VIEWS
OF PERSONS WITH DISABILITIES
ON FUTURE MOBILITY

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Our Motto

NOTHING FOR US, WITHOUT US

The 2020 European Sustainable and Smart Mobility Strategy highlights key actions for making new mobility solutions affordable, accessible, and safe for all passengers, including those with specific access needs. We present the mobility needs and challenges of persons with disabilities and initial attitudes towards future mobility solutions and associated technologies.

In a nutshell, our findings suggest that a number an interactive, real-time, accessible journey planner would motivate users to travel and make their journey more independent, faster, easier, nicer, and safer. Bike sharing, e-scooters, and motorbike taxis are largely rejected in their current format. Microtransit and cable cars, ride pooling and robotaxis are quite promising alternatives, but we should pay special consideration to women's reservations around safety. Cycle lanes hold a promise for participants upon modification.

According to our findings, persons with disabilities are open to using smart assistive technologies such as augmented reality, robots, artificial intelligence alerts, and wearables. We should consider their seamless integration for improving the overall levels of urban transport accessibility.

Our report also offers high-level design directions, as well as policy and industry recommendations for considerations.

Our conclusions

IN BRIEF

Our Survey
METHOD

The survey was accessible online from November 2020 to February 2021. The survey was addressed to persons with different disabilities or people answering on behalf of persons with disabilities.
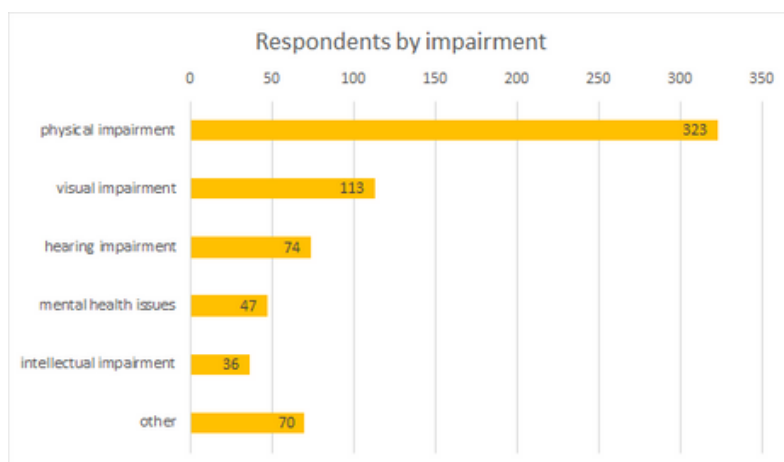
Our Participants
Our survey represents the views of **553 persons with disabilities** living in **21 European countries**. Our sample was relatively gender-balanced, with **45.8% women**.
The data shows a balanced spread across the age groups with mean age of 46.4 years. There is a
 pro-technology bias as participants would require access to and comfort in using the Web.

The participants were asked to assess nine emerging mobility systems:
- accessible journey planner
- bike sharing
- e-scooters
- motorbike taxis
- cable cars
- micro-transit
- ride pooling
- robotaxis
- cycle lanes

Respondents by impairment

impairment	count
physical impairment	323
visual impairment	113
hearing impairment	74
mental health issues	47
intellectual impairment	36
other	70

Our Survey
FINDINGS

"all of us depend on others, and on various support systems, including increasingly technological systems, for our lives"
G. Goggin

The **accessible journey planner** was the single most favoured solution by users (44%). People reported that it would motivate travel and make one's journey more independent, faster, easier, nicer, and safer. In contrast, **bike sharing** (17%), **e-scooters** (22%), and **motorbike taxis** (22%) scored low on all these dimensions and were the least favoured by all users. **Cable cars** (37%), **micro-transit** (32%), **ride pooling** (27%), and **robotaxis** (32%) also hold a promise across travel purposes from commuting and going to scheduled appointments to shopping and socializing. Women, however, hold some reservations which bear further consideration and research. Around 36% of respondents would favour the use of accessible **cycle lanes.**

When designing future transport systems, attention should be paid to the most frequently mentioned complaints around:

