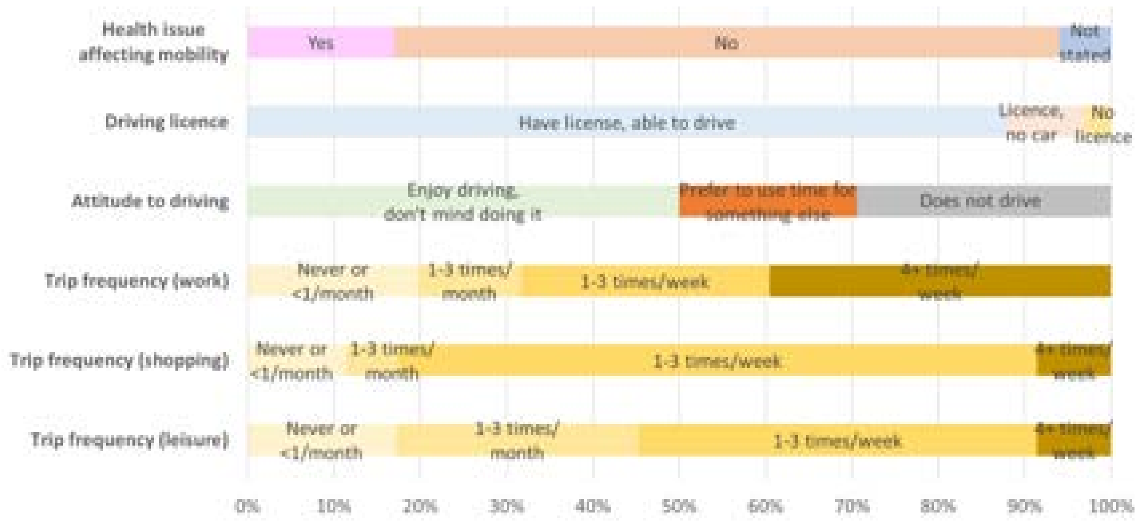
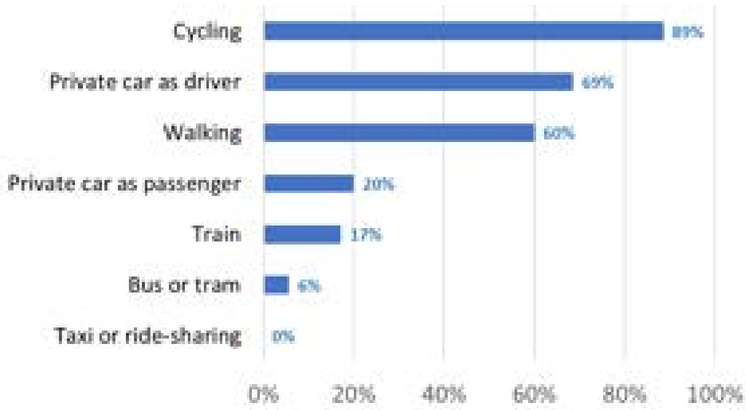



**Figure 13. Demonstration of self-driving vehicles – participant's current travel behaviour**




**Note**: participants could indicate more than one vehicle

**Figure 14. Demonstration of self-driving vehicles – participant's usual travel modes**

### 3.3.3 Prior awareness and experience with self-driving vehicles

Participants stated their levels of awareness of self-driving vehicles in pre-event questionnaires. 17 participants (i.e., 49%) said they were aware of these vehicles and have been following developments. Another 16 (i.e., 46%) said they were aware but did not know much about them. Only two (i.e., 6%) said they were not aware.

In the post-event questionnaire, participants stated whether they had previous experience involving fully self-driving vehicles. 20 of them (i.e., 57%) had experienced some type of self-driving vehicle. As shown in Figure 15, 34% of the sample had experienced a self-driving mini-bus or mini-shuttle and 17% and 11% had experienced a self-driving car and bus, respectively.



