DIGNITY

Digital transport in and for society

D4.4
Building a gender-neutral transportation system: Recommendations and checklist

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Executive summary

DIGNITY has included among the vulnerable-to-exclusion population «women» as an homogeneous group.

Main reason studied for possible exclusion from mobility have been the digital skills of the users.

This specific Task aimed at demonstrating that it is not possible to consider women as a single group without considering the internal socioeconomic differences, such as age, education level, income, to properly assess their potential exclusion from mobility.

An intersectional approach has been taken to demonstrate that digital skills are not the main reason for women's exclusion from digital mobility systems. Other already well-known gender-related barriers continue to exist also in a digital transport system which is not yet responsive to the specific needs of vulnerable groups such as women and the elderly.

Previous studies have identified the 4 main requirements for a transport system that can be recognised as inclusive: it should be affordable, accessible, available and safe. Following this definition, 4 main barriers to the adoption of digital mobility services have been identified:

 Availability: limitations due to lack of internet- and smartphone access

 Ability: limitations due to digital skills and confidence (accessibility)

 Affordability: limitations due to costs

 Appetite: limitations due to safety.

It is to be noted that availability and ability are linked (in our analysis) to individual digital skills and opportunities, whereas affordability and appetite are more related to the kind of mobility services offered.

The analysis carried out on the data available for Italy showed that the elderly, low income and low educated people are confronted with all 4 barriers. Women (with different demographic and social characteristics) on the other hand face mainly the barriers due to the transport system.

Elderly have proven to be the group whose needs are not met by both their digital skills and the mobility systems. Elderly women result then to be the most vulnerable-to-exclusion group. Specific attention to their needs should be given in planning the transport system, but also in designing new digital mobility services.

Women's representation in this technical field, both in decision-making positions, as transport operators and as mobility solutions providers, must be emphasised in order to adequately

incorporate their specific needs and develop innovative, inclusive (digital) mobility policies, services, and products.

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Contents

List of Figures

List of tables

1. Introduction

1.1 Project summary

The overarching goal of DIGNITY is to foster a sustainable, integrated, and user-friendly digital travel eco-system that improves accessibility and social inclusion, along with the travel experience and daily life of all citizens. The project delves into the digital transport eco-system to grasp the full range of factors that might lead to disparities in the uptake of digitalised mobility solutions by different user groups in Europe. Analysing the digital transition from both a user and a provider's perspective, DIGNITY looks at the challenges brought about by digitalisation. This will inform the design, testing and validation of the DIGNITY approach, a novel concept that seeks to become the 'ABCs for a digital inclusive travel system'. The approach combines proven inclusive design methodologies with the principles of foresight analysis to examine how a structured involvement of all actors - local institutions, market players, interest groups and end-users - can help to bridge the digital gap by co-creating more inclusive mobility solutions and by formulating user-centred policy frameworks.

The idea is to support public and private mobility providers in conceiving mainstream digital products or services that are accessible to and usable by as many people as possible, regardless of their income, location, social or health situation or age; and to help policy-makers formulate long-term strategies that promote innovation in transport while responding to global social, demographic and economic changes, including the challenges of poverty and migration.

By focusing on and involving end-users throughout the process of designing policies, products, or services, it is possible to reduce social exclusion while boosting new business models and social innovation. The result that DIGNITY is aimed at is an innovative decision support tool that can help local and regional decision-makers to formulate digitally inclusive policies and strategies, and digital providers to design more inclusive products and services.

1.2 Objectives of Deliverable 4.4

Deliverable 4.4 summarises the results of task 4.4 which specifically **focuses on the evaluation of gender differences in the adoption of digital mobility solutions, and the identification of solutions / strategies to reduce this gender gap.**

The results of this task will constitute the input material for the implementation of:

- Tasks 4.5, aimed at drafting conclusions and policy recommendations based on project results for its wide replication (deliverable 4.5 - Report/booklet with recommendations)

- Task 4.6, aimed at developing a user-friendly mean supporting public authorities, transport operators and private providers in considering needs and requirements of different segments of the population in their decision-making processes (deliverable 4.6 - Open-access DIGNITY toolkit (website with tools for co-design and education).