1. Getting on and off the means of transport
2. Reaching the transport mode
3. Using station facilities
4. Travel delays
5. Comfort on board
6. Limited access to information
7. Autonomy
8. Social barriers
9. Accessing help
10. Friendliness of the surrounding environment
11. Getting users oriented
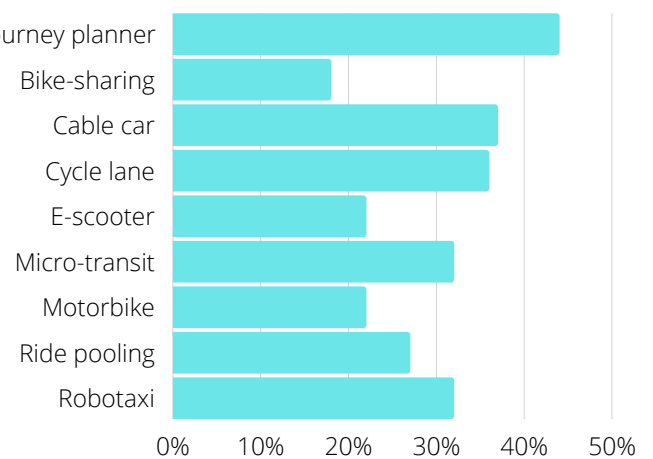
Participants with **physical impairments** had a clear preference for an accessible journey planner (53%).

Participants with **visual impairments** were not particularly interested in an accessible journey planner (38%) or cycle lanes (25%). Participants with **hearing impairments** were not particularly interested in an accessible journey planner (31%) and would make use of all other solutions at par with other groups. Interestingly, two-wheeled solutions were also least favoured.

Those with **mental health issues** favoured less all other categories, except cycle lanes (45%). Participants and or the carers of persons with **intellectual disabilities** favoured cable cars (47%), but shy away from solutions such as cycle lanes (18%), micro-transit (16%) and ride pooling (14%).
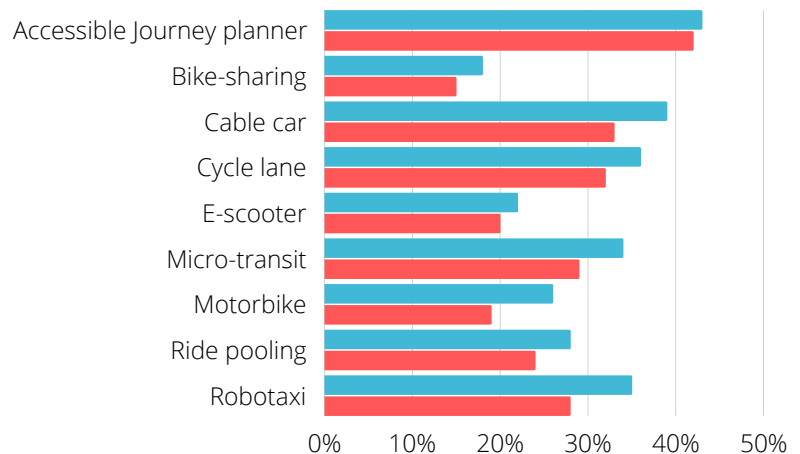
The gender
BALANCE

GENDER ISSUES TO BE CONSIDERED

There seems to be a significant difference in how women and men respond about their intention to use these systems in their daily life, i.e. for commuting or studying, and some early indications that women favour less some of these mobility systems.

Women are more reserved when it comes to cycle lanes, e-scooters, and ride pooling, for example. Cable cars and micro-transit are also less favoured by women. They are also less open to motorbikes and robotaxis.

Interestingly, women's views are more polarised in relation to the accessible journey planner. While the same number of women would use it, a considerable 10% more women consider it is not for them.

These indications bear further study and consideration.