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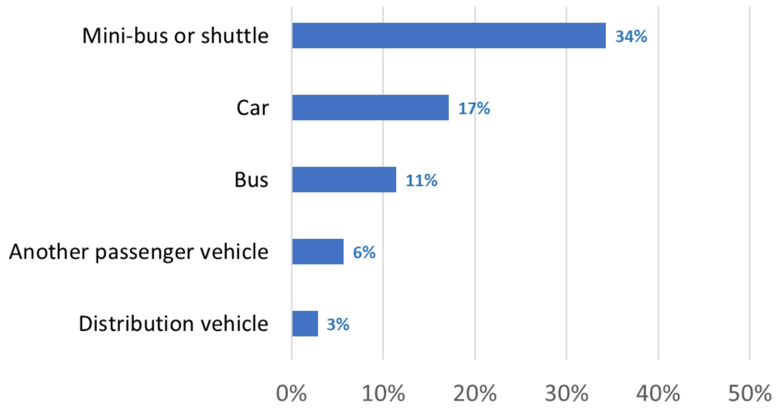


**Note**: participants could indicate more than one vehicle

Figure 15. Prior experience involving fully self-driving vehicles

## 3.4 Results

This section reports all the results of the demonstration including aspects participants liked and disliked (sub-section 3.4.1), feelings (3.4.2), safety perceptions (3.4.3), comparison between self-driving and human-driven vehicles (3.4.4), main concerns (3.4.5), and intentions to use self-driving vehicles (3.4.6). In the last two sub-sections, we analyse how intentions are related to opinions about the vehicles (3.4.7) and how both are related to the participant characteristics (3.4.8).

### 3.4.1 Aspects participants liked and disliked

Participants were asked open ended questions about the three aspects they liked and disliked about each of the three vehicles. We coded all the answers. Answers stating that participants did not have anything to report (e.g. "nothing", or "I liked everything" when the question was about dislikes) were removed from further analysis. The table below shows the number of valid responses across the whole sample, after excluding those mentioned above. Even though participants were asked for three aspects, not all of them did indicate three aspects. On average, participants indicated more "likes" than "dislikes", for all vehicles, although in the case of the mini-shuttle, the numbers were close.

Table 29. Aspects participants liked and disliked: number of responses

| | Like | | Dislike | |
|---|---|---|---|---|
| | Responses | Responses per participant | Responses | Responses per participant |
| **Bus** | 86 | 2.5 | 29 | 0.8 |
| **Mini-shuttle** | 65 | 1.9 | 53 | 1.5 |
| **Delivery robot** | 75 | 2.1 | 26 | 0.7 |

**Notes**: Each participant could indicate up to three aspects. Table shows valid responses only

The following figures show the aspects mentioned by at least three participants (i.e., by at least 9% of the sample).

Participants liked that that the bus felt safe (34% of all answers) and familiar (29%) (Figure 16). They also liked that the vehicle was quiet (20%) and the ride was smooth (20%). Some "likes" are



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related to safety, such as perceived safety when the bus encountered a pedestrian crossing, and presence of a safety driver inside the bus who could take over the vehicle command in case of an emergency. Other “likes” include comfort, the fact that the vehicle was regarded as innovative, the external design, and the space available. Interestingly, lack of space was also one of the main “dislikes” (20%), which shows that participants’ views differ in this respect. The other major “dislike” was the low speed of the bus.

