

Women and Mobility as a Service:

An exploration of the
issues faced by women
when using shared
mobility and possible
responses by providers



Foreword

The Smart Mobility Unit (SMU) is part of the Ebenezer Howard School of Planning here at the University of Hertfordshire and exemplifies what the team is trying to achieve. The SMU brings together academics and practitioners to produce research which is original and rigorous but yet rooted in real-world problems.

This White Paper, authored by Dr Maurizio Catulli and Dr Alex Buckland Stubbs, is in turn an excellent example of the work of the SMU. It draws on research undertaken by Maurizio and Alexandra, along with Robyn Thomas and Russell Fenner, which will in due course be published in world-leading academic journals. This White Paper is aimed at a diverse audience – policymakers, practitioners and anyone interested in transport, sustainability and equality.

The White Paper focuses on MaaS, Mobility as a Service, and DRT, Demand Responsive Transport. These innovative new forms of transport provision have the potential to make significant contributions towards addressing major societal challenges, including climate change and social exclusion. They could be particularly important in places outside cities, where traditional public transport struggles to reach those people and places that need it the most. Many people therefore see these models as playing a substantial role in the transport systems of the future.

However, it is vitally important that we understand the differential experiences of those who might use MaaS and DRT – there is a long history of transport systems being designed to suit one particular type of person, with the needs of others (for example women, or those who are less physically able) not always fully considered. If these new approaches are to be successful, they must be designed for the needs of all from the outset, an aim which is endorsed by the Department of Transport's Mobility as a Service Code of Practice. The research reported in this White Paper helps us to understand some of the barriers and challenges faced by women when seeking to use MaaS and DRT.

The areas of focus in this research – thinking about places outside cities, reflecting on those who have less of a voice in policy design and implementation – are central to the work of the SMU and the Ebenezer Howard School of Planning. I hope you find this White Paper as interesting and thought-provoking as I did.



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Meet the Authors



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This project was funded by





Executive summary

This White Paper reviews the latest knowledge on the relationship of women with Mobility as a Service (MaaS) and several measures that have been reported within the existing literature to address issues that women can encounter when using novel transport offerings, including technological, information-based and design-based solutions. The White Paper also presents the findings of research funded by the British Academy and conducted within the University of Hertfordshire's Smart Mobility Unit (SMU). The research draws on interviews with mobility users, transport providers and local authorities in Hertfordshire. The interviews with female transport users in Hertfordshire provided insight into their relationships with use of private cars, shared cars, public transport and mobility apps, as well as their perceptions of MaaS. Additionally, the results of interviews carried out with both female and male transport users in Hertfordshire revealed the impact of gender on safety perceptions and the usage practicality of MaaS transport offerings for male and female users. Finally, this White Paper presents evidence from transport providers and local authorities in order to summarise best practice for the governance of MaaS. It also looks at MaaS design principles, the quality assurance of MaaS offers and delivering social value, and probes to what extent MaaS applications can reassure users as human service personnel can.

Travel behaviours in the UK have changed over the last few years, with less travel now taking place for the purpose of commuting to work and more journeys being undertaken in order to engage in entertainment and holidays, as well as to accompany dependants, a category which disproportionately involves women. This White Paper notes that women have unequal access to mobility offerings and have differing transport needs and transport challenges to those of men, including factors related to safety concerns, convenience, cost and comfort. The research findings and literature evidence shared within this White Paper summarise the challenges that women encounter when using transport services and the safety precautions that they take while using those services and suggests potential solutions and recommended changes that will be needed to improve perceptions of safety for female users of MaaS mobility offers.

The White Paper reviews the existing literature evidence on this topic and presents primary research findings in order to recommend solutions aimed at improving the gender inclusivity of transport offerings, including: improving infrastructure and app design; increasing public and stakeholder consultation; building networks

of trust; enabling women and disadvantaged groups to participate in the design process of mobility offerings; improving investments in communication and infrastructure to enhance perceptions of safety and offer reassurance to users; and improving service delivery by taking a collaborative approach to how transport offerings are designed and implemented.

This research is timely and consequential, as although central and local government authorities are increasingly implementing sustainable transport offers such as MaaS and are continuing to invest in improving the quality of transport means and applications for service users, this White Paper provides evidence of the challenges women still encounter when using these services. The paper highlights the fact that issues such as perceptions of risk and safety concerns persist and may be negatively affecting women's access to transport services, including MaaS. Therefore, there is a pressing need to understand the challenges faced by women when using MaaS transport in order to ensure the following can be achieved: improvement of current and future transport offerings that takes these challenges into account; improved inclusivity of mobility offers; and reduction of the risk of liability for local authorities, MaaS transport providers and network partners in case of potential damages affecting service users, such as those caused by violence and harassment. It is hoped that sharing the evidence and research findings presented within this White Paper will better enable transport providers and policymakers to address the challenges women encounter when using MaaS transport offerings and will make them aware of the recommended solutions they can use to address these challenges.



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List of abbreviations

AI	artificial intelligence
apps	applications
DfT	Department for Transport
DRT	Demand Responsive Transport
CCTV	closed-circuit television
Covid-19	Coronavirus disease 2019
e.g.	exempli gratia (a Latin phrase meaning “for example”)
etc.	Et cetera (a Latin phrase meaning “and so forth”)
EU	the European Union
ibid.	ibidem (a Latin phrase meaning “in the same place”, referring to the source mentioned in the previous reference)
ICT	Information and Communications Technology
i.e.	id est (a Latin phrase meaning “that is”)
IG	interview guide
LAs	local authorities
MaaS	Mobility as a Service
NHS	National Health Service
QA	quality assurance
SMU	Smart Mobility Unit
TfL	Transport for London
UK	the United Kingdom
UX	user experience

Glossary

app

software designed to run on smartphones and other mobile devices

car sharing

the practice of sharing a car for regular travelling, especially for commuting

CCTV

Closed-circuit television, also known as video surveillance, is the use of video cameras to transmit a signal to a specific place on a limited set of monitors

Covid-19

The worldwide pandemic of coronavirus disease (COVID-19), an infectious disease caused by the SARS-CoV-2 virus, first observed in China in December 2019

data security

The practice of protecting digital data, such as those in a database, from destructive forces and from the unwanted actions of unauthorised users, such as a cyberattack or a data breach

Demand Responsive Travel (DRT)

a service available to the public, served by low-capacity road vehicles such as small buses, vans or taxis, which responds to changes in demand by altering its route and/or its timetable, charged on a per-passenger and not a per-vehicle basis

e-scooters

small vehicles which usually have two wheels between 8 and 11 inches (20–28 cm) in diameter, one or both of which are fitted with an electric motor, connected by a platform on which the rider stands, with a handlebar for support and steering

heresangela.com

Omnibus service alarms designed for women, which are used in transport and other public services

Mobility as a Service (MaaS)

a transport offering which enables users to book, manage and pay for diverse modes of travel through smartphone apps

MS Teams

Online application for team collaboration

QA

quality assurance

social value

Stimulation and satisfaction of consumption needs (hunger, housing, health, supply), employment needs (education and work) and societal needs (environment, policy, security)

Social Value Act 2013

The Public Services (Social Value) Act 2012, which came into force on 31 January 2013, requires public sector commissioners in England (and some in Wales) to consider how they could improve the economic, environmental and social well-being of their local area through their procurement activities

sociotechnical landscape

External structures of the context of society, e.g., material and spatial arrangements of cities, factories, motorways, electricity infrastructures and heterogeneous factors such as economic growth, wars, emigration /immigration, political coalitions, cultural values and environmental problems, which shape actors' interactions

transport equity

The morally proper distribution of the benefits and costs (burdens) of transport provision across members of society

UX

user experience





Section 1

Introduction

This White Paper presents the findings of research, funded by the British Academy and conducted by the Smart Mobility Unit (SMU) at the University of Hertfordshire, which focused on the challenges that women users encounter when using transport offerings that promise environmental and sustainability benefits. These offerings include Mobility as a Service (MaaS), which enables users to book, pay for and manage diverse means of transport through smartphone apps (Kamargianni et al., 2018) and Demand Responsive Transport (DRT), a service “[that is] available to the general public [...], served by low capacity road vehicles such as small buses, vans or taxis [...], which responds to changes in demand by altering its route and/or its timetable [...], charged on a per passenger and not a per vehicle basis” (Sørensen et al., 2021: 50). Both MaaS and DRT have little diffusion so far and there is little awareness of them in the public arena (Enoch and Potter, 2023), but both approaches promise environmental benefits (Jittrapirom et al., 2017).

