Citizen-led approach to designing inclusive digital shared mobility services

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Abstract: Several European cities have committed to a long-term mobility transition to achieve a target of zero carbon emissions. In order to reduce the use of private vehicles, it is argued that digital shared mobility services are sustainable solutions for citizens. This paper proposes early citizen engagement as an approach to designing digital mobility services in inclusive and accessible ways. We present the findings from a mobile probing study involving 10 citizens from Espoo in order to gain first-hand experience of citizens' mobility needs and behaviours. Our preliminary findings show that giving up private vehicles and distrust of shared mobility solutions is still a challenge. We explore citizens' attitudes towards shared digital mobility services and propose design guidelines to resolve challenges of accessibility and inclusion in those services.

Keywords: Digitalisation; Shared mobility services; Design research; Citizen engagement; Inclusion; Accessibility.

1 Introduction

Current societal and academic discourse on achieving a sustainable mobility transition highlights the role of public transport, cycling and walking as alternatives to private motoring. Also, combining traditional modes of transport with current innovations in shared mobility, such as car sharing and peer-to-peer vehicle sharing, ride sharing, bike sharing and scooter sharing (Machado et al., 2018) have been highlighted as a success factor for a transition towards more sustainable mobility behaviours (Shaheen et al., 2015). It is argued that shared mobility services reduce the use of private vehicles and enable citizens to share under-used assets more efficiently (Guyader, Friman and Olsson, 2021). Supporting citizens to become users of mobility services is important as cities strive to become inclusive, equal, sustainable and safe places to live for a broad range of citizens (Simonofski et al., 2019). A transition to mobility services could help create a sustainable mobility transition by sharing vehicles with a wider group of people via digital platforms.

From a citizen perspective, the use of shared mobility solutions means giving up private vehicles and utilising public transport, rental or peer-to-peer solutions. While public transport and sharing solutions are regarded as forms of innovations towards achieving green mobility (Santos, 2018), these solutions can be perceived as inequal solutions from citizens' perspective. Everyone does not have an equal access to shared mobility services in the city. At the same time, the COVID-19 pandemic has created a tendency for people

to return to using private cars. To enable socially just future, sustainable mobility behaviours need to be supported in a collaboration between citizens and the public and private sector. Hence, even if the sharing economy and shared mobility are not new innovations (Guyader, Friman and Olsson, 2021), it is only now that they are starting to gain broader impact. Consequently, their increased popularity requires new ways of thinking about their impact on sustainability. Digital sharing services must be designed with social sustainability in mind. The services should increase the level of trust and accountability in users to share their vehicles with complete strangers (Dolins et al., 2021). Also, the different user needs, socio-economic situations, physical or mental capabilities and access to digital platforms must provide a basis for creating socially just and inclusive digital mobility platforms.

This study explores shared digital mobility solutions from the citizens' perspective, offering fresh insights into what prevents or supports citizens in transitioning from private vehicles to shared solutions. We reflect on the challenges of creating shared mobility solutions without neglecting the various needs of citizens in order to create inclusive digital mobility services. The study was conducted in Espoo, the second largest city in Finland, located in the capital area. Due to the city's characteristics, the transition towards sustainable mobility has created challenges. In 2018, 46% of the trips in Espoo were done with private cars whereas 18% of the trips were done with public transport, 26% of the trips by foot and 9% of the trips with a cycle (Kangasmäki, 2020). Shared mobility services have only recently started to gain popularity in Espoo. However, user acceptance and usage are low. Regarding accessibility to shared mobility services, e-scooters and city bikes, for example, are only operating in parts of the city. Such services also require a strong identification for payments and a mobile phone app. To understand the current mobility paradigm from the citizens' perspective, a mobile probing study was conducted with 10 citizens from Espoo, Finland. This study was conducted by KONE Corporation[1] as part of an EU-funded Horizon 2020 project Sustainable Energy Positive and Zero Carbon Communities (SPARCS)[2].