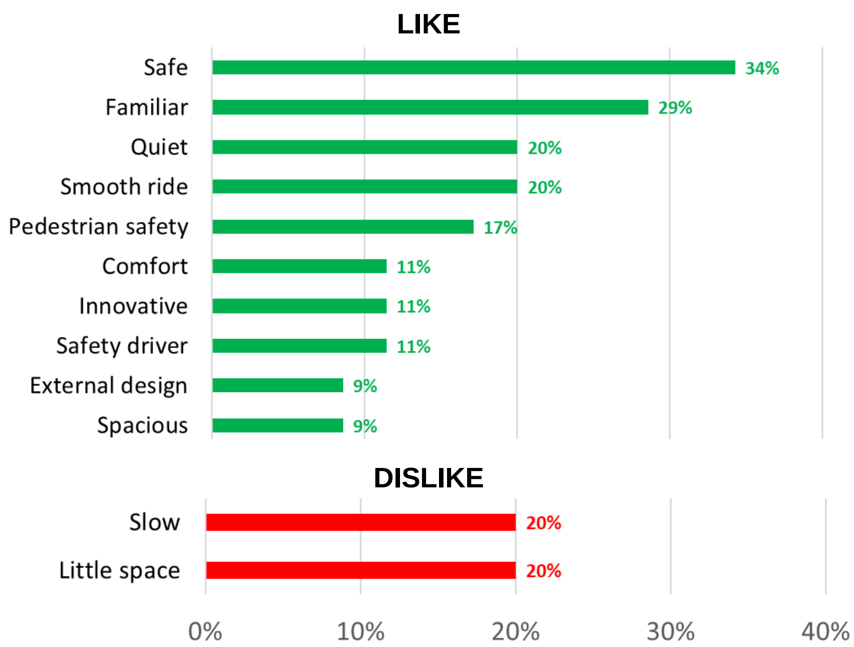


Figure 16. Self-driving bus: main aspects participants liked and disliked

Some of the “likes” in relation to the bus were also mentioned in relation to the mini-shuttle, such as perceived safety (20%) and the smooth ride (20%) (Figure 17). Other “likes” were the fact that the vehicle was in control (i.e., there was no driver), the information provided in screens inside the vehicle, the fact that the vehicle was innovative and quiet, and its suitability for small groups. On the negative side, a consistent opinion (held by 77% of the sample), was that the vehicle was narrow, with little space between passengers. In addition, there was no space for luggage. Some people did not like to sit backwards to the movement of the mini-shuttle, and others thought the mini-shuttle moved too slow.



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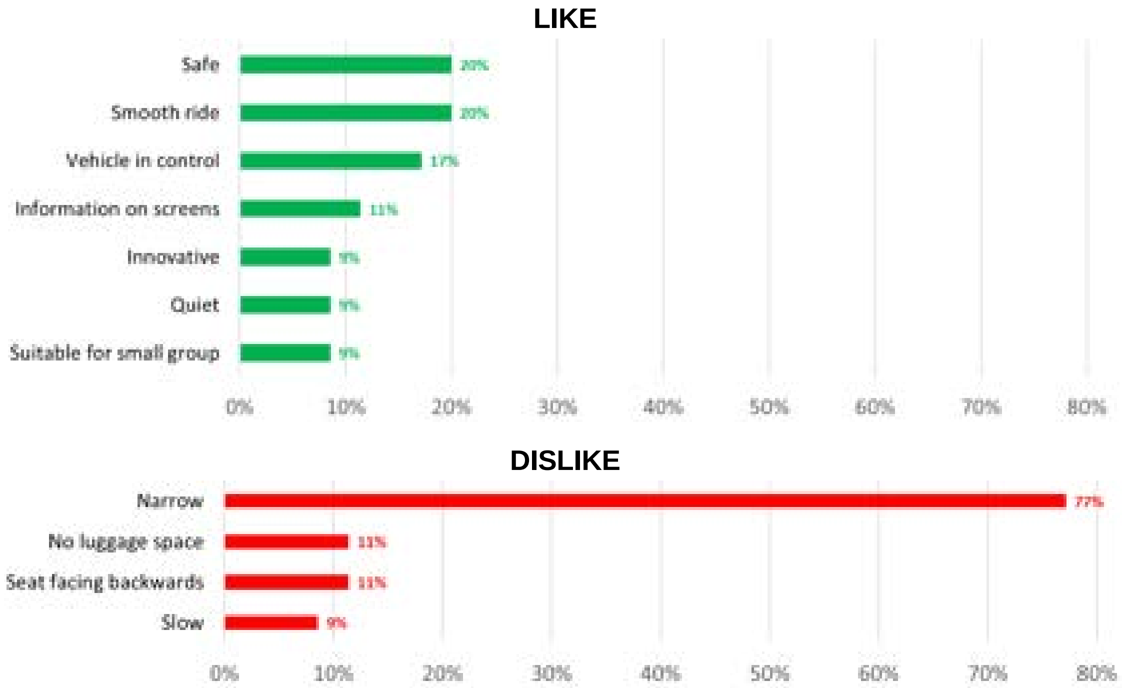


