How self-driving vehicles could change life and work in Europe

1. Self-driving vehicles: what we do not know yet

In the future, self-driving vehicles will be everywhere. These vehicles will not need human drivers because they will be controlled by computers connected to the road and to other vehicles. Some vehicles (such as cars, buses, or small pods) will be used to transport people, others (such as robots and drones) will be used to make deliveries.

Self-driving vehicles can change how we get around and give more opportunities for people who cannot drive. But it is difficult to know if these vehicles will be good for everyone, because they will change many things: roads, traffic safety, cities, the economy, social justice, health, the environment, and even crime.

For example, it may be easier for people to use public transport. This could reduce car use, which is good for the environment. But it could also happen that self-driving vehicles are so useful that each person decides to have their own vehicle. This would increase congestion and make people walk and cycle less, meaning less physical activity.
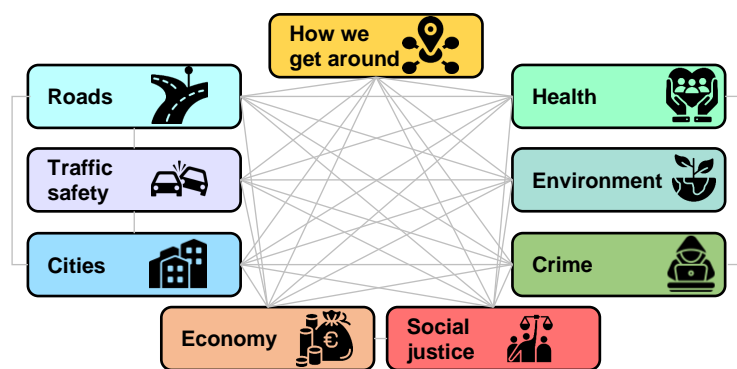
So there are many possible changes in how we live and work. However, governments, the transport industry, and citizens do not know yet how all these changes are linked with each other. We tried to understand these links better in a research project funded by the European Union (https://move2ccam.eu).

We organised various activities in 2023-2024 and invited citizens and workers representing organisations in eight European countries: Cyprus, France, Germany, Greece, Netherlands, Poland, Spain, and United Kingdom. Some of the activities were only in three cities: Helmond (Netherlands), Katowice (Poland) and Mytilene (Greece).

There was a balance between men and women and different age groups. The organisations represented various sectors.

The activities included workshops, experiences of using and observing self-driving vehicles, a virtual reality experience, an online questionnaire, and interviews.

People shared their opinions on how self-driving vehicles could change their lives and the lives of others in their regions. All activities were in local languages.

This document explains what we did, why we did it, and how. It also explains what we found and what we learned about self-driving vehicles. You can also download our 443-page full report.

2. Workshops

What we did

We organised 15 workshops in the eight countries of our project. Some workshops were with citizens and others were with people working for organisations such as governments and private companies.

In the Netherlands, Poland, and Greece, the workshops were face-to-face, and they happened in Helmond, Katowice, and Mytilene. In the other countries they were online. Each workshop had 10-40 participants and lasted for about 2 hours. Altogether, we talked with 232 citizens and 87 organisations.

At the end of the project, we brought 44 citizens and 10 organisations together in three final face-to-face workshops, in Helmond, Katowice, and Mytilene.

Why we did it

We wanted to know how self-driving vehicles will change the lives of people in Europe and the work of organisations. We also wanted to know if people's opinions vary from country to country and if people working for governments and private companies have different opinions from other people.

How we did it

Before the workshops, we asked citizens to register on a website where they could see information about self-driving vehicles. We also emailed this information to the organisations.

In the workshops, we showed participants different types of self-driving vehicles. Participants then talked about the possible positive and negative effects these vehicles could have on the lives of people in their regions and on the work of organisations.

Example of part of diagram

The participants then worked in small groups to draw diagrams with the links between those effects

In the final workshops, when we brought citizens and organisations together, we asked participants to discuss topics about which there was some disagreement in the initial workshops. We wanted to know if there was more consensus when citizens and organisations were talking with each other.