This research is situated in the context of the county of Hertfordshire in England. Within this context and that of the declared climate emergency, local authorities have set the following objectives: to reduce the environmental impact of travel and to increase the share of active travel carried out by local residents within their consumer mobility practices (Hertfordshire County Council, 2023b; Hertfordshire County Council, 2023a). These objectives are in turn supported by policies and funding by the Department for Transport (DfT), in line with central government’s net-zero-carbon policies (Department for Transport, 2021).

The ambition to implement sustainable mobility offerings such as MaaS has, however, been challenged by the findings of studies such as those of Weinreich et al. (2021), Bizgan et al. (2020) and Gekoski et al. (2017) among others, on the challenges that women encounter when using these resource-efficient mobility offerings. These challenges include the danger of being harassed by men (Weinreich et al., 2021), and contribute to a longstanding equity imbalance in transport services (Gekoski et al., 2017). McIlroy (2023) suggests that this equity imbalance should be addressed by ensuring that those who plan and populate the governance structures of transport services include more women in them. This is an urgent issue for multiple parties, as in addition to the ongoing challenges faced by female users, the

issue is also significant for transport providers and local authorities, as they may be held liable for damages suffered by users. Indeed, the Mobility as a Service: Code of Practice introduced in 2023 mandates that MaaS provisions need to be safe, secure by design and accessible to all (Department for Transport, 2023). Quoting from the code,

Personal safety should be a key consideration for organisations developing MaaS solutions. The journey options presented in a MaaS platform should consider the needs of users disproportionately affected, such as children, older people and women, by offering safe and appropriate routes.

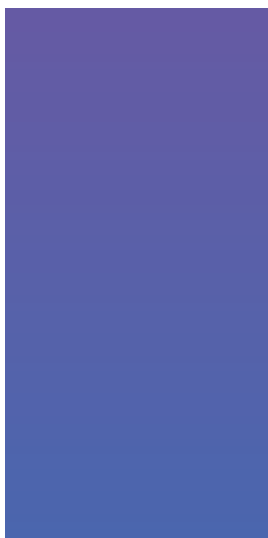
From the perspective of a transport provider, cases of harassment and violence to women may cause service users to associate their brands with danger and lack of safety (Hein et al., 2016). Therefore, in addition to being a problem of interest to policymakers and to women themselves, the challenges and risks affecting women when using MaaS are of great interest to MaaS providers, local authorities and their network partners.

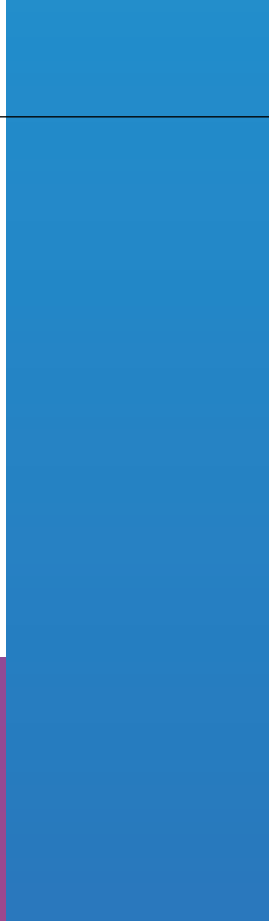
Sustainable mobility offerings such as MaaS need to deliver both environmental benefits and social value to diverse stakeholders. Social value was first defined by Schumpeter (1909) as the *stimulation and satisfaction* of consumption needs (hunger, housing, health, supply), employment needs (education and work) and societal needs (environment, policy, security). Further work has continued to develop the concept of social value, and to define it as including natural, human, manufactured and financial value (Porritt, 2007). Those who provide services and products for government departments are required to deliver social value owing to the Social Value Act 2013, which is an Act of Parliament that requires providers of public contracts to deliver social value in addition to the main services that they provide (Local.gov.uk).

When conducting the initial pilot of the interview guide (IG) as a part of this study, little awareness of MaaS was observed among the participants, as could have been expected considering the limited diffusion of MaaS mentioned earlier. The research team modified the IG to include references to equivalents of the specific MaaS apps developed by MaaS providers, e.g. Whim. Examples of these equivalents are Citymapper and Google Maps, and transport modes that encourage more sustainable

travel and less single-occupancy car use, such as car clubs, Uber and similar taxi services and bicycle-sharing offerings. These examples helped the SMU researchers and research participants to explore the relationship between women users and MaaS. The findings of this research are presented within section 3 of this report.

This White Paper aims to inform transport providers and policymakers by reporting the findings of research funded by the British Academy and carried out by the SMU, which was conducted with mobility user participants, transport providers and local authorities in Hertfordshire. The report aims to raise awareness of the issues that women can encounter when using MaaS transport offerings and provides recommendations on how to address these issues, while also seeking to stimulate debate. The report is structured as follows: it begins by providing a summary of existing literature on the subject, followed by a discussion of the findings of the primary research on users and transport providers. The report concludes with a list of recommendations on how best to address these issues.





Section 2

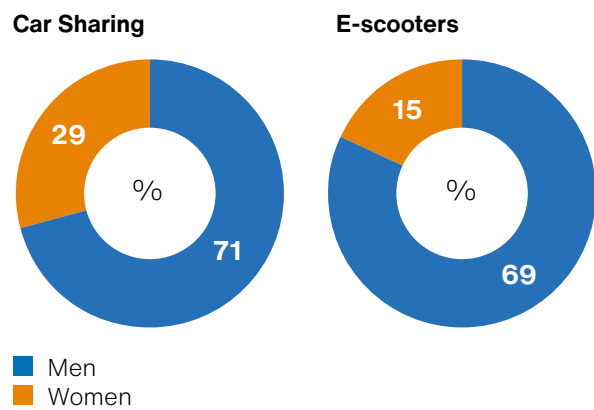
Summary of existing literature

2.1 Users and mobility apps

In terms of personal mobility patterns and reasons for travel, the share of journeys accounted for by those commuting to work has recently seen a notable declining trend. This share had dropped to under 20% of the distance travelled even before the advent of the Covid-19 pandemic (Enoch and Potter, 2023). In contrast, more journeys are now being made to accompany dependants to a destination (this has increased by 20% since pre-pandemic levels), and for entertainment and holiday trips (which have increased by 15% and 7% respectively). Women are more likely than men to practice these forms of mobility (Weinreich et al., 2021). Transport offerings can exclude individuals and groups with diverse characteristics; these may depend on their ethnic and socio-economic background, location, age and gender (Giorgi et al., 2021). Women encounter different challenges from those encountered by men when they travel between locations for work, home, shopping or leisure, and therefore, access to mobility is unequal (Sopjani, 2021). For example, in most countries, fewer women than men have access to cars (Duchène, 2011), and women tend to use public transport more often than men (Weinreich et al., 2021). MaaS could be an alternative to using private cars and public transport, but it presents women with challenges of its own.

In a study of four Western countries, Norway, Finland, Sweden and Denmark, it was found that 40% of women use MaaS offerings vs 49% of men; however, in those countries women's share of the use of certain elements of MaaS is much lower. For example, women account for 29% of car sharing and 15% of e-scooter use, while these figures are 71% and 69% respectively for men, as shown below in Figure 1 (Weinreich et al., 2021).

Fig 1 Differences in the share of use of car sharing and e-scooters by women and men in Finland, Sweden, Denmark and Norway



Source: Weinreich et al. 2021

Reasons for this include differences between the mobility practices of women and men. For example, women tend to walk and use public transport more than men, and to cycle and drive less (Weinreich et al., 2021). In addition, women tend to travel in sequential shorter journeys (Weinreich et al., 2021; Gekoski et al., 2017), such as going from the shops to the gym. They also transport children and accompany elderly relatives to visit healthcare services in higher numbers than men do; globally women are responsible for 75% of unpaid care work (ibid.), and are more likely to be single parents, which heightens tensions between work and unpaid caring (Hamilton et al., 2006). Additionally, women on lower incomes might not be able to access MaaS because they do not own smartphones (Choudrie et al., 2018); only 39% of women (vs 61% of men) have adopted multiple smartphone apps in the UK including transport ones (YouGov, 2020).

Safety is one of the four key priorities underpinning transport decisions, the others being convenience, cost and comfort (Bizgan et al., 2020). However, when using public and shared transport, women are more concerned about personal safety than men are (Weinreich et al., 2021). While for men, safety from aggression tends to be a secondary consideration, for women it is a key concern, and women would exclude MaaS from their travel options if the issue were not addressed (ibid.). When associated with bicycles, safety concerns for women include the risk of accidents as well as of aggression. This may prevent women from considering MaaS as a way of meeting their mobility needs (McDonald, 2020). Literature on shared mobility lists additional barriers to MaaS use by women. One of these is fear of contagion, which may discourage women more than it does men (Hensher, 2020). This fear is focused not only on the risk of direct infection (e.g. Covid-19), but also a perceived risk of contagion through traces left by a vehicle's previous users (Bardhi and Eckhardt, 2012). Another deterring factor is the concern that vehicles might not be available when needed (Firnkorner and Müller, 2012).