Gender was nearly equally distributed in the sample with some more men (51.4%) than women (45.8%). Male respondents were however over-represented among those with visual impairment (58.4%) and less represented in the group of mental health issues (38.3%) and intellectual disabilities (44.4%).
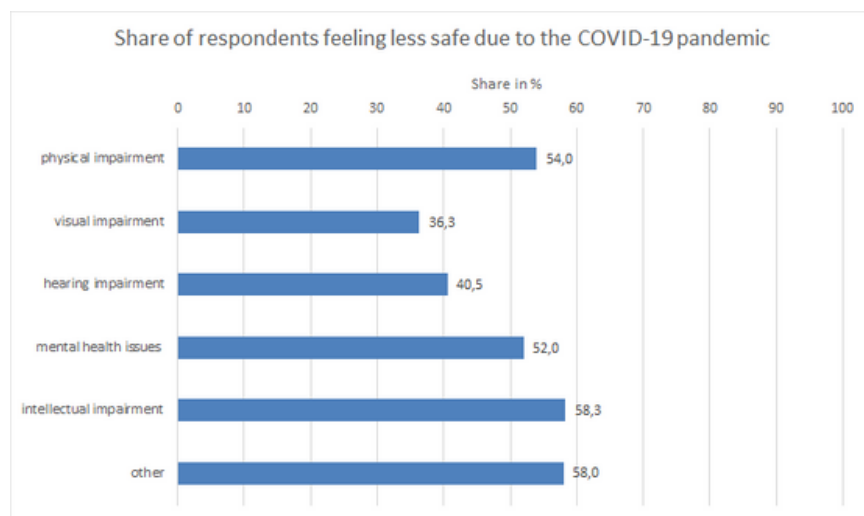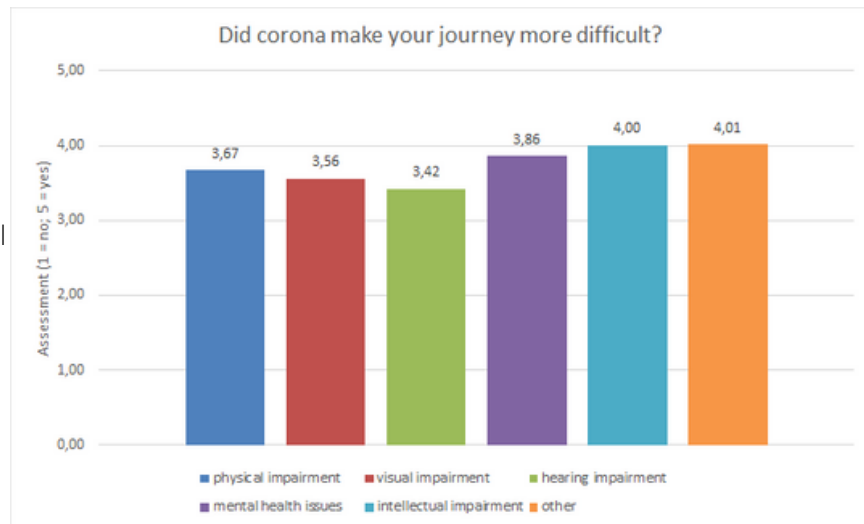
COVID-19 RELATED BARRIERS

Respondents assessed the impacts of the COVID-19 pandemic on their travel behaviour to be strong. Nearly 60% of the respondents strongly agreed with the statement that the pandemic made them less willing to travel. The pandemic made their journeys **more difficult**, **less safe** and **less nice**.

Persons with mental health problems or intellectual disabilities especially experienced that their journeys have become more difficult and less safe. However, there was also a considerable share of respondents stating that the pandemic did not make their journeys more dependent on others (28.2%, stated "no" and 10.4%, stated "not a lot"). The results empasise the need for designing and operating resilient public transport systems to ensure **mobility for all**.

EDF has issued a <u>list of recommendations</u>* to mitigate risks of de-prioritizing accessibility and passenger rights.

Did corona make your journey more difficult?

The ongoing COVID-19 pandemic has enormous impacts on the travel behaviour of persons with disabilities.

Share of respondents feeling less safe due to the COVID-19 pandemic

* https://www.edf-feph.org/xx-edf-recommendations-on-exit-measures-for-transport-services-in-light-of-covid-19/

Use intention of future assistive technologies

Technology	Value
smart communication aids	3,5
location-based alerts	3,6
augmented reality	3,6
exoskeletons	3,5
robots	3,7
wearables	3,9
3D printed protheses	3,3
autonomous wheelchairs and vehicles	3,7
artificial intelligence sign language translation	3,2
artificial intelligence alerts	3,7
automated captions	3,5
accessible navigation systems	3,6
smartcanes	2,9

Scale: 1 never, 2 rarely, 3 sometimes, 4 frequently, 5 always

USER VIEWS ON ASSISTIVE TECHNOLOGIES

We asked respondents whether they would use smart assistive technologies as these may mitigate some of the accessibility gaps in existing transport infrastructures.