The aim of the study is to understand the following question: *what are the needs of different citizens regarding socially sustainable and inclusive shared mobility services?* A sub-question is: *what are design drivers for socially sustainable and inclusive digital mobility services?*

2 Reflecting on social sustainability

There are many ways to define social sustainability. Yet, there is not one universally adopted definition. Justice, equality and the opportunity to influence are often associated with social sustainability (Kautto and Metso, 2008). Social sustainability also concerns issues of responsibility, inclusion, empowerment and human-centredness in broader terms.

Regarding inclusion, *"the idea that everyone should be able to use the same facilities, take part in the same activities, and enjoy the same experiences, including people who have a disability or other disadvantage"* (Cambridge Dictionary, no date), accessibility is a key

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[1] KONE is a global leader in the elevator and escalator industry with a mission to improve the flow of urban life (KONE, no date).
[2] SPARCS project webpage: https://sparcs.info/

factor. Accessibility is an issue of human rights. Accessibility means (also) enabling *"persons with disabilities to live independently and participate fully in all aspects of life"* (United Nations, no date). The European Union has a specific directive that requires accessibility for products and services (EUR-Lex, 2019). Disabilities vary greatly, and can be physical, cognitive or sensory. Disabilities can also be permanent, temporary and/or situational. Inaccessible environments create barriers to participation. Thus, every citizen experiences some kind of disability at some point in their life. (WHO, no date) Regarding barriers, there are also many other issues, for example, socio-economic circumstances, which influence accessibility and inclusion.

Accessibility includes both the tangible and intangible aspects of the environment from accessible routes to accessible digital services. Accessibility can also be extended, for example, to affordability and cultural sensitivity via inclusive and universal design. The idea is that by assessing "extreme" needs, the needs in between these extremes would also be fulfilled. This is in line with universal design principles described at KONE's web page as *"a stamp of architectural excellence"*, which implies that fulfilling the requirements stipulated by disabled users secures usability for everyone (KONE, 2020).

However, designing for accessibility can be complex. Firstly, what is accessible to one person might be inaccessible to another. For example, kerbs on pavements are an obstacle for a person in a wheelchair but may help a person with a visual impairment navigating with a white cane. Secondly, when considering images and impressions, which are inherent in product use, an accessible solution may not be inclusive. Edwards and Imrie (2003, p. 251) discuss *"back door treatment"* by which they refer to wheelchair-accessible routes, which are often back doors located in alleys behind the main entrance of a particular building. Such solutions are accessible but result in their users standing out as different. This is not exclusive to tangible solutions; intangible solutions can also differentiate users, for example, by available language(s) and word choices.

Accessible solutions may lack features that take into account multisensory experience (Jacobson and Ranne, 2021). Without qualities that convey the users' identities and make them blend in with the crowd or differ in a positive way, accessible and assistive products may be regarded as negative, even as stigmatising (Jacobson, 2014).

When designing digital products, accessibility typically refers to the usability of the user interface and qualities such as font types, their colours and sizes, contrasts and so on. However, it also refers to the clarity and format of language, both written and spoken, and the users' ability to use digital devices, including accessing them, as well as their affordability, is a part of accessibility. Thus, many issues need to be considered when designing socially sustainable – in this case – inclusive and accessible products, whether they are tangible or intangible.

3 Shared mobility services and inclusion

Shared mobility – the shared use of a mode of transportation – allows users to gain access to different modes of transport for a short period without owning the vehicle (Machado et al., 2018). Shared mobility services build on digital platform ecosystems in which multiple actors provide assets through a digital application in various ways. Shared mobility offers numerous ecological benefits. By maximising on under-used assets and reducing the number of single-use vehicles, shared mobility has the potential to reduce traffic congestion and CO_2e emissions (Santos, 2018). However, sharing services have also been criticised

for increasing emissions due to the increased use of cars instead of public transport or micro-mobility solutions, as well as the high need for vehicle transfer and servicing (Santos, 2018). The partial provision of shared vehicles on an urban or district level requires vehicles to be moved to different parts of the city. This undermines the physical accessibility to new solutions and the reliability of getting a vehicle when it is needed.