1.3 Outline of the deliverable

The report is structured in three main parts:

The first one (chapters 2 and 3) gives an overview of the gender issue in transport and IT, explaining the reasons for including women as a vulnerable-to-exclusion group in the project.

The second part (chapters 4 and 5) illustrate the quantitative and the qualitative analyses carried out using data from previous work performed in other project work packages. The analyses were aimed at confirming the hypothesis that women's vulnerability is not dependent from digitalisation 'per se' but is linked to other demographic and socio-economic variables.

The last part (chapters 6, 7 and 8) draws conclusions from the work performed and gives recommendations for future activities in the domain.

2. Background to the study

2.1 The gender gap in mobility

The concept that mobility is not gender neutral has been well known since the late 1970s when researchers started assessing the different travel patterns between men and women.

Several researches have already been conducted on mobility inequality between men and women. Recent studies have shown a complex interplay between gender, socioeconomic factors and localisation in defining mobility patterns (Mechakra-Tahiri, Hadded, Samson & Zunzunegui). Still more research is needed to understand the full scale of the multiple variables that influence gender inequality that should be addressed to achieve inclusivity.

Traditionally the 'productive work' (paid work) and 'reproductive work'(work for which they are not paid, such as taking care of the children) were physically separated. These different social roles created different mobility patterns for women and men. The tasks of running a household create a mobility pattern of frequently short multi-trips. On the other hand, the standard pattern of working men is usually a straight line from work to home. Such differences became even more evident when the role of women in society changed and women as well started contributing to "productive" activities. The new productive role though did not replace the usual caregiver's tasks, thus making women's travel patterns even more complex and demanding.

However, the gap between women's and men's mobility patterns is becoming smaller following the changing role of women in (western) society. It is becoming more common to share household tasks between the two genders (Susilo, Liu, Börjesson, 2018).

Despite their evolving social role, women are still experiencing barriers to their mobility. The major concern for women is security during their journeys (ITF 2018). Public transport and stations do not always respond to the need to prevent aggression or harassment. Bus stops and timetables often do not correspond to women's needs as they may be wrongly located or too seldom to avoid long waiting times in unpleasant situations. Proper considerations of this concern suggest that security and accessibility should be a priority for transport designers.

Another important barrier to mobility for women is affordability. In many cases the only family car remains available for the man in the family, making public transport the first mobility choice for women. When the standard transport lines do not meet displacement requirements, it is unavoidable to use other forms of transport, such as taxis; they are often too expensive, and the alternative is usually very time and energy consuming. New technology solutions, such as shared driving options, or 'transport on-demand" could help removing these barriers.

Digital technology has been making its entry into the transport sector rapidly and tries to make travel more sustainable, efficient, comfortable, affordable and inclusive. There is still little knowledge of the potential inequality or exclusion that the digitalisation of mobility services could generate.

ICT allows to plan a trip through a smartphone, offer services such as bike, car sharing platforms and MaaS; however, the implementation of digital mobility solutions is not gender neutral. If these services can in most cases benefit men, women's needs are not explicitly and fully considered, so that the final product does not always respond to their specific requirements. A proper impact assessment in the design phase should be done to ensure that they have no negative impact on women or other vulnerable groups.

2.2 Major issues limiting mobility

Previous research mentioned in bibliography has shown that gender-related limitation on mobility lie mainly on four elements: accessibility, availability, affordability, and safety/security. The analysis carried out in this task relates these elements to other socio-demographic characteristics of the users, such as age, income, education, and urbanisation.

2.2.1 Accessibility

Men and women have different travel patterns. This is due to the different traditional task sharing: women used to have the task of caregiver and men the task of provider for the household. This has created a gap in the work participation between men and women that, although smaller than a couple of decades ago, is still reasonably large. The differences between the four countries/ regions included in the DIGNITY project are as follows for on the national level.