**Figure 17. Self-driving mini-shuttle: main aspects participants liked and disliked**

The main aspects participants liked about the delivery robot (Figure 18) were its perceived safety (26% of all answers), the design (23%), and its multi-functionality (as a modular vehicle) (20%). They also liked that the vehicle was practical, quiet, compact, environment-friendly, and funny (in its design and/or movement). Some people liked that the vehicle had no driver. The main "dislike" was that the vehicle can be vandalised, it is slow, and small.

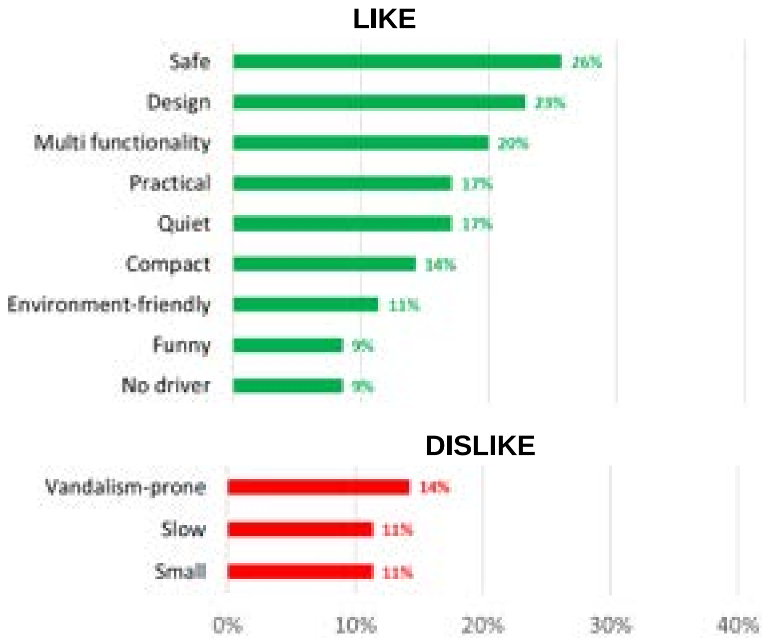


**Figure 18. Self-driving delivery robot: main aspects participants liked and disliked**



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### 3.4.2 Feelings

Figure 19 shows the feelings participants reported regarding their experience while riding the self-driving bus and mini-shuttle. The feelings were broadly positive and similar between the two vehicles (with only slightly more positive experiences reported for the bus than for the mini-shuttle). The most common feeling, reported by over 70% of participants was safety, followed by feeling “content”, “in control”, “surprised”, “motivated”, “amused”, and “confident”.

Other feelings were reported by less than 20% of the sample (i.e. by less than 7 people). This included all seven negative feelings (sad, melancholic, irritated, worried, annoyed, bored, and scared), but also “happy”. None of the 35 participants reported feeling sad, worried, or annoyed in the bus. Only one reported feeling melancholic or irritated. None reported feeling scared in the mini-shuttle and only one reported feeling worried, annoyed, or bored. Overall, the results point to a positive experience.