Switching between transport modes, for example from a shared car to another mode of transport such as a train service, can be perceived by women as being risky, particularly at night (Weinreich et al., 2021). Time of travel is also a challenge, as women may feel isolated and at greater risk when transport access points or modes of transport are empty or quiet. They may also feel at risk when transport modes are too crowded (ibid.), for example owing to a greater risk of harassment or potential for contagion, especially recently because of Covid-19 (Hensher, 2020). When car sharing, women may feel unsafe if travelling with strangers (Bizgan et al., 2020). For example, ride-share users may contact drivers via car-sharing websites, but these drivers are likely to be unknown to the users. Women users may be concerned about the driving skills and behaviour of these unfamiliar drivers, and the potential risk of experiencing direct threats from strangers (ibid.). Women also transport children and accompany people who need assistance to a disproportionately more frequent extent than do men, a fact which is not accommodated by the design of transport routes (ibid.), which often make travel more difficult for women. For example, the routes are poorly connected, requiring waiting time and walking on poorly lit pathways between stations, whilst the stations are poorly lit and staffed.

Different modes of transport are perceived as being more or less safe by women. For example, taxis are generally perceived as safer than ride sharing because of the presence of a licensed driver (ibid.). To generate trust in MaaS, trained human service staff play an important role, as they have the ability to reassure users (Giorgi et al., 2021). In turn, bicycles can be perceived as safe as women are able to just "pedal away" in case of unwanted attention from other road users (Weinreich et al., 2021), although there is a risk of accidents and of being hit by other vehicles (ibid.). In contrast, women perceive buses and trains (ibid.), and car and ride sharing as more

concerning, because using these transport modes could involve travelling in close proximity with people that they do not know (Bizgan et al., 2020). Similarly, on public transport services such as trains, women can feel at potential risk from other users and that they are "stuck" with whoever boards the train.

In addition, people who have never used MaaS have different attitudes towards it than those who have, who tend to have far fewer concerns about the use of MaaS than those who have not used it (ibid.). However, real incidents of concern do occur. When on public transport or using shared mobility, women are on the receiving end of harassment and aggression in far greater measure than men (Weinreich et al., 2021), for example on overcrowded buses (Duchène, 2011). In the UK, 37% of women reported having experienced specific incidents of harassment and aggression when using public transport (McDonald, 2020), and 15% of women reported they had been sexually harassed by men when using shared transport (Gekoski et al., 2017).

These issues shape the transport practices that women perform. Women utilise a range of strategies to deal with safety concerns, from avoiding areas perceived as risky (Duchène, 2011) and not staying out late to wearing shoes that they can run in and carrying their keys in between their fingers in their pockets as a potential weapon (Weinreich et al., 2021). Some women reported that they avoided carrying cash, cards or other valuables with them to avoid the risk of theft, as most purchases can now be made with a mobile phone (ibid.). Women may also ask their friends, partners or family members to track them via apps or may share their location with others, especially during the evening; other reported strategies included refraining from listening to music while travelling home and trying to sit close to other women or the driver on buses (ibid.).

CriadoPerez (2019) asserts that transport routes are often designed in a way that is less inclusive of women, who have differing needs from men because of their greater tendency to engage in multi-stop journeys, as mentioned earlier. MaaS may help to overcome those limitations, but women may be more drawn to private cars than to MaaS. Safety issues are relevant in all countries and locations, but with significant contextual differences; for example, far more cases of sexual harassment and violence are recorded on public transport services in India than in EU countries (Weinreich et al., 2021). Women are concerned by "space" – as defined by Giorgi et al.'s (2021: 267) – when they perceive that space is unsafe (Duchène, 2011). Such space might include isolated and deprived areas (ibid.), as well as those that lack policing or staff who could protect or help women in the event of danger, especially on public transport (Bizgan et al., 2020). Rural areas are difficult to service with MaaS offerings because they often offer fewer transport options than urban areas, which increases the risk of women feeling isolated there (Kubitz, 2020). In places with limited access to broadband

internet services, such as remote rural locations, every type of user’s relationship with MaaS is affected by this disadvantage; however, women tend to be more concerned about being stranded in isolated areas without internet or phone connection services (Giorgi et al., 2021). Mobility apps may fail to match real geography (ibid.); for example, a service shown as being available on an app may not actually be available, and certain roads might not be reported on electronic maps, which can make route planning harder (ibid.). Finally, in some contexts it is the “social” aspect of the sociotechnical landscape which excludes women. Examples include cultural barriers in some Arab countries, where women’s engaging in mobility practices by going to work or places of education may be frowned upon (Gekoski et al., 2017). In summary, because of the risks of using MaaS and public transport, women tend to prefer private car use as they consider private cars to be ‘cocoon’ (Pudāne et al., 2019: 17) that are safer and more comfortable than modes of shared mobility.

2.2 Responses from providers and policymakers

Giorgi et al. (2021) explain that it is necessary to build trust between service providers and users and to aid and support building trust between the users themselves. In respect to the importance of human contact, which was mentioned in section 2.1, trained staff should not only be present on transport vehicles but should also preferably have a standardised appearance (e.g., wearing a uniform); behave appropriately; and have sufficient communication skills to build rapport and minimise perceived safety risks for transport users (ibid.). Segregation from men is another potential solution that research participants suggested (Weinreich et al., 2021) in order to address the challenges that MaaS presents; i.e., availability of women-only services, with women drivers and women-only car clubs. Investment is also needed to address the quality of transport connections in response to women’s concerns (McDonald, 2020). The literature in aggregate suggests several measures that could be adopted to protect women when they use transport services, which are presented in Table 1.

Table 1 Proposed measures to protect and reassure women

Suggested measures	Authors
Designing infrastructure in such a way as to improve feelings of safety for users, with features such as better lighting.	Bizgan et al. (2020)
Installing CCTV and help points and ensuring the presence of security staff and live feeds for journey planning.	McDonald (2020)
Providing information about the specific location of lifts at stations.	Bizgan et al. (2020)
Providing route advice and route recommendations, such as alternative diversion routes during major incidents such as gas leaks or terrorist attacks, or routes with the best lighting.	Bizgan et al. (2020)
Providing a ‘panic button’ within an app that could alert authorities, specifically connecting to the British Transport Police and the Safe & The City app.	Bizgan et al. (2020), McDonald (2020)
Providing landmarks as well as road and street signs for walking routes to support people with visual impairments in navigating local areas.	Bizgan et al. (2020)
Using a system for rating and ranking of drivers or even providing the information and reviews of other users.	Weinreich et al. (2021), Bizgan et al. (2020b)
Sharing transport with the same person(s) to foster familiarity, which could be done by the users with support from specific matching apps.	Bizgan et al. (2020)
Placing trained personnel on trains and autonomous vehicles.	Weinreich et al. (2021)

MaaS apps should also convey information on the environmental performance of each travel option, because this is one aspect that might encourage women to use the MaaS app (Bizgan et al., 2020). The specific needs of women need to be addressed, so that they can both be and feel safer when they travel (Weinreich et al., 2021). Having considered potential ways of addressing this issue, Giorgi et al. (2021) state that it is not possible to find a one-size-fits-all solution. This is because of the range of different sociotechnical landscapes, which require the negotiated sharing of information between users and providers. Information management carried out via apps, whether this information is conveyed to or about women (e.g., their location), has the potential to reassure users. However, some have low trust in ICT systems in general and are reluctant to enrol in MaaS offerings (Catulli et al., 2021). Indeed, some women doubt the data security of these apps (Bizgan et al., 2020). Therefore, providers need to be transparent about their data usage and security practices, as well as ensuring their users' privacy and preventing the misappropriation and misuse of their data (Giorgi et al., 2021). Addressing the issue of transport equity challenges providers and policymakers to understand women users. To achieve this, Giorgi et al. (2021) suggest involving women users at the design stage. Finally, there is a need for significant investment in digital technologies and infrastructure for the design of service delivery sites (Ibid.). Sopjani (2021) suggests that including women in the design process is important to ensure that the service is suitable for women, and advocates UX (user experience) design (the process of defining a user experience when using a service; (Law et al., 2008). Indeed, engagement of MaaS providers with users that may be adversely affected by MaaS design choices is one of the key recommendations of the MaaS Code of Practice (Department for Transport, 2023). The next section presents the findings of the primary research conducted by the SMU at the University of Hertfordshire (UH) as a part of the present project.