What we found

This is what most people agreed is <u>positive</u> about self-driving vehicles

- Children and older people who do not drive will be able to get around on their own
- It will be easier for people in city suburbs or villages where there is less public transport, to go to work, shops, hospitals, and other places
- It will be easier to travel at night
- There will be fewer travel delays and traffic collisions

This is what most people agreed is <u>negative</u> about self-driving vehicles

- Some people might not be able to afford a self-driving vehicle
- The vehicles may fail in isolated areas or in bad weather and they may be hacked
- People will lose privacy because the system will collect data about all their trips
- Without a driver, there will be no one to act in case of emergencies, help people with disabilities, or protect passengers from crime
- Packages delivered by robots or drones may be stolen
- Delivery robots and drones will cause congestion on pedestrian pavements and air space

These is what that people <u>disagreed</u> about

- People may travel more or less – it is difficult to tell
- Road congestion could increase because there will be more vehicles. But it might also decrease because it will be easier to manage the traffic
- There will be less pollution and noise. But there could be new environmental problems because of more demand for electricity and disposal of batteries
- Some workers (such as drivers) will lose their jobs, but new types of jobs will be created (for example, to manage the system), so employment may increase or decrease

The organisations were usually more optimistic than citizens about thinking that self-driving vehicles will be more good than bad. But they were also more concerned about the investment needed to adapt their work and for the government to upgrade the road infrastructure. In Greece, citizens and organisations were less optimistic that this investment is possible, compared to other countries

What we know now

- Self-driving vehicles will be safe and convenient.
- The vehicles will work fine most of the time, but not all of the time.
- Not everyone will benefit. People with disabilities may not be able to travel easily in self-driving vehicles and those with low incomes may not be able to afford it.
- Some problems may get worse, including fear of crime in public transport.
- New problems will arise, such as the risk of packages getting stolen, vehicles being hacked, loss of privacy, and environmental problems related to electricity consumption.

3. Experiences of real self-driving vehicles

What we did

We invited 35 residents of Helmond (in the Netherlands) to use and observe three self-driving vehicles (bus, minibus, and delivery robot). We also invited 20 people working in local governments and public transport companies in Katowice (Poland) to use a self-driving minibus.

Why we did it

We wanted to know people's feelings and opinions about self-driving vehicles. For example, if they think these vehicles will be better or worse than the ones they know, driven by humans.

We also wanted to know if people would use a self-driving vehicle in the future, when they become available in their region. Using and observing these vehicles can change people's opinions, because a real experience is different from just seeing the vehicles in the news.

In our, people experienced different vehicles, some of them, like minibuses and delivery robots, are quite different from the vehicles they know. In past events, people experienced only one type of vehicle. We wanted to show our participants a wider variety of vehicles.

We also wanted to know if people of different genders and ages, and if citizens and organisations, have different opinions.

How we did it

In the Netherlands, groups of four participants used a bus and a minibus and observed a delivery robot. This was in a test site, not a public road. The vehicles showed how they drive themselves and react to some situations. For example, they turned several times. The bus also did a U-turn, accelerated, braked, and stopped when it saw a pedestrian crossing.

Route of the minibus

Minibus and bus

Delivery robot

In Poland, the 20 participants travelled in a self-driving minibus for 3.5 km. This was on a public road, used by normal vehicles. The speed was 24 km/h. A human driver was in the bus, ready to take over the vehicle in the unlikely event of an emergency.

After the experiences in the Netherlands and Poland, the participants told us how they felt when using or observing the vehicles, what they liked and disliked about them, and if they felt safe or not.

They also told us which type of vehicles (normal ones or self-driving ones) would be faster, cheaper, less stressful, more comfortable, safer from collisions, and safer from crime.

In the end, they told us if they would use these vehicles in the future or not. We compared this with their answers to the same questions asked before the experience.