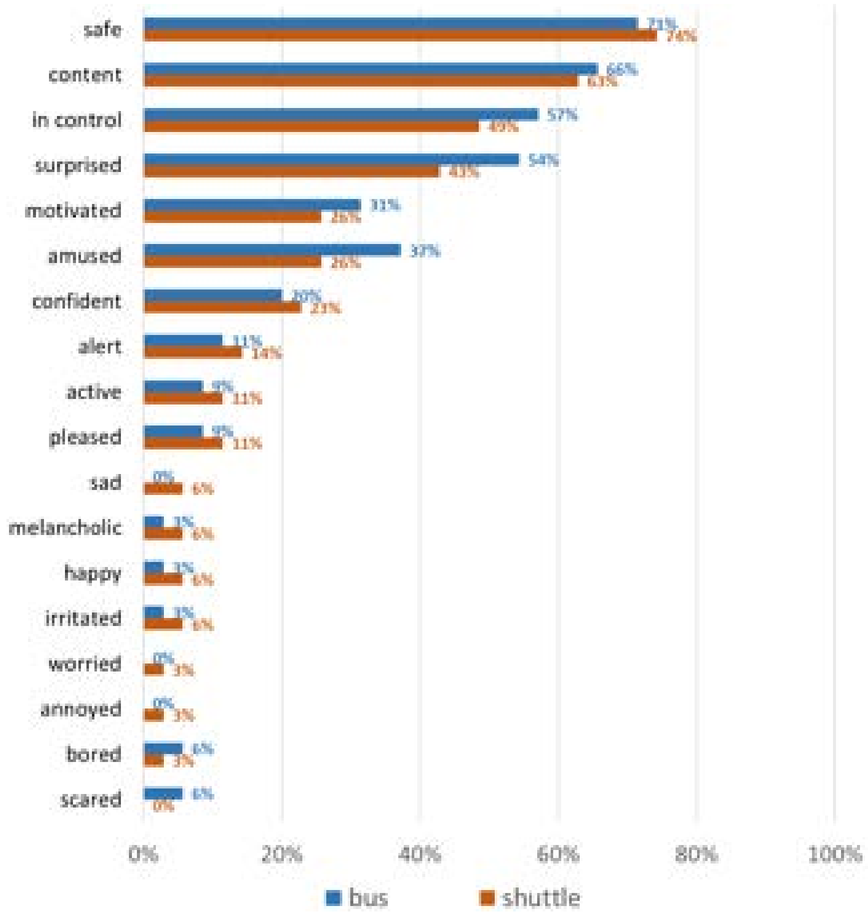


**Figure 19. Feelings while riding in the self-driving passenger vehicles**

### 3.4.3 Safety perceptions

The results on safety perceptions are also positive. The proportions of participants reporting feeling safe or very safe in the bus range between 83% and 97%, depending on the event (Figure 20). Only two participants reported feeling unsafe when getting off, and only one reported feeling unsafe when boarding and turning.



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The perceptions are even more positive in the case of the mini-shuttle, with proportions of participants reporting feeling safe or very safe ranging from 86% to 100% (Figure 21). Only two participants reported feeling unsafe when boarding and getting off, and only one reported feeling unsafe when the vehicle was turning.