For end users, it is argued that shared mobility services provide alternatives to owning private vehicles and new opportunities to make urban journeys in flexible ways. Shared e-scooters and city bikes, for example, have revolutionised urban mobility in many cities, providing opportunities to unlock a vehicle from the street with a mobile application, travel through the city, and park (or simply leave) the vehicle on the street after use. New vehicles on the streets have also created social challenges, such as e-scooters being left on the pavement, creating obstacles for pedestrians and an increased number of accidents. Furthermore, shared mobility has extended the role of citizens from users to providers of mobility services. For example, peer-to-peer models for renting privately-owned cars to other users through a digital service platform change the typical role of users to one of service provider or producer, often called *prosumer*. For users, these kinds of models provide an opportunity to generate an income and compensate for other costs associated with owning a car. (Machado et al., 2018) To this end, peer-to-peer sharing services and digital platforms also have accessibility challenges due to their dependence on mobile phone applications and credit card payment.

Many individual and social factors, such as individual physical health, location, life situation, financial situation and local options affect citizens' mobility needs and opportunities (Hunecke, Groth and Wittowsky, 2020). In the new mobilities paradigm, coined by Sheller and Urry (2006), social differentiation, i.e. the social exclusion of socially marginalised groups from the freedom of modality choices, has gained central focus in the development of the mobility sector. Social differentiation can be regarded as a socioeconomic challenge for the development of multimodal and shared mobility. Pensioners have been traditionally considered to be multimodal travellers (Scheiner, Chatterjee and Heinen, 2016; Nobis, 2007). However, the current generation of young adults is becoming a key user group for shared mobility services (Freudendal-Pedersen and Kesselring, 2018). It is argued that a non-automobile life situation and changing evaluations of different transport modes, alongside the eagerness of young adults to use modern ICT services and interconnected mobility services are key drivers of new *sharing mobilities* (Wittowsky and Hunecke, 2018; Hunecke, Groth and Wittowsky, 2020; Freudendal-Pedersen and Kesselring, 2018).

On the one hand, a transition to digital mobility enables the rapid scaling of solutions geographically and across different continents. On the other hand, it creates accessibility and inclusivity challenges that need to be addressed in order to reach wider user groups. The dependency on digital solutions, for example, mobile phone applications, online registration, secure identification and credit card payment is creating barriers for digital accessibility to shared mobility services. It excludes users, for example, pensioners who do not own a mobile phone and lack adequate digital literacy skills, but also underaged people without credit cards or people who have lost their creditworthiness.

4 Research design

In the study, we used design research and citizen engagement as an approach to designing shared mobility services. Driven by the recent smart city development, citizen engagement has become a key activity for enabling democratic, inclusive and sustainable urban planning. However, on a more profound level, a city will not achieve its ambitious zero carbon emission targets if its citizens are not engaged in the design processes from the start (Simonofski et al., 2019).

The traditional approach to citizen engagement views citizens as experts who are heard in the urban planning process (Simonofski et al., 2019). In our study, citizens are perceived as co-creators offering valuable ideas to meet social needs. Citizens were included in the design research process as co-creators experimenting with their current and novel mobility practices.

The mobile probing method was chosen in order to gain first-hand experiences of citizens' mobility needs and behaviours (Graham et al., 2007). We conducted the study with 10 citizens from Espoo living in two suburbs: Espoonlahti, which is an area under development, and Leppävaara, which is an already built and well established. Espoonlahti is undergoing major changes and is under construction, whereas Leppävaara has a more established infrastructure and environment. The aim was to gain better understanding of the current mobility challenges from the citizens' perspective and to gain insights from city areas representing the various stages of urban planning and development.

The final participants were chosen from 41 responses gathered through a preliminary online survey. The participants have diverse demographic characteristics, mobility needs and limitations, household and family type, and use various modes of mobility (such as walking, cycling, private car, public transport, taxi and micro-mobility solutions), as well as varying limitations and attitudes towards sustainable mobility. The four-month citizen engagement process comprised a pre-survey, a pre-interview, an eight-week mobile probing activity, a final interview and a co-creation workshop. Table 1 presents the participants' demographics and Figure 1 illustrates the empirical material gathered via mobile probing method.

Table 1 Participant demographics.