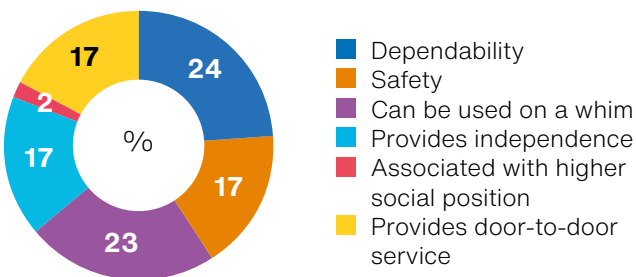
Section 3

Evidence from female users

3.1 Relationship with personal cars

The private car is still a dominant means of transport: participants choose it because it allows them to be independent, because they see it as dependable and safer than other methods of transport, and because it offers them a door-to-door service. Personal cars allow users to engage in spontaneous travel, as this statement illustrates *“there are no other people around you... (...). It takes less time to get to [your] point of destination, you don’t have to stand at the bus stop, or the tube stop and wait, and you know, you can just, jump into the car, and go where you need to.”* Most of the female user participants in the research associated private cars with safety and attributed a range of benefits to them; these are summarised in Figure 2.

Fig 2 Benefits participants associated with private cars



The benefits associated with the use of personal cars make them a tough competitor for MaaS offerings to beat, as illustrated by the following citation: *“the reason why I use my private car is for convenience because it’s quicker, because you don’t have to carry the bags, you just put everything you need in the car.”* Accompanying children is also problematic without a car, which limits users’ ability to travel on public transport: as one user put it, *“when you travel in the rush hour, sometimes you’d struggle with a number of children on the train because there will be queues next to the doors”*. Another user described their use of private cars for this purpose:

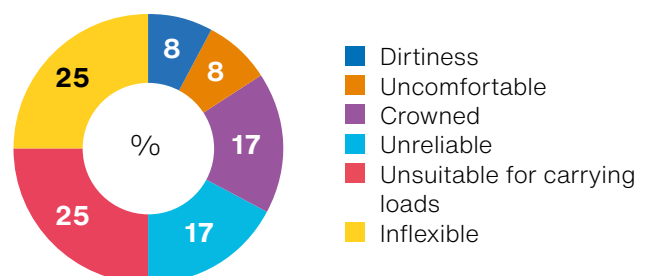
“I go, drop off the boys at school (...) and I collect them.” In addition, when users have elderly relatives they need to transport, they tend to prefer private cars as a mode of transport because they take the user door to door and often require less travel time than public transport journeys. Therefore, when journeys are urgent, such as going to medical appointments, users are more likely to use their private car.

3.2 Relationship with shared vehicles

MaaS elements include a range of vehicles, from public transport and shared cars to bicycles and scooters. Shared vehicles have different attributes to those of private cars, as summarised in Figure 3. They may seem poorly maintained, which could discourage people from using them. For example, one user said: *“I’ve seen (that they can) be quite rickety (...), even by the look of them.”*

Further, hygiene and cleanliness are key factors in users’ confidence in a vehicle. Another concern that users have is about security. To surmount this, cameras and other security hardware can be placed in vehicles and in the surrounding environment, for example inside and around trains and buses, train stations, bus stops and docking stations. The participants considered the security aspects of some vehicles, such as taxis, to be reassuring, because they can be locked and *“nobody can get in”*. Another safety feature which could be implemented within a shared vehicle is a free call service whereby users can push an alarm button for professional assistance.

Fig 3 Attributes associated with shared vehicles



The attributes listed in Figure 3 disadvantage using MaaS applications rather than private cars, especially when users must transport heavy items such as shopping and gym bags when travelling.

3.3 Relationship with mobility apps

Apps help users to map the landscape, including stops and direction of travel. Apps are virtual, but they are manufactured artefacts and therefore are “materials” that women can use as part of their mobility practices. Apps are useful for planning journeys and managing costs. For instance, a participant said, “*even Google Maps now flashes how much an Uber would be, not that I trust the price, (...) I’d always go and double-check, but in terms of usability.*”

Furthermore, one participant mentioned a help protocol, Angela (heresangela.com, n.d.), which is a personal alarm protocol which can be used when users feel unsafe, as illustrated by one participant: “*where if you’re out (...), you can just ask for Angela.*” This is an initiative which can reassure women when they are in public places whilst on the move. Users also find alarm devices and information available through their smartphone helpful, as help apps can reassure users, who derive from them feelings of control. Participants stated that the Uber app and taxi service generally has a good reputation. Apps were associated with safety by most respondents. For example, one user said: “*you know that the app will at least give you a route or a way to kind of (...) get home and as a woman that’s (...) comforting, it gives you a sense of freedom to go out as much and as long as you want (...) without [having to] worry about, oh God, (...) I have no idea how I’m going to get home.*” Participants also associate cameras with safety. Many respondents stated that they used apps to see which areas they would need to travel through on a journey, and whether these were dangerous areas. Table 2 summarises the expectations of participants of the functions MaaS apps should perform:

Table 2 What participants expect apps to deliver

App feature & information
Tracking ability (user can be tracked during travel)
Detailed information about the best route, best station, lighting conditions, etc.
Information on crowded services / the level of crowding
Providing location of a specific vehicle (Uber, bus)
Cost information
Ranking of service and or driver
Quality assurance/certification

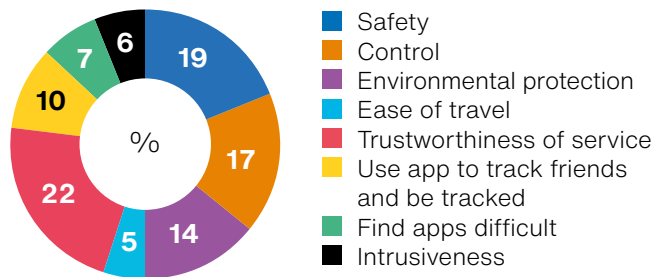
One participant said that the quality of information accessible through apps was good, although it was inconvenient to have to switch from Google Maps’ to the TfL and Uber websites to buy tickets separately. Another aspect of apps that gave participants a feeling of safety was their location-tracking features. For instance, one participant said: “*it gives me a real sense of security that I know I can just pull out my phone and get Google Maps up or TfL (Transport for London) to see when the next or the last bus or train (...) is going to take me home.*” Participants also reported that they had learnt to use apps to be tracked by friends and to track other people, as this citation illustrates: “*Danielle’s on my app, [...] she will follow me, and I’ll follow her. (...) she’ll say to me ‘well where are you?’ I’ll say, ‘just check on the app.’*”

However, the smartphone apps that MaaS requires users to download can sometimes overwhelm them and induce app fatigue, or what one participant referred to as “overapp”. MaaS apps also usually need to interface with bank details, and this can cause glitches, as the following quote illustrates: “*there was a situation where it would connect to the app, but for some reason my bank details wouldn’t go through and (...), I could (...) get on the train and potentially get fined for not having a ticket.*” In addition, as apps are downloaded onto smartphones and electronic devices which can run out of charge, some women reported that they experienced “battery charge anxiety”, with concerns about not being able to use their devices to access transport apps or to communicate with others if their devices run out of power.

Additionally, the cumulative work needed to learn the skills required to manage mobility apps can be challenging. As one participant reported, they often had to ask themselves: “*how many apps have I got? I got to download another app. So, you tend to kind of go back to the apps you’ve already got and then make it work rather than (download another app...).*” Participants also shared the information that they would worry about “*how big it [the app] will be and how much more new registration information (you need) to put in there (...) to make it work.*” It can be difficult to manage all the available (and possibly competing) apps, and the entry of additional personal information into various databases can be a deterrent to application use because of concerns about privacy and long-term commitment.

Apps and supporting smartphones and devices occasionally create an impression of intrusiveness amid these privacy concerns. One respondent told us: “*I do have a massive suspicion about (...) some of the smaller (MaaS) startups. (...). What are they using the data for? (...) I (...) quite often (...) turn them off completely (...) and make sure that they’re not (...) tracking me when I’m not using the app.*” Figure 4 offers a summary of the attributes participants associate with mobility apps.