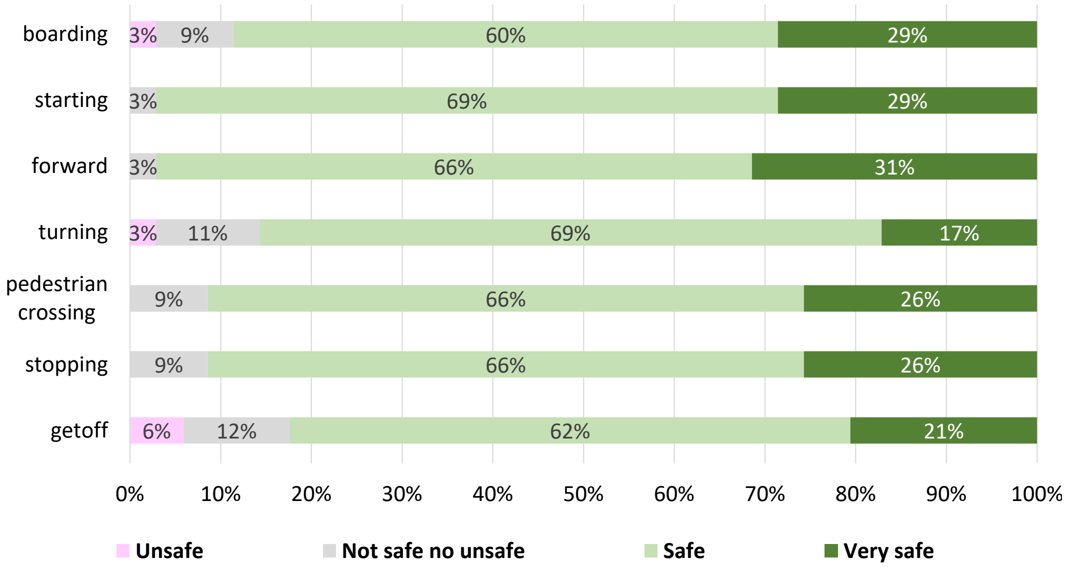


Figure 20. Safety perceptions (bus)

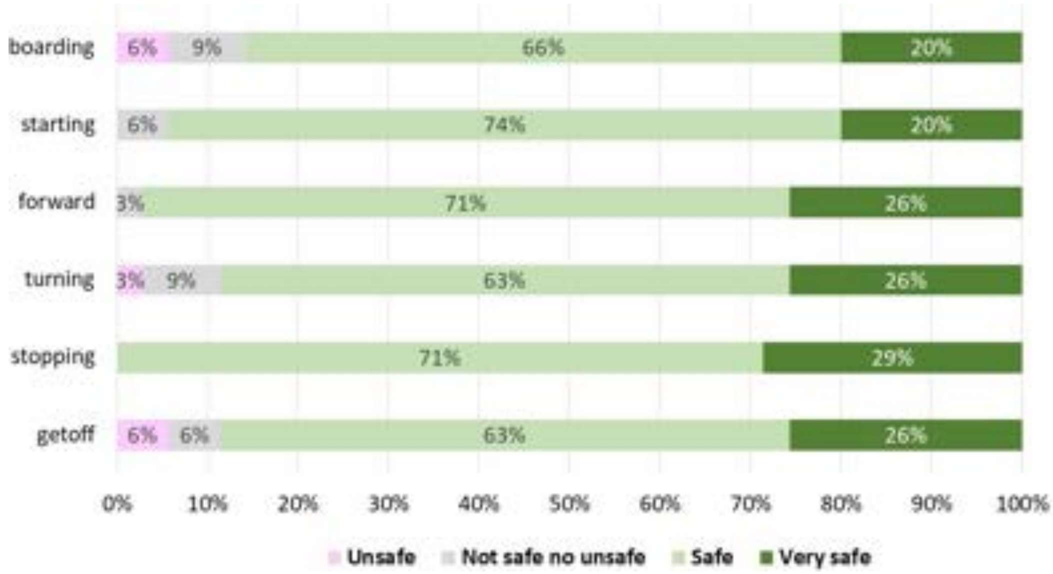


Figure 21. Safety perceptions (mini-shuttle)

The three vehicles were also generally perceived to be safe from the perspective of pedestrians and cyclists, although safety perceptions were not as positive as the ones from the perspective of the vehicle users, as reported above. The proportions of participants reporting that it will be safe or very safe for pedestrians to walk in streets used by self-driving vehicles were 86% (bus), 78% (shuttle) and 60% (delivery robot). The proportions reporting that it will be safe for cyclists were lower, at 79% (bus), 53% (shuttle) and 52% (delivery robot). However, only a few participants



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reported the vehicles as unsafe. In comparison with safety perceptions as user, the main change was the increase in the number of participants reporting "not safe not unsafe".