What we found

The participants in the Netherlands enjoyed the experience. Most of them felt safe using the vehicles in all situations (boarding, moving, turning, stopping, alighting). They thought pedestrians and cyclists would be safe too. The bus also felt familiar, only without a driver. They liked that all three vehicles were quiet and that the bus and minibus rides were smooth.
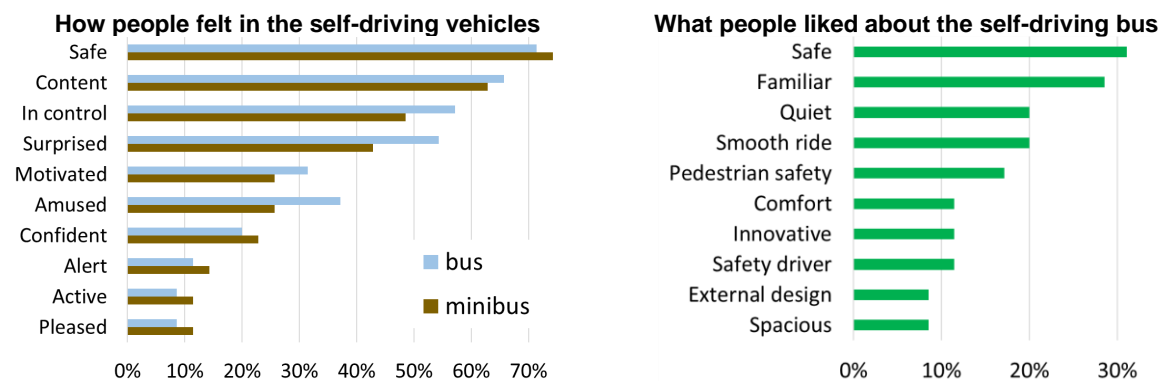
Some people thought the vehicles were slow, but this is because we programmed them to drive slowly so that everyone would feel safe. Some people also said the minibus was narrow and they did not like that it moved in both directions.

Before the experience, some people were concerned about the safety of the vehicles, but the experience increased their confidence that they are safe. They also became more open to the idea of using self-driving vehicles in the future. Before the experience, only 29% of participants said they would use them. After the experience, 62% said they would use a self-driving bus, 68% would use a self-driving mini-bus, and 71% would order packages delivered by a robot.

On average, participants (especially men) thought that in the future self-driving vehicles will be cheaper than normal ones driven by humans. But they also thought that self-driving vehicles will be less safe from crime. For example, they were concerned about the behaviour of other bus passengers and about people stealing packages from the robot or vandalising them.
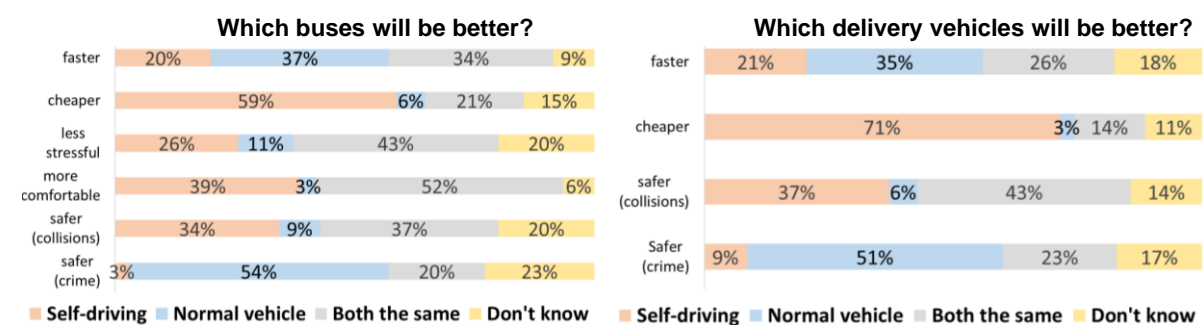
In Poland, where the participants represented organisations, the overall feeling was also positive and participants felt safe, but like in the Netherlands, participants were concerned about crime. They were also more concerned about the cost and stress of travelling and lack of comfort of self-driving vehicles, compared with our participants in the Netherlands.

What we know now

- People are more confident that self-driving vehicles are safe after using or observing one, so some change their mind and become keener on the idea of using one in the future.
- On average, people think self-driving vehicles will be safer and cheaper. But they are concerned about crime in self-driving buses and packages stolen from robots.