Gender	Age	Area	Mobility modes	Household
Man	58	Leppävaara	E-car (driver, passenger)	Wife, one child (18)
Woman	29	Leppävaara	Bike, bus, combustion engine car (passenger)	Partner, one child (baby, three months)
Man	41	Leppävaara	Bike, public transport, shared mobility (Uber, Yango)	Wife, two children (kindergarten, school)
Woman	20	Leppävaara	Combustion engine car (driver, passenger)	Mother, father, one sibling
Man	44	Leppävaara	Combustion engine car (driver)	Wife (no driving license), three children with multiple hobbies
Woman	67	Espoonlahti	Combustion engine car (driver)	Husband in wheelchair
Man	39	Espoonlahti	Combustion engine car (driver)	Partner, three children (kindergarten, school)
Woman	27	Espoonlahti	Bike, bus, metro, light rail, train, borrowed combustion engine car (driver, passenger)	Living alone
Man	37	Espoonlahti	Combustion engine car (driver)	Living alone
Woman	54	Espoonlahti	Bike, metro, shared combustion engine car (driver)	Mother (77), one child (teenaged)

Figure 1 Footage of the mobile probing material, including WhatsApp messages with text and photos of the participants' daily routines.

Analysis

After the user study, the research group organised two collaborative data analysis workshops. The analysed material comprised written research interview transcripts and mobile probing data for each participant, consisting of written messages, photos and transcribed audio messages. The analysis focused on identifying the challenges and opportunities of sustainable urban mobility through thematic clustering. Figure 2 shows six clusters: Sustainable mobility and behavioural change, travelling via private vehicle, travelling via public transport, hybrid and shared mobility, walking and micro-mobility, and online ordering and home delivery.
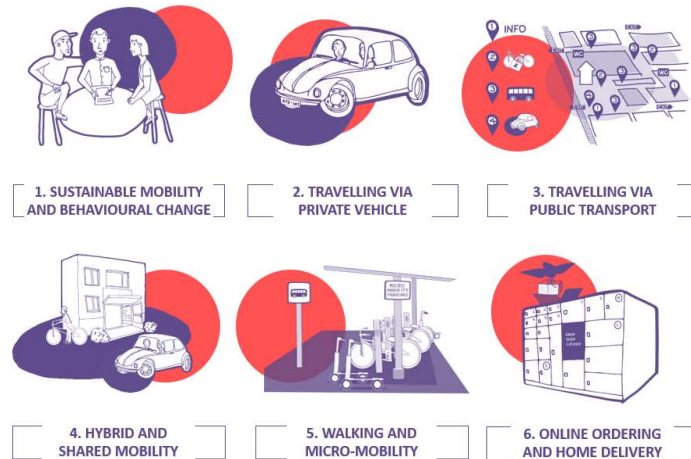

Figure 2 Thematic clusters from the mobile probing data. Images: Saga-Sofia Santala and Satu Niemi.

Based on the clusters, the scope was narrowed down to factors affecting Espoo citizens' shared mobility behaviours. In the further analysis of the material, we focused on five participants, all of whom had varying life situations and described issues that impacted their use of public or shared mobility services. One participant had a partner in a wheelchair who they cared for at home. The second participant was on parental leave. The third participant was living with their parents, who paid part of their living expenses. The fourth participant was a single parent who looked after their elderly mother, and the fifth participant was a parent living with a spouse and two children in a car-free household. From the material, we identified enablers and hinderers of sustainable mobility behaviour, focusing on ecological sustainability, social sustainability and experiences of shared mobility services.

5 Findings

Our findings show that, in the context of Espoo, the accessibility to and inclusivity of shared mobility services remains a challenge. Giving up private vehicles and distrust of shared mobility solutions require a radical change in citizens' attitudes and current practices. We present four themes that the citizens found challenging in the adoption of shared mobility solutions. The participants' quotes have been translated from Finnish into English.

Transition from ownership to usership takes time

While the general trend shows a change from ownership to usership and a prosumer economy, Espoo is still characterised by a considerable amount of private motoring. The tradition and mental models supporting ownership are strong in households, in which the entire lifestyle is based on the use of private vehicles. The responses to the mobile probe indicated that children's leisure time activities and family schedules create pressure to use a car, commuters value the convenience of a private vehicle and people own summer cabins that are hard to reach via public transport.