**Figure 22. Safety of walking and cycling in streets used by self-driving vehicles**

### 3.4.4 Assessment of self-driving vs. human-driven vehicles

The following three figures show how participants compared self-driving vehicles to human-driven ones. The results for the bus and mini-shuttle are similar (Figure 23 and Figure 24). On average, self-driven buses and mini-shuttles were judged to be more interesting, cheaper, but also slower and more insecure (in terms of crime) than human-driven ones.

Most people either did not know or thought that human-driven and self-driven buses and mini-shuttles will be equal in terms of stress, comfort, and danger in terms of accidents. However, among participants who did have an opinion, there were more people thinking that self-driven buses and mini-shuttles will be more comfortable, less stressful, and less dangerous (safer) in terms of accidents, than their human-driven counterparts.



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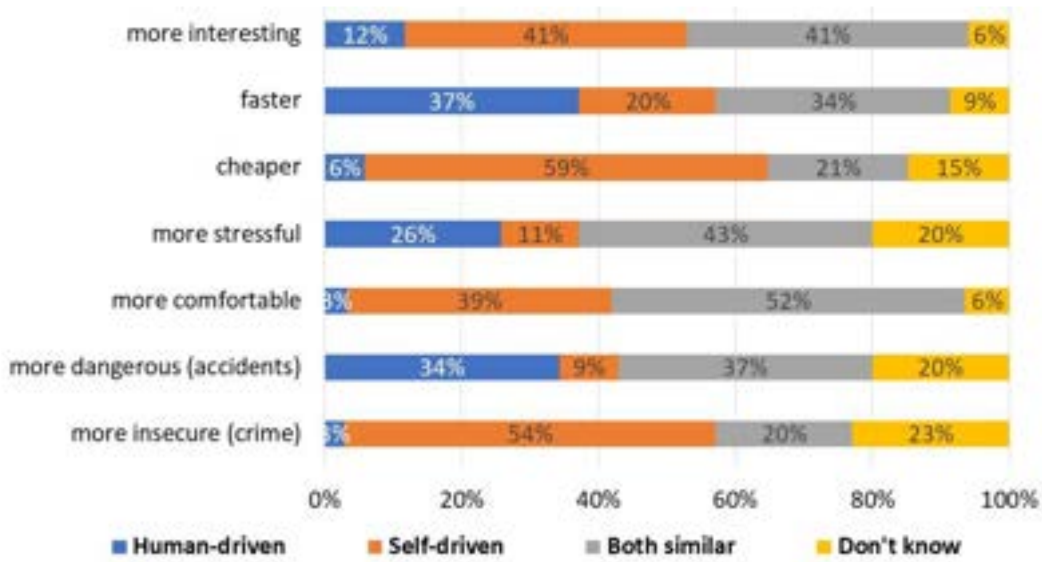