4. Experiences of virtual self-driving vehicles

What we did

We invited 92 citizens of Helmond (Netherlands), Katowice (Poland), and Mitylene (Greece) to experience a self-driving car and a bus in virtual reality.

Why we did it

Most people are not used to seeing self-driving vehicles, so they may find it hard to imagine a world with them. With virtual reality, they can experience different vehicles in various traffic conditions. This way, they get a clearer idea of what travelling in self-driving vehicles will be like in the future.

We wanted to know how different genders and age groups feel when using a self-driving car and bus and how they think these vehicles compare with normal ones.

How we did it

In groups of four, the participants experienced a 6-minute virtual reality trip. They could choose between a self-driving car or bus but could switch (once) from one to another during the trip.

Virtual self-driving car

Virtual self-driving bus

Several things happen during the car and bus trips. It gets darker and sometimes the vehicles cross ugly industrial areas.

Congestion gets worse but only in the car, not the bus, which uses a bus lane.

The human assistant

In the bus, there is a human assistant, who leaves during the trip. For some time, the bus is crowded with other passengers. It gets less crowded but then some passengers are annoying, putting their feet on seats, playing music, and laughing loudly. At the end, there are no passengers at all in the bus except the participant.

Earbuds (Emotiv MN8)

Participants wore a pair of earbuds, like the ones normally used to listen to music. These earbuds had sensors which safely recorded the electrical activity in the participants' brain. This method is called electroencephalography. The data can show us if there were any moments when participants felt stressed during the experience.

We asked participants to answer a questionnaire before the day of the event and another one just after. At the end, we showed them images of things they saw in virtual reality. They then talked among themselves about how they felt about those things.

This type of experiment can be complicated, from the technical and the ethical points of view. We tried to solve possible problems in advance. For example, what to do if someone felt unwell when using the virtual reality headset. We wrote up our solutions in this document which may help others doing this type of experiment in the future.

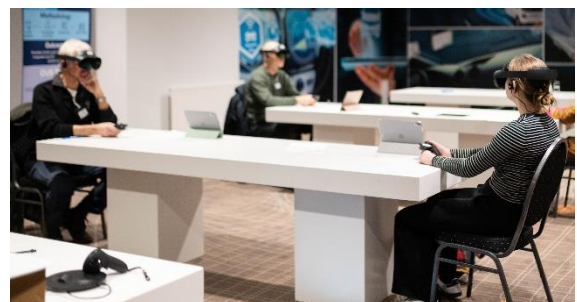## What we found

Participants thought the experience was realistic and noticed most changes in the trips. They felt content and safe. The experience increased their intention to use self-driving vehicles in the future, from 40% to 58% (car) and 70% (bus). They thought these vehicles will be more comfortable than normal ones but did not like the seat arrangement in the car.

Some people were concerned about congestion. Some also said they would feel safer (from collisions and from crime) if there was a human assistant in the bus. The assistant could also help passengers who have disabilities.

Things people noticed in the <u>virtual bus</u> trip

The car trip did not cause too much stress. In fact, some people said they felt bored. This may happen in the future when there is no need to drive anymore. 68% of participants said that in that case, they would just look around. 13% would use the time to work, and 30% for entertainment.

Some parts of the bus trip caused stress, but not for everyone. The diagram below shows who felt stressed and when. The top part of the diagram (in grey) shows what was happening during the trip at each moment. For example, at the start, the bus was in the city centre, it was daytime, there were few passengers, all minding their own business, and there was a human assistant. The bus then moved and some of these things changed.

The bottom part shows stress levels, using this scale: *Less stress* ▢▨▥ *More stress.* On average, men were never stressed and those aged 18-64 were stressed in only one part of the trip (but not much). Women and those aged 65+ felt stressed in many parts of the trip, especially when there were annoying passengers in the bus, but also when there were many passengers and none at all.