Most users, irrespective of the type of their impairments or disabilities, would welcome and make frequent use of wearables, artificial intelligence alerts, and robots, as well as autonomous wheelchairs and vehicles, which seem to cater not only to the needs of those with physical disabilities but also for those with intellectual disabilities.

As expected, smart canes and automated captions were seen as specialised tools for those with visual and hearing impairments.

Somewhat less expected, accessible navigation systems were welcome by blind people but also by people with intellectual disabilities.

Artificial intelligence alerts were particularly welcomed by those with intellectual disabilities who are also open to a host of other assistive technologies, like location-based alerts, augmented reality, robots, and smart communication aids, and autonomous wheelchairs.

Automated captions and artificial intelligence alerts are seen as useful tools by those with hearing impairments.

Those with visual impairments would welcome accessible navigation systems, robots, and augmented reality solutions.

Persons with physical impairments would prefer a variety of specialized solutions from autonomous wheelchairs and exoskeletons, to more general ones, such as wearables, robots, location-based services, and to some extent augmented reality.

ACCESSIBILITY IS A DOOR TO DOOR ISSUE

This section presents respondents' ideas on how to improve the accessibility of mobility systems which should be considered in their future design.

Accessible journey planner: Due to its popularity across disability groups, respondents' ideas are diverse. Users stress the importance of the application: a) to be accessible; b) to contain real-time information about accessibility, for example, availability of seats in the next bus or if certain accessibility infrastructure is "out of order"; c) to be able to act as a navigation tool en route, possibly be able to interact with it like with Alexa; d) to give information in multiple ways (sign language, audio, lip-reading, etc.); e) to be integrated with smart glasses; f) to be available without registration and free, but also point to the need; g) to have a smarter mobile phone; h) to be more comfortable with using digital technologies.

Bike sharing: Bike sharing is one of the least popular means of transport in our survey, as people using wheelchairs and those with visual impairments feel excluded, as well as those who do not know how to or are physically unable to ride a bike. Some people had a hard time envisioning answers to this question and perhaps feel a bit cynical about it. For example, people gave answers such as: "If my legs allowed me to ride a bike, then I would not be disabled" or "another pair of eyes".

What do users
WANT

On the other side, there were also practical suggestions about: a) self-balancing bikes; b) tricycles, handcycles, quadricycles, attachments that convert wheelchairs into cycles, and c) adaptable steering wheels for those with upper body impairments; d) electric or self-powered bikes, e) well-marked cycle lanes; e) safety measures, such as physical barriers; f) cycling education. There were also more systemic suggestions such as: g) accessibility of the bike-sharing station and h) access to a smartphone and an accessible app in one's own language.

Cable car: The cable car was a very popular solution across groups with different disabilities, hence suggestions also vary in nature. The guaranteed existence of standing personnel while boarding and exiting the cabin is a must not only as a help to onboard but also as a person to protect passengers with disabilities from other passengers and guarantee their safety. Some respondents requested: a) a person to get them a ticket; b) a vocal narration of the journey so people can know where they are; c) wheelchair accessibility of the cabins and the seats; d) written narration and announcement of stops; e) short booking times; f) quiet motors; g) short distance and accessibility to the cable stations; h) accessibility of the cable platforms; i) accessibility of the city and inclusion of the system in an integrated city map. Some even dreamed of systems that may not require personnel on platforms; others mentioned their fear of heights.

Cycle lane: Cycle lanes received a mixed reception by persons with disabilities People using wheelchairs see the possibility of using the cycle lane infrastructure as an alternative to sidewalks: "I sometimes use the cycle paths in a wheelchair but it is by default if the sidewalk is not accessible", and so they are interested in the extent of the network to allow them to go everywhere and some protection from faster riders to secure their safety:

"In a wheelchair, I am not safe on the cycle paths because I go much slower than the cyclists." They want cycle lanes a) not to have bumps; b) to have 'parking places' where people can put down their bags, long canes in order to onboard the cycle, c) to be wide enough to cater for wider forms of cycles (e.g. tandems or tricycles); d) wide enough for others to overtake them at a distance, for them to feel safe or separate cycle lanes altogether, avoidance of intersection with cars and traffic; e) clear signposting and control of traffic. There were also comments that dismiss cycle lanes: "this is rubbish" and some people made recommend-ations about the types of cycles and cycles' ownership, which we have included in the section on bike sharing.