Country	% Of women working	% Of men working	% Gap
Netherlands	62.4%	71.3%	8.9
Spain	52.7%	62.4%	9.7
Belgium	49.8%	58.8%	9.0
Italy	39.9%	57.7%	17.7

Table 1 Working participation in the various DIGNITY countries (International Labour Organisation,2022)

Because of this difference in working participation women tend to have more non-work related activities, travel more in off-peak hours and choose flexible modes of transportation. The complexity of trips between men and women is measured by two variables: the entropy of patterns and the number of trips per hour as a measure of trip chaining (Scheiner & Holz-Rau, 2015). Most of (western) city transport systems have been designed by men for men whose main task during the week was commuting between home and work. This created poor trip chaining

opportunities contrary to what women's mobility pattern would require. The disconnection between different transport means often makes accessibility to seamless mobility difficult.

2.2.2   Reliability

It is claimed that the reliability of public transport is the most important quality attribute of public transport for users. Much research has been conducted on the effect of reliability (among others Monchambert & De Palma, 2014). If the punctuality of public transportation is unreliable, it plays a role in the modal shift of commuters as they may incur extra costs due to waiting time, arriving late or missing the bus (Mohring, 1972).

As mentioned before, female travel patterns consist of more trip chaining versus male linear travel patterns (Wei-Shiuen & Acker, 2018). Women also make more use of public transport and this means that it is important that the reliability of these services is high. People will look for the easiest option in which they can do as many activities with the least amount of travel. If public transportation is unreliable, people will look for different options (Hensher & Reyes, 2000). A proper application of mobility ICT could provide more services promoting customer-friendly intermodal mobility. Access to new forms of mobility, such as rideshare services, can help increasing the ability to be mobile by integrating access to transportation, services and personal needs (Marolda, 2019).

2.2.3   Affordability

One of the main excluding factors of the use of mobility (and related digital services) is the cost of travel with public transport. If mobility becomes too expensive it can cause transportation poverty, exposing people with little to no income to exclusion from mobility. On a daily basis, public transport brings people to their daily activities such as work or leisure. For people with a low income or who live on welfare this can become a problem when it is combined with poor transit accessibility, poor health or inability to afford a car (Allen & Farber, 2018). A household that devotes more than 10% of its expenditures on how the household members move from point A to point B can be considered "transport poor". Among other causes for this spending are high mobility needs requiring to rely on transport availability, accessibility and cost.

Women are a vulnerable group just as low-income individuals, disabled people and the elderly when it comes to transport poverty. As presented in Table 1, the work participation of females in the countries participating in the DIGNITY project is lower than the male working participation, varying from 8.9 to a 17.7% gap (ILO, 2022). Women in the European Union earn on average 16% less per hour than their male counterparts, and 32.6% of women in the EU work part-time compared to only 9.5% of men (Commission, 2013).

2.2.4   Safety/Security

Safety is probably the discriminant factor for women to make use of a service, no matter how accessible, affordable and reliable it is. Transport safety and security are key factors in women's mobility habits and choices (ITF, Women's Safety and security A public transport Priority, 2018).

The perception of safety, which is also a determining factor for using a specific service, may differ across women and in different cultural environments.

Several surveys carried out in the past show that sexual harassment in public transport is massive and is a growing phenomenon. 90% of the women who participated in the surveys had experienced sexual harassment in public transport. Sexual harassment has a big impact on women's daily and professional lives. 80% of women that experienced sexual harassment changed their travel behaviour. 48% of women said that they changed the way that they dressed. 34% said they started using other types of transportation, and 9% of women said they did not travel alone in public transport (UNWOMEN, Women's access to safe transport, 2020).

Trip chaining can also have consequences on women's safety feeling. Walking through or waiting in areas that are unsafe in order to reach public transportation is often considered highly unpleasant by women. This, combined with the poor accessibility and non-reliability of public transportation, especially late in the evening or early in the morning, makes women more prone to sexual harassment or robbery (UNWOMEN, Safe public transport for women and girls, 2010).

2.3   Women and IT

Technology is commonly considered to be gender-neutral. The persistence of strong unconscious biases can generate gender inequality in the digital sphere, which have been proven by data trends and qualitative analysis.