Start of trip ──► End

Landscape	City centre				Industrial	City Centre	Industrial	City centre	Industrial	Residential
Time of day	Daytime				Getting darker and darker				Night-time	
Passengers	A few		Many		A few				None	
Behaviour	Passengers are minding their own business					Some passengers are annoying				No passengers
Assistant	Present					Absent				
Men										
Women		Yellow	Orange	Orange	Yellow	Orange		Red		Yellow
18-34		Yellow								
35-64						Yellow				
65+			Orange	Red		Orange	Dark red	Dark red	Orange	Orange

In groups, participants talked more about their experience. The word cloud on the right shows, for example, how they felt when they were alone in the bus. They noticed the situation ("alone", "empty", "quiet"). Some were OK with it ("nothing") but others did not like it" ("strange", "unsafe") and explained how this situation is different in normal buses ("driver"). You can see more word clouds in our full report.
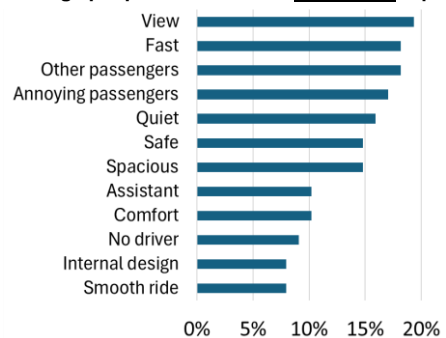
What we know now

- Virtual reality can help people understand how travelling in self-driving vehicles will be like, and worry less about traffic safety
- Bus passengers (especially women and older people) may feel insecure when buses do not have a driver or a human assistant.

5. Questionnaires

What we did

We asked citizens in the eight countries (Cyprus, France, Germany, Greece, The Netherlands, Poland, Spain, and the UK) to fill a 15-minute online questionnaire about several types of self-driving vehicles, to carry passengers (car, taxi, or bus) or packages (drones or robots). We received answers from 7,941 people. This is about 1,000 per country, except in Cyprus where we received 500 responses. We made sure the respondents were representative of gender, age, and of each of the 64 regions in those countries.

To understand more about what people think about self-driving delivery vehicles (vans, drones, and robots), we made another 15-minute questionnaire, answered by 700 people in the UK only.

Why we did it

We wanted to find out if the questionnaire respondents want to use self-driving vehicles for travel or for delivering packages they order online. We also wanted to know the many ways these vehicles might change the lives of the respondents and others in their regions.

Our other activities (the workshops and experiences) gave us some information about these changes. With these questionnaires, we wanted to reach more people in the eight countries. This helps us compare what people think of different types of self-driving vehicles and see how opinions vary from country to country and from region to region in the same country. We also wanted to know if people of different genders and age groups have different opinions.

How we did it

We showed respondents information about self-driving vehicles for people (car, taxi, bus) or packages (robot, drone).

Private delivery / pick-up robot

A privately owned robot that goes and collects your orders (products or food) from one or multiple locations and bring them at your home or the location you indicate. The robot can also be used in case you want to send goods to one or multiple locations within the city.

Characteristics of the service:

- You purchase and maintain the robot
- You send it out whenever you want to pick up or deliver something from/to one or multiple locations.
- You save time from travelling and looking for parking.

We then asked them how likely they were to buy a self-driving car or use a self-driving car, taxi, robot, or drone. We also asked them how much they were willing to pay for that. Then we asked them if they would change the way they travel and order packages online.

Finally, we asked them what they think will happen in their regions. For example, if travel will be easier and safer (from collisions and from crime), if cities will change, and if self-driving vehicles will be good or bad for the economy, environment, health, and social justice.

In the UK-only survey we showed people different possibilities for receiving a package (van with a driver, self-driving van, robot, and drone) and asked them which one they would choose.

What would you choose?