Figure 23. Assessment of self-driving vs. conventional bus

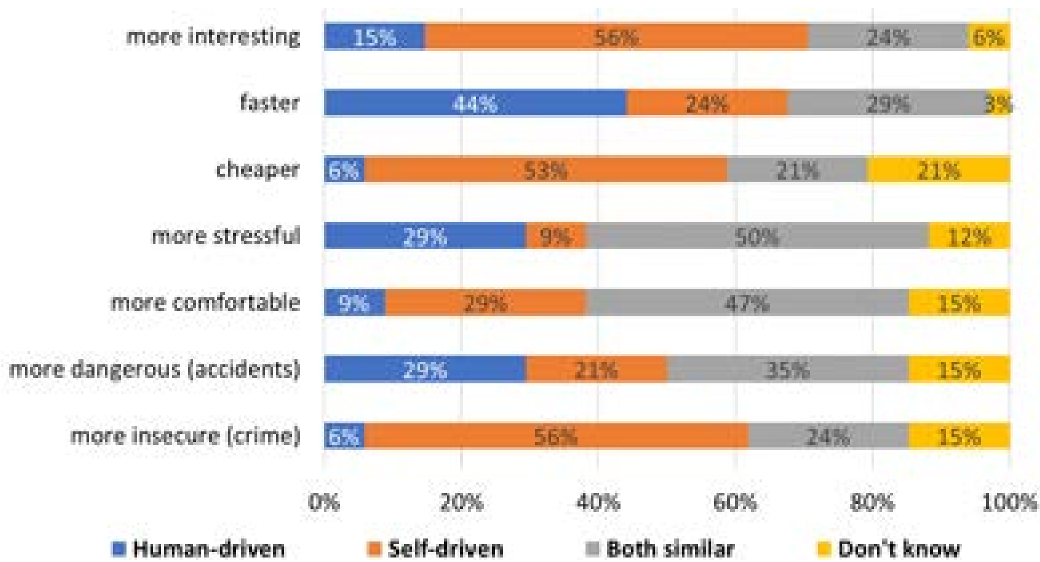


Figure 24. Assessment of self-driving vs. conventional mini-shuttle

The large majority (71%) thought that the delivery robot will be cheaper than human-driven vehicles (Figure 25). This is a higher percentage than in the cases of the self-driving bus and mini-shuttle in the previous figures. Only two participants (6%) thought the delivery robot is more dangerous in terms of accidents (this compares with 21% in the case of the mini-shuttle). There is a balance of opinions regarding speed, although more people thought that that human-driven vehicles are faster (35%) than the delivery robot (21%).

On the negative side, the delivery robot was judged to be more insecure (in terms of crime) than human-driven vehicles.



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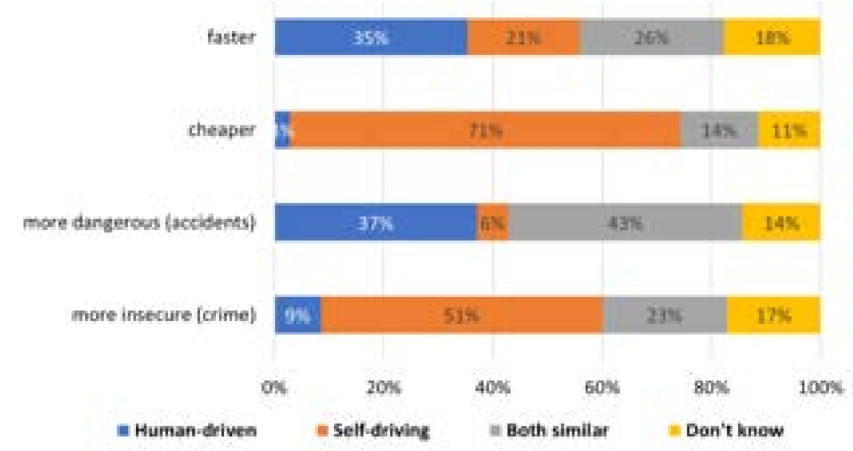


**Figure 25. Assessment of self-driving delivery robot vs. conventional delivery vehicle**

### 3.4.5 Main concerns

Participants were asked open ended questions about three concerns about each of the three vehicles. We then coded all the answers. Answers stating that they did not have anything to report (e.g. "nothing) were removed from further analysis. The table below shows the number of valid responses across the whole sample. Fewer concerns were reported about shuttle (1.1 per person) than about the other two vehicles (1.7-1.8).

**Table 30. Concerns about self-driving vehicles: number of responses**

| | Responses | Responses per participant |
|---|---|---|
| **Bus** | 62 | 1.8 |
| **Mini-shuttle** | 39 | 1.1 |
| **Delivery robot** | 60 | 1.7 |

**Notes**: Each participant could indicate up to three aspects. Table shows valid responses only

The following figures show the concerns mentioned by at least three participants (i.e., by at least 9% of the sample). The five concerns meeting this threshold for the bus and mini-shuttle were the same (although not in the same order of frequency). For this reason, they are shown in the same chart (Figure 26). The main concern is fear of crime and anti-social behaviour from other passengers. This was mentioned by 46% and 54% with regards to the bus and shuttle, respectively. The other concerns were what happens in unexpected emergency situations, technology failure, interaction with other road users, and general safety.



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