A study carried out by Iclaves, SL. in cooperation with the Universitat Oberta de Catalunya for the Europen Commission shows that there is a shortage of digital skills in the EU that affects the whole population (reference in bibliography).

"When it comes to basic skills, there is no gap among those under 55 years old. There is a 6-percentage points difference between men and women over the age of 55. When considering advanced digital skills, girls under 24 surpass their male counterparts, while in the other age groups a gender gap negatively affecting women still persists. There are, though, relevant differences among the EU countries regarding the gender gap of digital skills" ("Women in the Digital Age", 2018)

The research also shows that despite having similar levels of basic digital skills women tend to underestimate their own capabilities and skills to a greater extent than men. The research also highlights gender differences in citizens' attitudes towards technology and innovation.

"Technological change is shaped and structured according to societal norms and relations, which are in turn influenced by technological transformations. On the one hand, this means that the types of technologies used in different historical, political and cultural contexts, their design and meaning are created within gender relations and thus reflect pre-existing gender inequalities. On the other hand, by offering different tools and methodologies for work, entertainment and care, technologies themselves shape those gender relations." ("Gender Equality Index 2020 - Digitalisation and the future of work", European Institute for Gender Equality, 2020).

According to OECD data, there are almost no differences between young women and men in basic and above-basic digital skills (59% of women and 60% of men). Among older people the gender divide widens, showing how the attitude towards technology is changing.

Source: Eurostat, ISOC (isoc_sk_dskl_i).
NB: Digital skills are measured in relation to activities performed across four domains of digital competence: information, communication, problem-solving and software skills. Individuals with above basic skills displayed them across all four dimensions; individuals with a basic level had at least one basic level of skills and no 'no skills' across four domains; individuals with a low level of skills missed some type of basic skills, i.e. had from one to three 'no skills' across the four domains; individuals with no skills did not perform any activities in any of the four domains, despite declaring that they had used the internet at least once during the past 3 months; digital skills could not be assessed for those who had not used the internet in the past 3 months. EIGE used numerical data rounded to zero decimal places by Eurostat; therefore the percentages may not add up to 100 %.

Figure 1- Levels of digital skills of individuals in the EU, by gender and age (%), Eurostat 2019

Women in general experience more obstacles than men in improving their digital skills. Generational and geographical differences are an obvious reason for that, but also other societal and economic factors and traditional gender stereotypes play a big role in creating this gap.

"Discussion about the impact of digital technologies often lacks assessment of the broader social, economic and political implications, especially from a gender perspective. Further analysis of intersectional inequalities in acquiring digital skills is needed, especially given the fast pace of digitalisation and risk of exclusion. This is particularly relevant to closing the gender gaps for older people and people with low education." (EIGE, 2020)

Education plays an important role: women, although outnumbering men among tertiary education students, are unequally represented across study fields, where only 17% of female

students opt for STEM studies compared with 42% of male students. It is particularly evident withing the field of ICT, where 82% of students are male.