	Van (with driver)	Self-driving van	Robot	Drone
Delivery location	Front door	Walk 3 mins.	Front door	Front door
Human interaction	Driver	Telephone	No	No
Delivery time	3 days	1 day	1 day	2 days
Time window	2 hours	2 hours	1 hour	2 hours
Problems	10%	5%	10%	5%
Cost (£)	4	2	2	4

We also asked them about possible problems that can happen when ordering deliveries by self-driving vans, robots, and drones, and how they would feel when walking, cycling, or driving in streets used by these vehicles

What we found

Our [full report](#) has 135 pages showing the results of the European questionnaire. Here are some of the interesting things we found:

- 21% of the respondents did not know that self-driving vehicles existed and 22% thought they will never be used in their region
- There was only mild interest in buying or using self-driving vehicles - see the maps on the right
- People are willing to pay less for using them than what they now spend on transport

Respondents (especially men) thought that if they could use a self-driving vehicle, they would travel longer and more often. But they would not increase the number of home deliveries they order online.
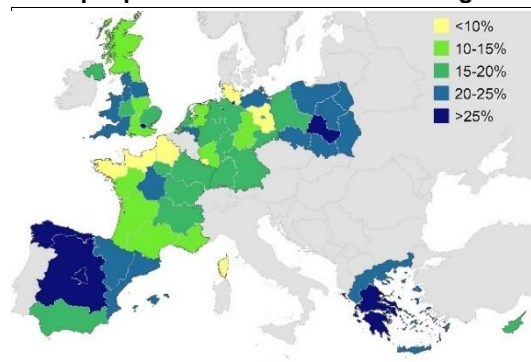
Self-driving cars could replace 27% of trips now made by bus and 31% of trips made by walking/cycling. Only 51% would travel in a self-driving taxi with strangers.

On average, they thought that people in their region would travel more but this would not increase road congestion or parking spaces. There will be fewer road collisions. Self-driving vehicles will be mostly good for the economy, environment, and health.

% of people who would use self-driving bus

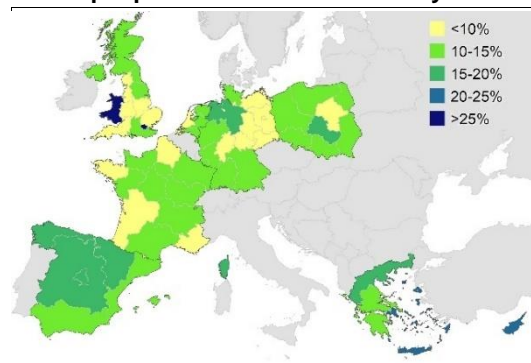**% of people who would use delivery robot**

At the same time, respondents thought that travel costs will increase. People may become dependent on technology, which will cause obesity and cyber attacks on the transport system. There are different opinions about what will happen to jobs (increase of decrease) and if many people will either move to central or rural areas.

Respondents from Greece and Cyprus were the keenest on using self-driving vehicles (especially cars) but the least confident that these vehicles will be good for the economy.
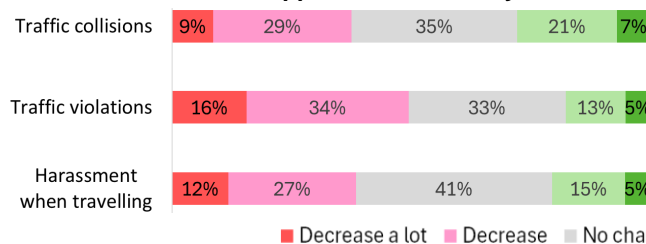
What will happen to traffic safety

	Decrease a lot	Decrease	No change	Increase	Increase a lot
Traffic collisions	9%	29%	35%	21%	7%
Traffic violations	16%	34%	33%	13%	5%
Harassment when travelling	12%	27%	41%	15%	5%

What will happen to the environment

	Decrease a lot	Decrease	No change	Increase	Increase a lot
Emissions	9%	29%	38%	19%	5%
Demand for electricity	3%	10%	30%	36%	20%
Noise	12%	32%	38%	14%	5%

■ Decrease a lot ■ Decrease ■ No change ■ Increase ■ Increase a lot
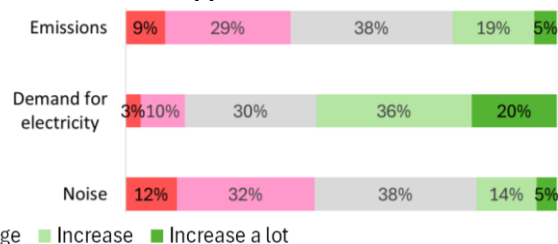
In the UK-only survey, respondents would only use self-driving vans, robots, or drones if the delivery was £8-£10 cheaper than by normal van. This is because respondents (especially those aged 65+) prefer to have human interaction. 50-60% were concerned about stolen packages. 40% would feel uncomfortable walking or driving in streets used by self-driving delivery vehicles.