> *"If very flexible, convenient and easy to use shared cars were available, I might give up my private car [...] I could easily live without a car if required, but there is a convenience factor that I'm not ready to give up."*
>
> *(Woman, 29, mother of a baby)*

As the participant states above, users regard private vehicles as being convenient. Status also plays an important role in the unwillingness of citizens to give up their private vehicles, which are a symbol of freedom to many people. A change from private vehicle ownership to using rental and leased solutions would require changing lifestyles, daily routines and attitudes.

In parallel, some of the participants addressed the practical challenges relating to giving up their cars and the monetary challenges relating to adopting more sustainable mobility solutions. One participant stated how she uses her car on a regular basis, which is regarded as a limitation to sharing her car with other people. She regards her car as a space that she can personalise:

"A lot of my stuff is in my car, for example oil, windshield washer fluid, a travel blanket, sometimes food, personal belongings, for example, perfume and cards, things like that. So if my car was to be part of a car sharing service, it would need to be properly cleaned before it was handed over to another person."

(Woman, 20, private car driver living with her parents)

For people who have active and mobile lifestyles as well as a personal relation to their cars, the transition from car ownership to shared car service usership can be challenging. Such people might need additional support in the transition. Financial incentives alone are not enough. People need practical guidance and emotional peer support. Life situations vary and require different kinds of support and guidance for different people. A person can be temporarily disabled, for example, because of a changing physical condition. A parent with a stroller is faces certain challenges and must consider using new routes, as reflected by one of the participants:

"When your life situation changes, you suddenly have a stroller and are facing new challenges to navigate freely. At that point, the importance of guidance is on a completely different level."

(Woman, 29, mother of a baby)

Thus, different options should be available for different users. This perspective was supported by one of the participants, who wished that different shared mobility options were available, for example, e-scooters, city bikes and rentable boats, even if she did not consider herself a user.

In light of these examples, the most optimal way of enabling accessibility and inclusion is by increasing the number of options to meet the various requirements set by diverse users. Thus, a given option might not be suitable for all users, but every user would have at least one suitable option.

Reliability and safety poses concerns

Compromising reliability and safety were considered to be a challenge in a sharing economy. One of the concerns of Espoo citizens was about whether a vehicle would be available when it was needed and that the vehicle was clean, worked properly and was in a safe condition. The participants expressed their concerns about using existing shared mobility services, as well as providing their own vehicles for others to use, as described by the following participant:

"As someone who cares about safety, how can I be sure that someone else hasn't crashed the car on a previous journey and that something is broken but isn't visible."

(Man, 41, lifestyle cyclist)

Regarding the physical safety of e-scooters, one of the participants described their personal experiences. Due to the participants distrust of their own steering skills, e-scooters were perceived as unstable and risky compared to a regular kick bike. This insight was

interesting because electric micro-mobility vehicles can be perceived as unsafe for pedestrians, but also for drivers themselves, which may reduce the popularity of shared micro-mobility vehicles.

Responsibility between the vehicle owner and the user was brought up as another challenge in sharing. Regarding peer-to-peer sharing, the participants were worried that a total stranger would use their vehicle or that somebody would harm their possessions. They were concerned about taking a financial and material risk that would override the benefits of sharing, such as earning extra income. Lack of trust and knowledge of peer-to-peer sharing services could be regarded as an obstacle to utilising sharing services and attracting a sufficient number of users. This is evident in the following participant's response:

> *"I've never registered my own car with that kind of [sharing service], even if I thought about it at some point but didn't get it done. And maybe I would have been slightly worried regarding who is driving it."*

> *(Woman, 29, mother of a baby)*

Additional income was described as a strong reason for sharing. However, concerns were expressed about who would be responsible if something happened to the shared vehicle and for taking care of maintenance, storage and operation of shared vehicles. Thus, sharing services should be operated by a trusted third-party actor who would take care of the practical arrangements of sharing between the owner and the user of the vehicle.