Fig 4 Attributes associated with mobility apps



3.4 Perceptions of MaaS

To a certain degree, participants associated shared mobility managed via apps with environmental protection. In this respect, the perception of the concept of MaaS is positive. However, if the people engaging in shared forms of mobility are strangers, then lack of trust between users of shared mobility can be a constraint. Users may be wary of other people passing on their information. Similarly, a busy area such as London might come across as safe, as help is always at hand, but could also be perceived as being risky, as public transport can be crowded and crowds can also be a source of danger. Users explained that some transport services such as bicycle-sharing schemes are associated with getting “sweaty” and require them to carry equipment such as helmets – which can make it harder to switch between modes of transport. Users also claimed that MaaS service agreements requires *extra work* and cost to acquire the necessary status and privileges to take advantage of them. The use of specific types of materials, such as vehicles and smartphones, is associated with a user’s *social position*. For example, one participant explained that in her country, the use of buses is associated with *lower social groups* in society. Therefore, when using MaaS, some users would feel less inclined to book a bus than a shared car. Transport means such as car clubs and other shared transport offerings are often perceived as complicated, because they may require the user to acquire membership of the club or app. For example, as a participant said: “*I just think that car clubs are a lot of fuff in my head, I think there’s a load of admin that comes with it and a lot of associated cost.*” Complexity and the sequential booking of different modes is also a deterrent. For instance, one participant said: “*The only thing that would put me off is if it was too complicated, (...) a mishmash of train booking and scheduling club cars.*” Some participants said that they would be deterred by the need to plan their journey. Using apps, for example to book a bicycle, takes precious attention away from the user’s surroundings and can jeopardise their safety, in much the same way as reading a book or listening to music while travelling.

Some participants also said that they believed that booking through apps would commit them to travelling using that specific travel mode on that journey, and therefore they would prefer to pay in person rather than utilising an app. Other participants claimed that they would rather walk than use other transport means.

3.5 How being a woman affects safety perceptions of MaaS

The male interview participants said that they felt confident when travelling. However, the men were concerned about their female dependants and family members using MaaS. They felt that they should protect women if they saw any threatened by others and that they should keep their distance from women they are unfamiliar with while travelling, in order to avoid alarming them. A male participant, who was a father of two young women, said that he could see how women could feel threatened when walking alone near a male.

Female participants stated that complaining about harassment made them feel self-conscious, as it might attract attention to them. They reported that this made them feel vulnerable and unable to demand fair treatment. This situation can make women feel powerless and intimidated by men while travelling. The women stated that they were aware of and feared the risk of crime. Two participants spoke about how the combination of their gender and ethnic identity affected them. For example, an Asian woman felt threatened by other travellers, who were hostile towards her because they associated her ethnicity with the Covid-19 pandemic. Some participants simply stated that as women, they felt threatened by unfamiliar men, e.g.: “*where I felt uncomfortable, it has been a male to make me feel uncomfortable.*”

Certain types of clothing that a woman might wear, such as a business suit, dress, skirt or shoes with heels, may also affect her travel behaviours as, for example, some of these items may make the use of scooters and bicycles more difficult. Therefore, identity-specific items that women wear may deter them from using MaaS. The prams and car seats that women sometimes use to transport infants and children can also limit their freedom. Helmets can increase safety when using bicycles and scooters, but can also make travel harder for users, because they can be incompatible with smart clothing and must be carried and stored between uses.

Being in a transitional period in one’s life, such as changing job or other status, or having children, can also affect women’s behaviour. A trans woman who had transitioned to being a woman reported how she was: “*always a little worried occasionally walking around at night, but (...), now [that I have transitioned to a woman], it just takes someone who decides that I don’t look quite right to (cause) an issue, (...) and so I’m much more careful than I ever used to be.*” University students, who

are often going through a period of change, may be more likely to try novel offerings. One participant stated that: *“as a student you’re probably more carefree and you just want to save money.”* Therefore, students may be more likely to try innovative low-cost transport offers.

In comparison with men, women tend to be more engaged in multiple activities that involve visiting several locations, such as shopping, caring for children and looking after older relatives (McIlroy, 2023). Such activities might include visits to medical appointments. Combined with travel to work, gyms and engaging in other leisure activities, this can result in women making more multiple-stop journeys than men. Women also tend to transport more items during their journeys than men, – such as car seats, shopping bags, prams, among others – which can make switching vehicles through MaaS problematic. Women may also modify and vary activities that they get involved in during the day based on the availability of shared transport, i.e. whether other people are driving in the same direction and could share a vehicle with them. This availability may shape the user’s travel plan.

Some female participants also stated that they need to rely on their “street-smart” skills to be safe. This suggests that they see a gap in the safety measures of transport providers and local authorities. They said that they try to stay in bright or busy areas in order to make it difficult for would-be harassers to target them. They also deploy their own landscape knowledge, such as their knowledge of where the most isolated stations are. Female participants mentioned that they avoid travelling when it is dark, and therefore at night. Many participants also reported “ad hoc” self-defence practices, such as carrying bunches of keys in their hand and wedging keys between their knuckles so that these could be used as weapons if needed. Women may also choose to carry devices to protect them; as one participant said: *“they’ve got rape alarms, as in where they pull the thing out and it’s a really high-pitched sound.”* Furthermore, specialist apps can be helpful. For example, one participant stated that she had the “Find My Friends” app on her phone for tracking and safety purposes.

The social perception that women face more risks than men affects their travel behaviours. Some participants claimed that women are somewhat “socialised to be afraid,” to be concerned about safety and to see transport as a possible danger, and that this can be a defining feature of women’s identities, as this quotation illustrates: *“every woman I know has this, and it might just be ingrained in us from young ages, which I didn’t get, (...), but I’m getting it from my friends now.”* Media communications also contribute to diffusing these messages. Participants all cited the Sarah Everard case, where a woman was kidnapped, raped and murdered by a male police officer who accosted her while she was walking home from her friend’s house (Topping, 2022). One participant stated that most people who travel are fine and have no problems, but that the news *“only*

report[s] the bad things (...), 99.9% of people travelling are fine, you just hear about (...) the really bad things so that (...) stays on my mind.”

Women may consider any connections between modes of transport which involve their having to walk, or wait in an isolated location, to be unsafe; this is particularly so if it occurs at night or in secluded or poorly lit areas. Table 3 shows several factors that participants cited as sources of anxiety.

Table 3 Summary of safety concerns

Battery anxiety

Suitable attire needed

Too many people/wrong people/not enough people in the vicinity

Risks from criminal activity

Lack of ICT (e.g., cameras) and human (e.g., transport officers and police) vigilance

Having to rely on other people for lifts

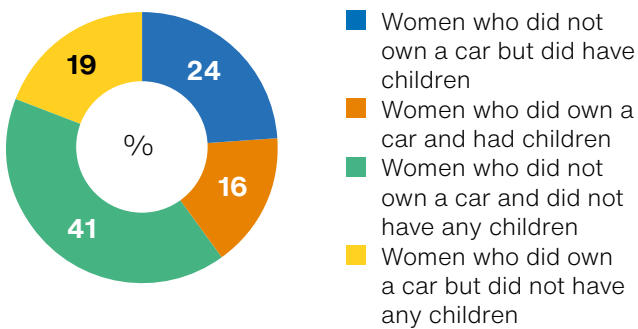
Privacy concerns connected to apps, i.e. the risk of being tracked

Hard work and planning are a necessity when using MaaS



Figure 5 shows the proportion of women participants who associated MaaS or other forms of shared mobility with negative interactions with men, according to whether or not they were car owners and/or had children. The figure indicates that women who were not car owners and had no children tended to associate MaaS and other forms of shared mobility with negative interactions with men to a greater extent (41%) than women who did own a car and did have children (16%).

Fig 5 Proportion of women who associated MaaS with negative interactions with men, according to whether they were car owners



These figures could be interpreted to mean that women who must use public transport and MaaS because they do not own a car associate mobility with the risk of harassment.

3.6 The role of geography and communities

Deserted, neglected areas are not reassuring. Participants associated darkness, night travel and empty, isolated locations with danger and lack of safety. Most participants perceived connections between modes of transport, such as switching from a train to a bicycle, as the least safe parts of their journey. Some respondents mentioned that apps can help to reassure them by providing them with knowledge of the available services nearby, the surrounding area and the identity or professional details of vehicle drivers, if applicable. On the other hand, apps can also be misleading or potentially detrimental at times, because although they may provide users with details of the shortest route, such routes are not always the safest option and may pass through a dark alley or a poorly lit park instead of a well-lit road. Therefore, local authorities and providers need to invest in infrastructure to improve safety in these locations, as well as the route options that are available to users.