What we know now

- Many Europeans are not interested in self-driving vehicles, especially delivery vehicles
- Europeans expect that these vehicles will be good for citizens and businesses in their region
- But some people may not be able to afford to use them, and others may lose their jobs

6. Interviews

What we did

We asked 11 people working in organisations in European countries to talk to us for 30-60 minutes. The organisations were from 7 different countries (all the countries in our project except France). We invited organisations of different sizes and sectors.

Who did we invite for these conversations?

| Companies that need vehicles for their main work activity | • 4 bus companies
• 1 company making deliveries
• 1 company making emergency deliveries using drones
• 1 company responsible for waste collection |

| Organisations that need vehicles to transport their staff | • 1 local government
• 1 university |

| Companies that are making self-driving vehicles | • 1 company producing a self-driving bus
• 1 company developing software for self-driving vehicles |

Why we did it

We wanted to know what organisations in Europe think about self-driving vehicles and what concerns they have about them. We also wanted to know if they are planning to use self-driving vehicles and how that could change the work they do.

We had already collected information about these things in the workshops we talked about in part 2 of this report. However, in one-hour one-to-one interviews, the organisations can explain their views in more detail. They can also talk about the effects of self-driving vehicles in their own organisation, and not only in the region as a whole.

How we did it

We had 30-60 minutes video calls with each of the 11 organisations. We offered the interviewees the opportunity to talk freely about their opinions about self-driving vehicles. However, we made suggestions about the topics we most wanted them to talk about. Because the organisations worked in different countries and sectors, the topics varied from interview to interview.

We asked interviewees to talk about one type of vehicle. For example, the bus companies talked about self-driving buses and the delivery company about self-driving trucks. The interviews were confidential. So, in our full report we do not identify the people we interviewed or their organisations.

Interviewees told us what they thought about self-driving vehicles, what needs to happen so they could buy one, and how their work might change. For example, financial, operational, and employment changes. They also talked about how their region could change.

We then tried to find themes in what the interviewees told us about each vehicle. We also made a SWOT analysis for each organisation. This shows their **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats in a future with self-driving vehicles.
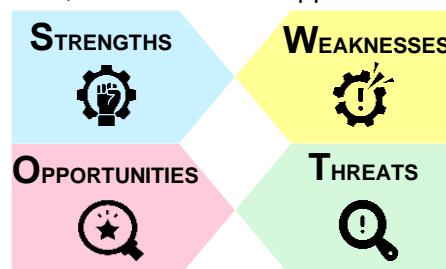
What did we find?

These are some of the themes we identified when organisations talked about self-driving buses, drones, and waste collection vehicles:

Bus
- Bus companies want to use self-driving buses. They may even be forced to use them, because it is getting difficult to recruit drivers
- These buses will be expensive but can help companies to cut costs
- There will be more bus services, including at night and weekends
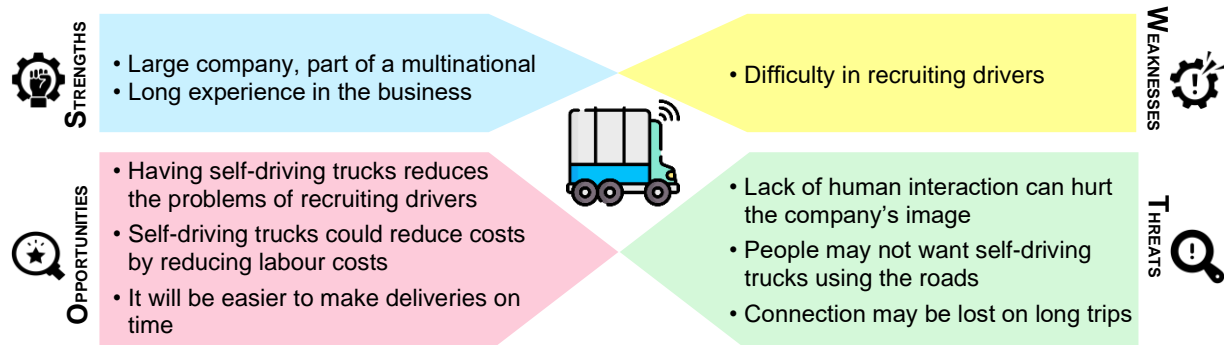- Buses will be safer from collisions, and it will be easier to stick to schedules