Sharing within communities calls for facilitation

The study showed that providing and developing attractive shared mobility solutions requires an understanding of the communities in which people would find it attractive and useful to share vehicles or rides. Espoo citizens were willing to share their vehicles, for example, with their family members, friends or neighbours, but not outside their known social circles. Different ideals of cleanliness and potential accidents that impact the safety of the vehicle were described to limit willingness to share.

> *"I think a car is so personal. Maybe it's connected to the fact that I like to drive my car and want to keep it for myself. So I wouldn't rent it to anyone."*

> *(Man, 58, electric car owner)*

The participant described unwillingness to share a private vehicle and continued to reflect on the differences between sharing with family and sharing with friends:

> *"In my own family, other people can of course drive my car, but even if I should give a car to a friend… I don't think I would do that because if something were to happen to the car it could be tricky. It might even ruin the friendship, so perhaps this is not a good idea. The same rules should apply to both friends and strangers, and it would need an agency and an insurance and so on, in advance."*

> *(Man, 58, electric car owner)*

This comment highlighted the need for an external actor – a company – that would facilitate the sharing process with both friends and strangers. Also, some communities were regarded as being more practical than other communities regarding shared mobility. For example, commuting to work versus a weekend trip with friends to a cabin entails different logistical requirements regarding the location, the need to transport both people and goods, and access to a shared vehicle. Thus, there could be diverse trusted community sharing models and business models that fit different sharing situations and that fulfil the needs of safety, security and reliability.

Physical and digital accessibility requires smooth integration

One of the challenges in transitioning from ownership to usership is a lack of practical awareness of the available alternatives. The participants had surprisingly little knowledge about shared mobility services. Some of the services that they had tried included the following: renting a car, using e-scooters and city bikes, as well as lending their own car to a family member or friend. Several participants had heard about sharing services and were generally positive about the idea, although they had not tried it themselves.

However, it should be noted that peer-to-peer mobility services were regarded as being rather unattractive due to a lack of information, and were perceived as unfamiliar by many of the participants. They lacked knowledge of existing opportunities and emphasised that there was a lack of sustainable mobility options. For example, the Espoonlahti district does not currently provide city bikes, which is why this participant had not been able to try one:

> *"I've not tried a city bike. Sure, I could try them if the city bike
> stations were closer to where I live. However, they're still not
> available in many places."*

> *(Man, 37, combustion engine car owner)*

The accessibility and reliability of the digital application is of critical importance when using sharing services. Digital applications and an on-the-go payment process impacts the flow of mobility. While a mobile application can work well for one user, it can be problematic for another user, which is what happened to a participant who was traveling with a friend. The friend was able to use an e-scooter, while the participant had difficulties registering, which slowed down the journey. The same application worked differently for both users, which can be seen as an accessibility issue.

Online payments may also create new challenges that limit the accessibility and user friendliness of a sharing service. Young users in particular, who do not necessarily have a bank account or control of their mobile phone bills are in a difficult position:

> *"As I don't yet pay my own mobile phone bills. I don't want to use
> my phone to pay for 20 euros journeys. Which means that my mum
> has to pay it, in which case I would prefer to pay for it myself.."*

> *(Woman, 20, private car driver living with her parents)*

In order to overcome the current lack of familiarity with digital sharing services, there could be opportunities to experiment with new alternatives. The lack of experimenting with alternative mobility solutions became evident when the participants were asked to

challenge their typical mobility routines by testing a new sustainable mobility solution as part of their final mobile probing activity. This proved to be a challenging task for the participants and also highlighted the absence of relevant, accessible and attractive shared mobility services.

6 Discussion

Based on the findings, we have defined a design space for socially sustainable – in this case – inclusive and accessible mobility solutions. Towards this end, we have outlined design drivers for inclusive shared mobility. Finally, we have reflected on our selection of research methods and the scalability of a citizen-led approach in other contexts.