Figure 2- Percentages of ICT students and graduates in the total student population by sex (2018) and percentages of women and men among ICT students and graduates (Eurostat 2018)
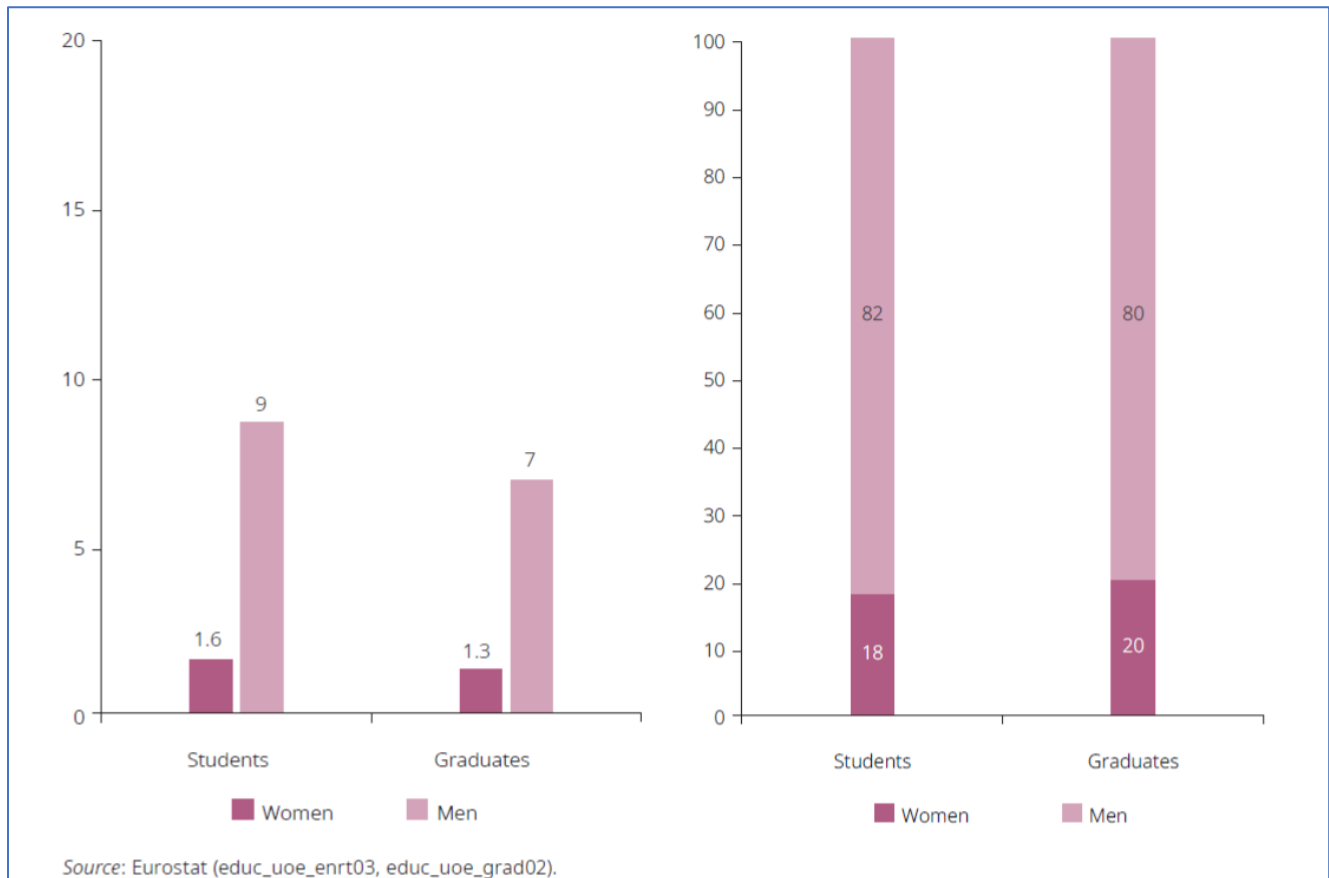
This trend is also confirmed by the small number of girls aspiring to become ICT professionals.
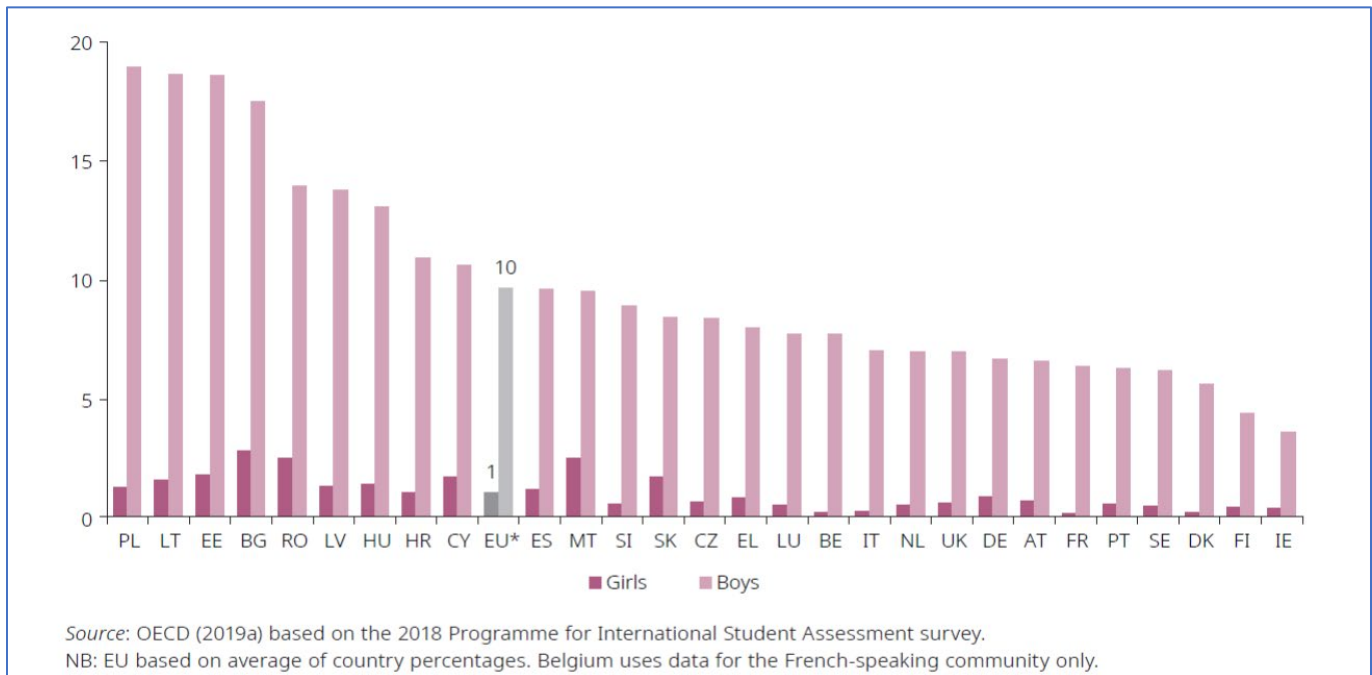
Figure 3 - Percentages of 15-year-olds expecting to work as ICT professionals at age 30, by country and gender (2018)