Drone
- Drones can be used to carry urgent deliveries, but not heavy ones
- They are safe and fast and can make deliveries on time but there are problems with batteries and landing. Senders and receivers also need training
- They are expensive. It is also complicated to deal with regulations
- Companies will probably hire drone services, rather than own a drone

Waste Removal
- The vehicle needs to both move and handle waste on its own
- It will be expensive to buy but it might reduce costs
- Vehicle repair will be more difficult and expensive

The SWOT analysis showed that self-driving vehicles create opportunities for the organisations, but they also bring several threats. Below is the analysis we did for one of the organisations we interviewed, who talked about self-driving trucks

SWOT analysis of <u>self-driving trucks</u> for a delivery company

STRENGTHS
- Large company, part of a multinational
- Long experience in the business

WEAKNESSES
- Difficulty in recruiting drivers

OPPORTUNITIES
- Having self-driving trucks reduces the problems of recruiting drivers
- Self-driving trucks could reduce costs by reducing labour costs
- It will be easier to make deliveries on time

THREATS
- Lack of human interaction can hurt the company's image
- People may not want self-driving trucks using the roads
- Connection may be lost on long trips

Here's some of the things that the organisations said it might happen in their regions:

- Travelling will be easier and safer from collisions, but more expensive and less safe from crime. People with disabilities may also find problems.
- Some depots may be moved away, but many parking spaces will be needed in the city centre
- There will be new jobs, but others will be lost. Workers will be more productive and less stressed because they can work while travelling and there will be less congestion
- The transport sector could become even more male-dominated than it is now
- Governments and companies will need to invest a lot to adapt to the new situation

What we know now

- Self-driving vehicles are expensive but may be worth the investment. Organisations will work better, and their regions will benefit from that
- There are problems that needs to be solved: technical, financial, legal, and job-related

7. What we know now about self-driving vehicles

Self-driving vehicles are coming. We do not know exactly when, but it is likely than at some point in the future, cars, buses, and taxis will be driven by computers. There will also be delivery robots and drones. We asked people in Europe what they thought about this, as citizens or as workers in governments or private companies. This is what they told us about what might happen when self-driving vehicles start to be used in their regions:

What will happen to..

How we get around	• It will be easier to get around, especially for people who do not drive • People will travel more, especially by car • Travel will be more comfortable • Passengers will be able to work while they travel, even by car • It is difficult to know if travel will be cheaper or more expensive
Roads	• There will be more vehicles on the road • Congestion will not increase because traffic management will be more efficient – but roads need to be upgraded
Traffic safety	• It will be safer to travel but there will still be collisions • It is difficult to know what will happen in emergency situations
Cities	• Some space will be released from the centre • It is difficult to say if cities will need more or less car parking space
The economy	• Workers will be more productive • There will be more economic growth • Some jobs will be destroyed, but new ones will be created • Prices may increase because companies will need to invest more • Large investments are needed for the economy to adapt
Social justice	• Areas far from the city centres may have more transport • It may be difficult for people with disabilities to use buses • Transport may become too expensive for people on a low-income • The transport industry may become even more male-dominated, and some older workers may lose their jobs
Health	• There will be fewer health problems caused by bad air quality • It will be easier to travel to hospitals • It is difficult to say if travel stress will increase of decrease • There will be less social interaction
The environment	• There will be less noise and air pollution • There will be other environmental problems because of more demand for electricity and the need to dispose of batteries
Crime	• People may be more afraid of using buses because there will be no human driver or assistant to protect them from crime • Packages delivered by robots or drones may be stolen • Vehicles may be hacked and used for terrorism • Vehicles will track people's movements