A design space for inclusive shared mobility

Based on our findings, we have identified at least two ways to design inclusive and accessible shared mobility solutions: A single mobility solution can be designed to be usable to as many users as possible. However, a wide array of different solution can also increase accessibility as every user can find a suitable solution out of many, even if one solution might not be usable for everyone. Both tangible and intangible products, such as digital platforms and services, as well as vehicles, need to be designed to be inclusive and accessible. We suggest the following three design drivers for identifying user needs for inclusive shared mobility:

1. **DIVERSITY.** *Every user is individual, and the diversity between users' needs to be considered when designing new solutions.* What a person regards as inclusive and accessible depends on their characteristics and circumstances. This requires peoples' diverse needs, abilities, motivation and opportunities to be taken into account. Designing suitable physical vehicles also requires designing a digital service platform and ensuring that diverse users have access to it. If people are not offered real opportunities and realistic alternatives that meet their personal mobility needs, they might be unwilling to change their mobility behaviours.

2. **ENGAGEMENT.** *Diverse users need to be engaged in every phase of the iterative design process.* The design of inclusive shared mobility services and mobility transitions require the engagement of diverse end users in every stage of the design process. To be able to consider user needs as thoroughly as possible, the design process needs to be iterative from the start phase to the follow-up phase. This means that designers should continuously define, evaluate and co-create solutions in partnership with users.

3. **CONTEXT.** *Scalability requires understanding and considering each particular context.* Solutions need to be tailored to the context. Local trusted communities can convince citizens to share vehicles and rides in an accessible, relevant and reliable way. Community sharing could be promoted by experimenting with available options targeted at local communities. One way to achieve this is for different service providers to organise low-threshold experimentation possibilities with new shared mobility services that are free. Experiments could include discounts, regional campaigns, free test drives and so on.

Scaling up the citizen-led approach

Reflecting on digital solutions and their accessibility, consideration should be given to the applicability of digital platforms in citizen engagement. Online platforms are regularly used to enable the wider public to provide real-time feedback and to even participate in budgeting and decision making for new mobility solutions (Simonofski et al., 2019). The design should be based on the premises of citizens and their needs, instead of merely aiming to gain approval of existing solutions, which is often the case in urban planning processes.

Mobile probing as an engagement method can be criticised for excluding citizens who do not own their own mobile phones or who lack adequate digital literacy skills. Thus, careful consideration was given to the selection of participants and supporting their participation by handing out mobile phones to each participant in the study. Based on the participants' feedback, the mobile probing method provided a desirable and easy way to document their mobility behaviours via the WhatsApp application. It also increased the citizens' understanding of their own habits. However, in order to avoid treating participants as mere research subjects (Sanders and Stappers, 2014), a more active role should be planned in every stage of the design process. To enable active participation, the weekly probing activities included small assignments that were experimental by nature, as an example to try out a new mode of mobility and document the experiences.

Citizen engagement leaves us with the challenge of scaling up the results by applying similar solutions in other urban areas with same kind of needs. In order to make shared mobility services attractive in other cities, local citizens should participate in the experimentation and co-design of digital shared mobility solutions. However, the engagement of citizens is not enough. The work is local in nature, highly regulated and hard to scale up. Thus, shared mobility companies often struggle to establish their services in a new city or area. To became successful, sharing services require close collaboration between the local ecosystem partners: citizens, mobility service providers, ICT companies, city authorities and public sector institutions.

7 Conclusions

Digital transformation creates new opportunities for shared mobility services. However, shared mobility services have not managed to achieve their full potential due to shortcomings in accessibility and inclusivity. Giving up private motoring would require a major process of de-learning and making changes in daily routines. This also raises an ethical question about the extent to which individual preferences could and should be adjusted for the common good of the planet during a time of increasing environmental awareness. This has not been the focus of this paper but offers an interesting topic for further research.

To support sustainable shared mobility solutions in cities, our study offers both practical and theoretical contributions by taking a citizen-led approach. We argue that the engagement of diverse end users in co-creating new shared mobility solutions together with public and private stakeholders is a way towards achieving inclusive and accessible solutions. Moreover, user engagement potentially offers peer support that could foster the transition from ownership to sharing. Considerations of inclusion and accessibility highlight the theoretical contribution within the field of mobility and digitalisation. We have extended the current research by providing results that could contribute to sustainability of shared mobility services ensuring their success in the future.

Acknowledgements

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