E-scooter: Much like bikes, e-scooters are non-applicable to those with visual impairments. For those with physical impairments, balancing is an issue, as well as standing for a long time. Many consider using e-scooters "impossible", some discussed solutions that would: a) allow users to balance, like three-wheel or four-wheel e-scooters; b) the option to have a sitting e-scooter; or c) to use an e-scooter as traction for a wheelchair was discussed and even the possibility of a tandem e-scooter. Some people requested: d) voice assistance; e) charging stations across the city; f) safe lanes away from traffic. Much like other solutions, g) the booking apps must be accessible in any device they use (smartphone or laptop) and h) in the local language, and people should have ownership of a smartphone or other such device.

"You only need empathy in design if you have excluded the people you claim to have empathy for"
L. Jackson

Micro-transit: Suggestions about micro-transit covered a variety of incremental to futuristic suggestions from a fully accessible app to an "avatar for the hearing impaired". Some could not see a big difference with scheduled buses and it is our understanding that many of the concerns around onboarding and travelling on buses also applied here. Particular concerns related to micro-transit: a) accessible ways to find the 'stop'; b) short booking lead times; c) guaranteeing arrival times.

Motorbike taxi: Much like the other two-wheel solutions motorbike taxis were unpopular and even out of the question to the extent that some respondents felt a sense of cynicism even being asked about it: "Good grief, make the existing system accessible instead of making up such nonsense." or "Comes on the wheelchair and ventilation, out of the question!" were indicative answers. Interestingly, this solution did not attract many suggestions. On the contrary, people complained that they would not want to communicate with the driver, that they would not see the driver's face to interact en route, other respondents would not want to hold on to the driver, had no idea how to bring their companion dogs on it or carry their wheelchair or did not feel safe on a motorbike due to the limits cause by their disability. There were a few users who would use the system and they had nothing to add apart from safe drivers and an easy and accessible booking system, which was a common concern across solutions.

Ride pooling: To make ride pooling accessible, people would need: a) an accessible mobile app to book it; b) and it should be able to guide them to the meeting point; and c) monitor the journey to reassure users that they are safe. Preferably the journey is: d) from door to door and f) is much cheaper and affordable. The vehicle should be: g) accessible for wheelchair users or able to store one and h) has single seats. Also, i) drivers should still be able to help users and j) allow companions or personal assistants.

Robotaxi: There were enthusiastic adopters:" to make it available, I need absolutely nothing but ROBO TAXI" to deniers: "Stupid questions". Naturally, there were also many who had concerns about safety and requested that robotaxis are: a) legally and ethically mature and approved; b) drive safely; c) help in case of an emergency, d) reassurance that robotaxis are properly maintained and some respondents would bestow their safety only to a human. Other suggestions related to it: d) an accessible booking application; e) a means to notify a blind user that their car has arrived; f) help with onboarding the vehicle; g) space for an electric wheelchair; g) space and help to store a wheelchair; h) affordability; i) a simple payment system; j) narration of the journey to reassure users with visual impairment that they are on the right track; k) accessible ways to interact with the car (e.g., text-to-speech, voice commands, laptop apps); m) the ability to geo-locate users when they do not know exactly where they are.