There is evidence that diversity, particularly in intensively knowledge-based industries such as ICT, increases performance and innovation. If equality in the digital sphere is not achieved, we will miss talent, vision, resources and wealth. The lack of diversity, particularly of women, in teams developing technology has an impact on innovation too.

"Technology reflects the values of its developers and that of the information they draw from. It is clear that having more diverse teams working in the development of such technologies might help identifying biases and prevent them." ("Women in the Digital Age", 2018)

2.4 Inclusion criteria for digital mobility services

The literature analysis allowed us to identify barriers to women's mobility and lack of familiarity with digital technologies of the elderly population. Based on this and on the data collected in DIGNITY via the national surveys four main barriers to the adoption of digital mobility systems have been indicated by the following 4As:

> **Availability**: access to Internet and/or ownership of a smartphone
> **Ability**: Limitations due to digital skills and confidence (accessibility)
> **Affordability**: limitations due to costs
> **Appetite**: Limitations due to safety

It is to be noted that

Availability and **Ability** are linked (in our analysis) to individual digital skills and opportunities, whereas

Affordability and **Appetite** are more related to the kind of mobility services offered.

The analysis carried out on the available data for Italy showed that the elderly, low income and low educated people are confronted to some extent with all 4 barriers.

Women (with different demographic and social characteristics) on the other hand face mainly the barriers due to the transport system.

Elderly women can be considered among the most vulnerable-to-exclusion groups, being confronted with both the traditional barriers, as identified in 2.2 and the new challenges due to technological development.

3. The gender dimension in DIGNITY

The gender dimension is embedded in the concept of inclusiveness of the DIGNITY approach. DIGNITY acknowledges the different mobility users and their different abilities, specifically focusing on the vulnerable-to-exclusion groups. Women are also listed as a separate group, not considering that they represent about 50% of each of the other groups identified as vulnerable-to-exclusion.