Most participants said that they prefer travelling where there are other people. If multiple people are sharing services, and if they know each other and have a common purpose or destination, this can help to reassure users. People rely on other people for safety, as this citation illustrates: *“she [her friend] goes home after darkness, she usually calls her mom. And so, she’s on the call with her mom or at least sometimes she might pretend that (...) she is.”* However, having to share space with others who seem creepy, are abusive or appear to be intoxicated or in an unstable state of mind can compromise individuals’ safety and make them feel vulnerable on shared transport services. Indeed, all participants cited proximity to people affected by physical or mental ill health, drunkenness or the influence of drugs, and those who are fighting, as alarming situations. The ratio of female to male drivers is also important. Participants said that they would prefer to be in a vehicle driven by a woman, as this statement illustrates: *“I’d much prefer a woman driver to pick up my daughters than a man driver.”* Furthermore, if there were more female drivers on shared vehicles, then women could decide to share with other females on female-only services.

Participants stated that they felt reassured of the trustworthiness of a transport service if it was associated with a community they belonged to, particularly if that community had a shared purpose. For example, they preferred car sharing with friends or people they knew. Examples of such communities included the women’s workplaces, the NHS and schools. These communities are, of course, outside the control of MaaS providers; however, these may still benefit from efforts to aggregate users around communities. For example, the Brompton Racers club was formed by Brompton, a company that manufactures foldable bicycles and provides the same bicycles for rental. Communities may be protective of those of its members who are affected by special circumstances, such as wheelchair users, and may seek ways to assist them. Some participants referred to the concept of “do-it-yourself safety”, whereby friends and family look out for each other’s safety. Providers’ apps may support these efforts, because they can enable people to keep track of where their friends are. A participant stated that she preferred using shared mobility while on holiday to using it in her everyday life. Figure 6 summarises the safety precautions taken by female users.

Fig 6 Safety measures taken by female users



Table 4 presents a summary of potential improvement measures that could address some of the challenges that female users reported they had experienced when utilising shared transport services. Table 4 also highlights various literature sources that relate to some of these suggested improvements.

Table 4 Potential improvement measures suggested by female service users

Potential improvement measures	Examples	Literature sources that relate to the suggested improvements
Improved app functionality	Route advice, ability to track other users and be tracked	Bizgan et al. (2020)
Community anchoring	The MaaS offering can be connected to communities such as residential estates, workplaces, clubs and brand communities	Catulli et al. (2021)
Quality assurance measures	Third-party endorsement, regular monitoring, qualified staff	Catulli et al. (2021)
Personalisation of services	Name and photo of service staff visible, ranking on web pages and apps	Bizgan et al. (2020), Weinreich et al. (2021)
Female-targeted services	Female drivers and female-only sharing partners	
Various security devices	Lockable doors on taxis, security cameras, locking devices, panic buttons	Bizgan et al. (2020), McDonald (2020)
Traceability of vehicles	Visible brand and identification, available helplines	
Human contact instead of AI	Service personnel present during service delivery	

In summary, the female participants expressed several concerns related to using public transport, and these concerns also apply to MaaS and other models of shared mobility. However, women may consider mobility apps, and therefore MaaS, as empowering when compared with public transport because they can use them to access information through their smartphones. Nonetheless, when women have access to personal cars, they appear to prefer using these to make journeys because of their perceptions of the enhanced safety, convenience and reliability of such vehicles. The next section presents the findings of the workshops and interviews with representatives of the supply side of MaaS.

Section 4

Evidence from providers and local authorities

This section illustrates how a sample of providers and local and central authorities perceived the challenges faced by women when using MaaS as a complement to public transport, and the measures that they have considered implementing to address these challenges. The transport network and infrastructure should cater to travellers' needs, whether they commute or travel for other reasons. This section is structured as follows: It describes the governance of MaaS, and then its design principles. Next, it compares MaaS apps with human service personnel and discusses quality assurance. Lastly, corporate communications are discussed.

4.1 The governance of MaaS

The participants stated that local authorities (LAs) may demand that transport providers deliver social value (defined in section 1), which is consistent with the Social Value Act 2013. Specifications may be included in the bidding process to secure the supply of transport services that require this contractual aspect. Safety is an essential element of that value as it helps users to access jobs, education services and health services. Safety must be part of the social value delivered to all sections of society. Participants in the workshops stated that some services are withdrawn by authorities because of damage to and theft of materials in deprived areas, so these areas receive less and less investment as a result. As one provider said: *"we have incidences of vandalism (...) where the situation has become so acute (...) that the easiest way to stop the vandalism is just to take the bus stop away."* However, withdrawing services from a deprived area creates distributive injustice because as a result, authorities do not deliver necessary services to people who are poor and disadvantaged, who are therefore discriminated against and further disadvantaged.

Providers and local authorities seek to identify unsafe areas. They may use measures such as installing CCTV and panic buttons in those areas, as well as responding to user concerns by simply selecting locations for service provision that are lit and not isolated. If LAs have no comprehensive data, then it becomes difficult for providers to determine which areas are safe. Indeed,

assessing potential spaces is expensive and resource intensive. One provider said that ideally, to guarantee the safety of every location, it would be necessary to get a team of, (...) about 40 inspectors driving all over the UK inspecting these things. And that's not going to be cheap. So private investment (is needed) from a government perspective" to ensure this can be done. Furthermore, in some instances:

when inspections do take place, there is evidence that local authorities and providers find it hard to keep up with technical advances, 85% of the sites we've surveyed so far do not have sufficient lighting, 77% are not covered by a security camera. We've got headline statistics for the bandwidth, for accessibility and it's not great, but (...) the industry has been accelerated so much that they've not been able to pause and reflect on the actual use case for the charge sites, and the people who are going to be using them.

Consumers' expectations shape the provision of services. For example, users want freedom to pick up and leave vehicles in disparate areas; this is known as the "free-floating" model of vehicle sharing (used by companies such as UbeeQo). This model can be problematic but at the same time it offers a flexible solution that suits the desires of most users. Governance requires accountability. Providers who participated in the workshops said that they saw safety and protection as the responsibility of local authorities, while the latter said that the responsibility lies with providers, so there is a tension between the expectations of policymakers and providers, as neither seem to want to invest or to take responsibility.

Route planning is a key aspect of a transport service. In an ideal world, transport planners would try to plan journeys so that they pass through well-lit areas and avoid dark and isolated areas, which may limit services for some users. Black spots are the result of policy and underinvestment, as this quote illustrates: *"some authorities have withdrawn school bus services because of issue(s) over vandalism or unsocial behaviour, so yeah, authorities in my experience do change the policy because of the issues."* Consequently, deprived areas may remain underdeveloped, as this quote illustrates:

“For dedicated bays then, all of a sudden, you’re trying to lean on the places that (...) are better lit or do have CCTV, which almost gives you that vicious circle” of creating blackspots. In those blackspots, the participant reported, it is hard to *“overcome the gaps in the network, but it’s hard for the network to fill that because of the other gaps”*. Both providers and local authorities seem reluctant to invest in and add value to facilities such as docking stations and stops and the areas where they are situated. On the positive side, the installation of facilities such as CCTV in at least some locations shows that there is a will to provide safety and security in places that are used by the general public.

Parking spaces are assets that landowners and local authorities are not always willing to allocate to the charging of cars and electric bicycles, as these actors use parking spaces as an income generator by charging drivers for their use. Decisions to allocate spaces to electric charging stations instead of to parking might need to be supported by a business case whereby the charging stations produce a comparable income, e.g. from charging providers for use of space to cover those costs.

MaaS requires multiple travel options to be in place for it to function. Participants explained that MaaS apps can offer little help if some of the means of transport the user can select from are not available and if the supporting infrastructure is insufficient. Internet coverage is uneven in diverse contexts and the availability of transport options depends on the types of stations the user travels through – e.g., rural areas are certainly more deprived than urban areas because they offer fewer options for mobility, so there is a stark difference between rural, peri-urban and rural areas. Indeed, there is a nearly fatalistic attitude among policymakers on rural vs urban transport: *“in a very rural area (...) If you’re getting a bus in the middle of nowhere you probably assume that even if you phoned the police, they’re not going to do anything about it, whereas if you alerted TfL (Transport for London) (...), the next stop they’re going to be there with handcuffs aren’t they?”*

Financial criteria are dominant in shaping decisions. There must be a business case for investments in safety, and funding from central government is a determinant. Safety appears to be a secondary concern until something happens – e.g., a newsworthy incident – or until the authorities receive complaints, which bring safety issues to the fore. Such incidents prompt providers and local authorities to identify where *“the safest locations are and where they’re trying to develop transport routes along those safe routes”*; therefore, the investment strategy *“tends to be very reactive”*.