A look at the

FUTURE
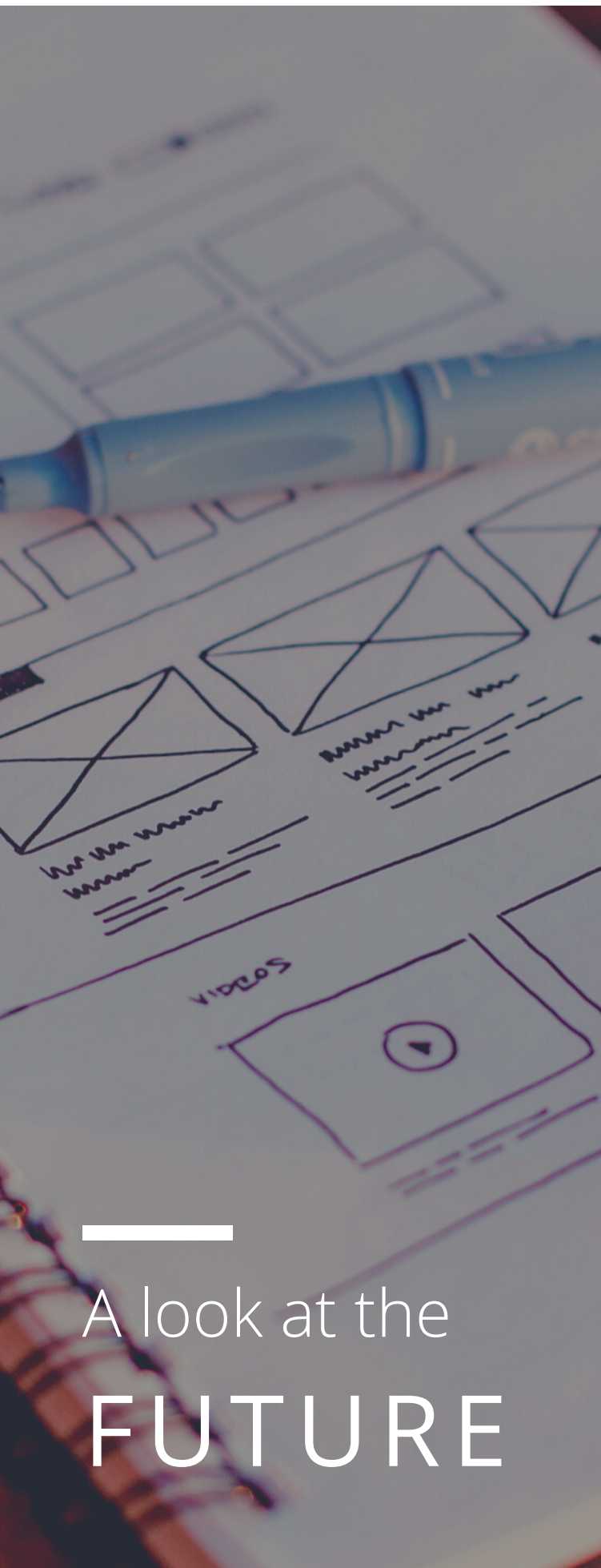
Overall

OUR DESIGN SUGGESTIONS

For persons with disabilities to take full advantage of the ideas and solutions promoted by the 2020 European Sustainable and Smart Mobility Strategy we need a systemic look into accessibility. This will require engaging persons with disabilities in the design of a) future mobility vehicles, (b) apps and interfaces for using smart mobility services and vehicles, (c) the urban infrastructure that enables access to them. To this end, we would like to recommend:

- First, prioritise a journey planner that can provide accessible information about the accessibility of door-to-door journeys. It would greatly improve people's mobility and willingness to travel. Information should be accurate and reliable in real-time.
- Second, redesign bikesharing schemes, e-scooters and cycle lanes to ensure investments in such initiatives are appealing for everyone facing mobility issues.
- Third, ensure AI solutions are developed in a participatory manner involving persons with disabilities and disability/accessibility experts to avoid any bias and ensure equal access and utility.

Persons with disabilities have ideas and the willingness to collaborate with transport and urban planners and engineers to co-design accessible solutions for smart mobility and living and we propose the establishment of a **European Accessible Design Centre** that can provide a platform for such collaboration.

Overall

OUR POLICY RECOMMENDATIONS

To solve the door-to-door accessibility issues, we suggest a systemic approach that requires greater collaboration across urban planning, transport planning, social services, and education systems. In particular, policy-making should:

- Enable persons with disabilities to own smart technologies and smart assistive technologies to enable them to interact with smart mobility systems;
- Raise the digital competence and confidence in the use of smart technologies of persons with disabilities;
- Ensure greater collaboration between urban with transport planning to design accessible routes to modes of transport.
- Prioritize the accessibility of all vehicles in 'green' fleets to minimize time delays due to inability to board or overcrowding.
- Invest in the accessibility of cities and transport infrastructure.
- Invest in public campaigns to improve social attitudes and transport etiquette towards citizens with all types of disabilities and access needs.
- Make mandatory the participation of disability/accessibility experts in standards developments for vehicles, mobility systems and transport services.
- Update and upgrade the laws and policies on EU transport accessibility and passenger rights and their enforcement across member states.
- Invest in a European Accessible Design Centre of excellence that can provide relevant expertise to European companies.

A look at the

FUTURE

MOBILITY SYSTEMS INDEX

Accessible journey planners: Accessible journey planners are online systems or mobile apps that you can search for how you can travel with public transport from point A to B when you use a wheelchair or you want to avoid walking up and downstairs.

Motorbike taxis: Motorbike taxis are a taxi service on a small motorbike (like a scooter or a moppet). You can book a ride on a mobile app. The scooter driver picks you up from your location and drops off at your destination. You have to wear a helmet and there is usually a small space to store stuff on the bike. Sometimes, bikes are electric. Motorbike taxis are very popular in Asia, because you don't have to get stuck in traffic and they are cheaper. This is also great for city traffic and pollution, but would it be good for you?

E-Scooters: E-Scooters are electric-powered scooters that can be picked up from a nearby location in the city and dropped off at another location in the city. You can use a mobile app to find one close to you, and also pay for it and unlock it so you can use it. A scooter should be driven on the road or a cycle lane, (not the pavement) and can reach around 30 kilometers per hour. You are expected to balance on a scooter to drive it, and you can control the speed and break from the bar handles. Hiring e-Scooters for short city rides have become very popular in many cities.

Micro-transit: Microtransit is a minibus service that can only service your local area. Imagine that you plan a long journey and you need to reach the main rail station, but to get there is really complicated. You book a Microtransit service, via a mobile app. The minibus will not pick you up from your doorstep, but from a nearby location and drop you off at the rail station.

Ridepooling: Ride pooling is a kind of shared taxi. Imagine that you need to go across town. You book a taxi via a mobile app. The taxi also picks up other people that are going in the same direction. It might take a little longer as the car needs to stop to let people on and off on the way to where you are going. The ride is cheaper than a normal taxi, but you have to share, and sometimes you are not brought all the way to your doorstep.

Bike sharing: Bike sharing is a scheme of public bicycles that can be rented out for a (short) period of time. Bikes can be picked up from a nearby and dropped off at a nearby parking dock or outside one's destination (for dockless systems). A mobile app shows you where you can find one, and also allows you to check it out and pay for it via your phone. The bicycle should be driven on the road or cycle lanes (not the pavement), wearing a helmet. The users should be able to ride a bicycle, and, of course, watch out for road traffic. Although there are some electric-assisted bikes, most rental bicycles require manpower and may (or may not) have gears. Increasingly cities dedicated cycle lanes, usually located next to car lanes.

Cycle lane: A cycle lane is a visibly marked road lane dedicated to cycling, and more recently to e-scooters too. Perhaps other micro-mobility solutions may be able to use these in the future. Cars are not allowed to drive or park on them. The lanes are usually 1.5 meters wide, and cycles and scooters can reach a speed up to 50 kilometers per hour. While there are no cars on these lanes, riders still need to be able to steer their cycle or scooter to avoid other riders and follow instructions and signs to navigate.

Cable Cars: Cable cars are cabins on steel ropes high up above ground that go from one station to another. The cabins can fit 10-20 people, depending on their size. Cable car cabins are at ground level and can be stopped so that wheelchair users can easily get on and off. Station staff is usually available at these getting on and off points for assistance. Cable cars are becoming popular because they avoid road traffic, are relatively inexpensive and they don't take much space to build, they are electric and hence less polluting and run automatically which makes them cheap to run.

Robo taxis: Robo taxis are autonomous cars that are driven by artificial intelligence which checks the road and traffic via sensors, GPS and other smart technologies that communicate with other cars and the road infrastructure. Very likely these cars will also be electric. Because they are driverless, these taxis will be more affordable, and you will be able to book a taxi by a mobile app.

A New Approach to Designing Transport Systems Free of Mobility Barriers

"TRansport Innovation for disabled People needs Satisfaction" (TRIPS).
The EU-funded project, TRIPS, aims at making public transport more accessible
for persons with disabilities, elderly voyagers, and really everyone.

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