Local communities, and equal numbers of female and male users, should be involved in the governance and design of transport service provision. For example, this could take the form of users being able to provide service ratings and assist providers by contributing to the design process of services.

The social value delivered to users depends on the amount of capital that the community is willing to invest in developing an area of service and shared ticketing systems. The value represented by the vehicles and other equipment needs to be protected, whether it is corporate or community value.

In summary, an important theme emerging from this analysis is the attribution of responsibility. Providers tend to pin the responsibility for the safety of the service locations onto local authorities. However, the latter maintain that the responsibility lies with the provider because it is a condition of their contract, and this complicates the issue. Users should have a voice in governance, although this seldom occurs. Data and information on “good” locations also needs to be shared for provision to be inclusive and effective – which is a view that not all stakeholders may agree with.

4.2 Design processes and materials

Consumer research by providers needs to focus on the distinctive needs of women as well as those of men. Providers and local authorities need to understand women users’ practices and concerns, and like those users, providers’ human operators may need to acquire specific competences to negotiate transport services, in their case to perform the supply of mobility and to inform service design. This learning process needs to focus on women users’ needs; these may include, e.g. multiple stops, complicated journeys and trips made to accompany dependants and carry items. Women users as a market need to be segmented around the type of journeys that they make, their reasons for travelling and what proportion of their travel is done for commuting purposes and what proportion is social. This information is accessible through government statistics, e.g. from the Department for Transport (DfT) (Department for Transport, 2019).

In one participant’s words, research could even focus on what models of cars or scooters appeal to women or men. A scooter with *“wider footboards (...) might appeal more to women or some models have a hook on the stem that can (be) where you can hang a tote bag (...), relatively small design features like that can have a big impact”*. Women travellers could be profiled by their interests; for example, some users may be more interested than others in green issues.

Further information is also needed about the ICT skills and usage of female users, such as how proficient they are at using mobility apps, and the type of information that they would like to access through those apps. It is also important that the apps that enable MaaS are designed to be equally attractive, equally inclusive and equally accessible for both women and men (McIlroy, 2023).

Some of these insights could be generated by the existing data sets that are shared by transport companies. One participant suggested that providers could enlist the services of design companies managed by women. Community input can also help. In one participant's words, *"if we're partnering with a council, the council could help us in getting some (...) community female volunteers, as it were, and do the same process. They start looking at (...) the product features that we're working on and give us some kind of constructive feedback around how we can shape that product."* Another participant described this as UX design, (defined in section 2.2). Service design involves co-designing physical infrastructure, e.g., avoiding locating stops and vehicles in deserted areas with poor lighting. The difficulty is that this requires collaboration, and the infrastructure may belong to a local authority rather than a train or bus company.

The quality of information delivered through the apps is important, and it must report the physical landscape correctly, which does not always happen. The failure is often the result of a lack of infrastructure. For example, there may not be any services that sufficiently accommodate the needs of women within an area, or the mobility app may show that these facilities are present, although actually no physical facility is there. To resolve this problem, data on the infrastructure and surrounding area that meets required standards of quality and timeliness must be available. As this comment illustrates, *"another angle which we can look at MaaS and safety from is (...) data collection, (...) because (users) will need to know when their accidents and incidents happened, or (...) if there (are) certain areas where we (think users) would feel particularly unsafe"*.

Therefore, an accurate match between the information available on MaaS apps and the infrastructure in place is an important factor. Essential tasks that should be undertaken to ensure this include data collection, storage and sharing. A participant explained that good design should be conducted *"involving (...) women and (...) many different types of users in the design process. It is very key and it's not all about safety."* In summary, the design process must be inclusive of communities, women and diverse ethnic groups, as recommended by Sopjani (2021), reported in section 2.2.

4.3 Mobility apps vs human service personnel

One important question is whether MaaS apps can replace human service staff. Participants listed cameras and other monitoring equipment as improving safety and say that they could play the role of a deterrent for unwanted behaviours and safety breaches but there are issues with privacy and legality. Participants mentioned the usefulness of online information, some of which can be crowdsourced in the form of user reviews on the safety and efficiency of services. The crowdsourcing

nature of some of the feedback that users can contribute to MaaS apps, where they can make comments on the safety and effectiveness of the offering, can create a sense of community through these digital platforms.

The literature says that users value the role of human contact. The availability and visibility of service staff is more reassuring than any artificial intelligence (AI) application and hardware. Users tend to appreciate the support and reassurance given by service staff. Providers even acknowledge that having more service staff, including women drivers, would provide reassurance. Providers should aim to move away from a "macho" and homogeneous image of service staff such as drivers, as illustrated by this participant: *"we're so short of drivers, we need to encourage [people to join] the drivers' pool from a wider cross-section of society."* Indeed, one of the proposed solutions to women's inclusivity issues is to have a larger proportion of women involved in transport-related jobs (e.g., drivers). This is a point that emerges both from the relevant literature and the user interviews. However, as one provider put it, *"the hours aren't particularly family friendly. Bus drivers (...) have shift patterns and these (are) not necessarily conducive to childcare hours, school hours and so on."* Therefore, shift patterns and unfavourable working hours in transport-related roles could potentially deter those with caring responsibilities from applying for these positions. Women are under-represented in certain transport-related roles, and although efforts to recruit female workers in the transport sector are improving, employment within that sector still tends to be male-dominated and issues such as recruitment bias and the gender pay gap persist (Woodcock and Roseanu, 2023).

The problem with allocating staff to services is that it is resource intensive. For transport companies, the trend has been to remove conductors and similar personnel from vehicles. Indeed, examples of automated transport are increasing in popularity, such as Tesla's fully autonomous vehicles (Karamitzios, 2013). Since services are structured as a network, the materials involved belong to different actors, and therefore it might be difficult to attribute responsibility for operations. Vehicles host alarms, cameras and other surveillance equipment that are connected to a "depo" or control room, which enables providers to say to users that human "inspectors" monitor the service. The message that the provider wants to convey is that someone is looking "after" the user. Nonetheless, cameras and monitoring equipment are important design features; these hardware and software facilities reassure users and can protect both people and revenue by deterring thefts and damage to vehicles. Access to multiple options for travel is necessary, and the design of a service is also important; an example of this is the difference between round hire services, where vehicles need to be returned to where they were picked up, and free-floating services, where they can be left in other locations, an option which restricts providers' control over where vehicles will be.

One of the participants suggested that MaaS apps should give information on such details as whether there is a drop kerb or a bench nearby, or even whether there is a customer toilet on a public vehicle. A limitation is the incompatibility of data systems, which calls for a shared Application Programming Interface (API), a software interface which offers a service to other pieces of software to create a connection between computers or between computer programs (Reddy, 2011). Here the bus company is challenged by its users to combine their own DRT provision with micro-mobility offerings.

4.4 Quality assurance processes

Networking with other organisations is essential for quality assurance (QA). Whoever “owns” the customer, which means to have exclusive access to the data with enables the management of the customer interface and make the promise of travel, needs to ensure that the journey is delivered, by building redundancy into the system in the form of multiple alternative means of travel that are available for use. If one of the modes of transport within a MaaS system fails – e.g., a cycling company – then it is important that the MaaS provider can transfer the work of that company and its unfulfilled journeys to an alternative service, and possibly subsidise the cost. However, operators may not be prepared to collaborate. Bus companies commonly refuse to transport e-scooters on bus services. There is also little trust between providers, and they are reluctant to share customer data. However, providers might have to rely on each other to complement any mode that fails.

From the governance and QA point of view, ownership of the customer and the responsibility for that customer lies with the network providers. However, within a MaaS system, who is responsible for the user’s safety? And where and at what point within a journey are different network providers responsible for their customers? As one delegate reported: *“as somebody (who) works in the office, I neither know nor care who gets on the bus. And I don’t know how they got there. And I don’t care what they’re doing when they get off the bus. (...) It’s nothing to do with us. Once they’re gone, they’re gone.”* So, after a user has left the bus, if an incident happens while they are on another means of transport, the bus company that was interviewed would not feel that they were liable for that incident or responsible for the user at that point within their journey.

QA is costly because of the level of monitoring required, as explained in section 4.1. It can be supported by certification schemes (from independent bodies) and by driving and operating licences (corporate and individual). These should be advertised to users because they ensure that quality standards are achieved, which can reassure people (both male and female users). QA is also linked to information, quality data and equipment. So, although certification is mainly about QA, it is the information infrastructure that makes QA possible.

Rating services on websites and apps are a type of “informal” assessment of providers by users, which can act as an effective means of QA. Ratings and feedback provided by users are informal but have the advantage of leaving a record, as there is a “paper trail” online. This is not an “expert” form of QA issued by providers; however, it is an impartial and articulate testimonial by experienced consumers of mobility services and captures feedback from service users which can be utilised to make necessary improvements, and therefore it can successfully contribute to the design process and the continuing enhancement of both providers and their services. QA also takes the form of contractual relationships between authorities, and companies bidding for contracts for transport provision must implement certain practices to guarantee safety. Regular maintenance and cleaning are also important, in order to reduce potential health risks, for example (Hensher, 2020).

Companies may train people, as the participating bus company does, to use safety protocols introduced by government schemes. One example of this is “Ask for Angela” (heresangela.com), a protocol established as a collaboration between the Metropolitan Police, the Mayor of London and Safer Business Network (<https://www.saferbusiness.org.uk/>), a community interest company which aims to improve the security of urban and transport spaces. Ask for Angela is a means by which transport operatives can help and support women who feel vulnerable or unsafe. Training includes advice on how staff should react to risky situations, e.g. aggression. Safety training should be aimed at users as well as service personnel, and this could be done using demonstration areas and hubs.

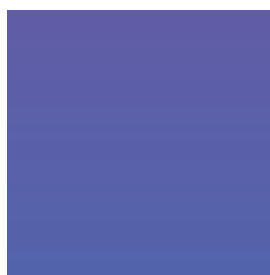
4.5 Corporate communications

Infrastructure improvements are needed to encourage women to use MaaS, as well as reassurance; both of these could be achieved through corporate communications. This needs to be supported with information about facilities such as cameras, lighting and other measures that are implemented to protect users’ safety. Most of this communication could be routed through apps. Apps (e.g. Google Maps) could also be used to communicate the green ratings and certifications of MaaS offerings. Planners should avoid labelling people to avoid offending and typecasting groups. As one participant said, *“if you’re looking at a marketing strategy to reassure women that it’s safer, please do not say this is safer for women because you actually end up upsetting a lot of men. And also, women.”* Two-way communication is needed to support governance, so that users have an opportunity to voice their requirements and influence the design and implementation of services. The implication here is that there should be a link between communications and performance. Table 5 summarises potential solutions that could address some of the challenges faced by women users of shared transport services.

Table 5 Potential solutions to address the challenges experienced by women users of shared transport services

Type of Solution	Solution
Governance	Resolving contentions over who is responsible for safety
Hardware/Software	CCTV cameras and recording devices employed on vehicles
Informatics	Empowering users to share reviews and ratings of services and providers
Human resources	Employing more women as drivers and service personnel
Design processes	Ensuring there is participation and representation from a diverse set of service users, including women, in the design process

The following section concludes this White Paper and outlines recommendations on how to improve the provision of shared mobility offerings such as MaaS for women users.



Section 5

Conclusions and recommendations

The implementation of sustainable and resource-efficient sustainability offerings is desirable, but the issues arising from their implementation, including the inclusivity of service provision for women and others within diverse societies, should be considered and researched. There is evidence that women can face risks when using shared mobility and public transport and that their feelings and perceptions of both types of transport provision, including MaaS offerings, can be influenced by these potential risks. While providers invest resources in the quality and implementation of new transport means and apps, legacy issues remain, such as facilities being located in isolated areas, poor service reliability and connectivity and the condition of the old, neglected stations that are often found in deprived areas. These issues are not conducive to reassurance. The findings prompt the following recommendations:

- i Consultation between local authorities, central government, providers and local communities needs to be initiated to determine the type of value that users require from transport provision and the safety features that are necessary. Police forces should also be encouraged to participate in these consultations.
- ii Policy needs to facilitate the formation and development of industrial networks, involving large incumbent actors such as train companies. These networks should be characterised by positive relationship atmospheres and trust building and should be supported by the creation and nurturing of actor bonds, e.g. relationships between human participants based on trust and providers' shared activities, such as the collaborative management of data and joint investment in technologies like smartphone apps.
- iii The design processes that lead to the implementation of mobility offerings need to involve participation and representation from women, people of diverse backgrounds and disadvantaged groups. Investments should also be made by employers to improve the attractiveness of transport employment roles for women, and to encourage more women to apply for and to be hired in positions in the transport sector.
- iv MaaS and other mobility apps should be designed with the specific needs of women in mind, as well as the needs of other service users; for example, they should include safety information and should be able to suggest safe routes for users, depending on their needs.
- v Investments in infrastructure should be planned to reduce the likelihood that users need to use bus stops, train stations and shared vehicle docking spaces that are situated in deserted areas. Since MaaS involves the use of multiple means of transport, a collaborative approach is necessary to ensure that the transitions between different vehicles and modes are protected and are performed in safe areas.
- vi Investments in communications should also be made to reassure users regarding the level of safety on transport services by providing detailed and truthful information about the safety measures that are being implemented.

Section 6

Notes on methods

This report is supported by qualitative data as a means of addressing the need to generate rich information on women’s transport practices and their perceptions and experiences of using shared mobility services such as MaaS. This report has also gathered the responses of providers and policymakers to explore potential solutions to some of the issues that can be experienced by women when utilising shared transport services such as MaaS. The methods used to complete this research included:

- 1 Thirty-two interviews with female users, one with a transgender female and two interviews with two men. The male participants were interviewed so that their opinions could be compared with those of female interviewees. These participants lived in Hertfordshire and were from diverse backgrounds. Table 6 shows the demographic characteristics of the interview participants:

Table 6 The demographic characteristics of the interview participants

Age	Car owner	Children	Ethnicity	Profession	Sex
30–39	Yes	No	White UK	Lawyer	Female
20–29	No	No	White EU	Student	Female
20–29	Yes	No	Black Afro-Caribbean	Medical	Female
20–29	Yes	No	White UK	Other	Female
30–39	Yes	No	Indian UK	Other	Female
30–39	No	No	White UK	Lawyer	Female
20–29	Yes	Yes	Black Afro-Caribbean	Nurse	Female
30–39	No	No	White UK	Other	Female
20–29	No	No	White UK	Other	Female
20–29	No	No	White UK	Counselling	Female
40–49	Yes	Yes	White UK	Tradesman	Male
40–49	No	Yes	White UK	Other	Female
20–29	No	No	Asian UK	Other	Female
50–59	Yes	Yes	White UK	Medical	Female
20–29	No	No	Asian UK	Other	Female
30–39	No	Yes	Black Afro-Caribbean	Student	Female
40–49	No	Yes	White UK	Academic	Transgender F
20–29	No	No	Asian UK	Other	Female
30–39	No	No	Asian UK	Other	Female
20–29	Yes	No	White UK	Student	Female

20–29	Yes	No	Black Afro-Caribbean	Medical	Female
40–49	No	No	Asian UK	Other	Female
20–29	Yes	No	Indian UK	Researcher	Female
Over 60	No	Yes	Asian UK	Retired	Female
20–29	Yes	Yes	White EU	Stay-at-home mum	Female
30–39	No	Yes	French	Consultant	Female
40–49	Yes	No	Indian UK	Academic	Female
20–29	No	No	Asian UK	Unassigned	Female
30–39	No	No	White EU	Other	Female
30–39	No	No	Black Afro-Caribbean	Other	Female
30–39	Yes	No	Indian UK	Other	Female
20–29	No	No	White UK	Psychologist	Female
20–29	Yes	No	White UK	IT	Male
20–29	No	No	Asian UK	IT	Female

- 2 Four workshops with staff members from local authorities and several transport providers. Table 7 shows the segmentation of the sample:

Table 7 The segmentation of the workshop participants

Type of participant	Number of delegates
Car-sharing company	2
Bus-service company	5
MaaS-app provider	1
Local authority in Hertfordshire	3
University	3
Regional Economic Development Authority	2

The interview and workshop participants were selected through a convenience-sampling strategy complemented by snowball sampling. The interviews and workshops were conducted online via MS Teams, for reasons including the safety practices informed by regulations relating to the Covid-19 pandemic and cost management. Both methods were piloted to finalise the interview guides and to ensure that the online environment was conducive to the collection of good-quality qualitative data. The interviews and workshops were recorded and subsequently transcribed. The transcriptions were coded using NVivo. The video recordings were also replayed multiple times to capture the emotional tone of the participants. The robustness and trustworthiness of the research is assured by a “paper trail” made up of the video recordings and transcripts of the interviews and workshops and the subsequent analysis in NVivo. This paper trail enables and ensures the replicability of the research. It is suggested that future research could be done in which these findings are compared and confirmed, with the use of large-scale surveys on appropriate samples of users, providers and other stakeholders.

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