DIGNITY provided a great deal of quantitative and robust qualitative data on the adoption of digital mobility services and products by different vulnerable-to-exclusion groups. This was an opportunity to conduct disaggregated in-depth analysis to demonstrate the relevance of gender and how to analyse the influential factors comprehensively.

3.1 Project definitions

3.1.1 Digital gap in mobility

The digital gap in mobility is defined in DIGNITY WP 1 as "a mismatch between digitalisation in mobility and the digital ability of individuals". This definition, however, only focuses on the digital skills and abilities of the users. The work carried out in this task has privileged the perspective to look as well at other (socio-economic) factors that prevent specific categories of users from benefitting from digital mobility services and products

3.1.2 Digital mobility products and services

DIGNITY identifies digital mobility services and products as 'all mobility products and services that can be used for travel, transport and mobility and include digital interaction with the end-user'.

Digital mobility consists of the various possibilities offered by digital services and products based on the implementation of digital technologies, used in isolation or in different combination within the trip chain. This includes:
1) Mobility as a Service (MaaS) where various types of mobility are integrated into a single mobility service on demand with a single payment system (Alliance, nd.).
2) Mobility sharing applications for e-bikes, e-steps, e-scooters, etc. (e.g. Dott, Lime, Tier, Bird).
3) Travel planning applications for public transportation; being able to plan your trip with public transport showing what line you need to take and how late it departs to arrive on time. (e.g. My Cicero)
4) Car sharing; car rental for the time that you need it, making the need for a personal car obsolete. (e.g. Sharenow)
5) Booking a taxi via an application (e.g. apptaxi)

6) Carpooling; A ride where multiple people in the same vicinity drive together to their destinations. (e.g. Blablacar)

All these services aim at increasing transport sustainability by reducing the use of personal transport means and consequent emissions and pollution. They should also enhance travellers' experience making the trip safer, cheaper, faster and leaner.

The analysis carried out in this Task shows that not all the services today on the market meet these goals; they fail in considering some specific users' groups (in particular women's needs and limitations).

Highlighting such deficiencies will help developing more inclusive digital mobility solutions.

3.1.3 Gender inequality

The term gender inequality will be used based on the definition of the European Institute of Gender Equality: "legal, social and cultural situation in which the sex or gender determines different rights and dignity for men and women, which are reflected in their unequal access to or enjoyments of rights, as well as the assumption of stereotypical social and cultural roles".

3.1.4 Intersectional analysis

Various gender mobility studies have investigated the differences in mobility patterns between men and women. However, these studies frequently focus only on gender, as if men and women were monolithic, homogeneous societal groups.

'Intersectionality' describes overlapping or intersecting categories such as gender, sex, ethnicity, age, socioeconomic status, sexual orientation and geographical location that combine to inform individuals' identities and experiences. Researchers and engineers should not consider gender in isolation; gender identities, norms and relations both shape and are shaped by other social attributes (Buolamwini and Gebru, 2018).

Collaboration with other projects addressing the issue of women's mobility through intersectional analysis was foreseen for the good completion of the work in Task 4.4 of the DIGNITY project. In particular the TInnGO project (Transport Innovation Gender Observatory, Horizon 2000, https://www.tinngo.eu/) aims to combine existing tools and knowledge with the new approaches. This is achieved by collecting existing mobility data and setting new standards for the collection of socio-demographic mobility data, which enable intersectional analysis to identify and meet all different women's transport needs.

The TinnGo project has well defined what intersectionality in mobility means:

"In terms of transport, peoples' mobility patterns depend upon many factors, where they live, what they earn, their caring responsibilities, as well as characteristics such as race, gender, sexuality, and age (Levin et al, 2020). Using intersectional analysis can show how these factors can overlap and influence access to transport mobility. The role of designers here is to make sure that they are not creating products and vehicles which exclude certain groups by failing to

understand different needs and requirements. The digital divide is a good example of the need to apply intersectional thinking to transport and smart city initiatives. Students are digital natives, their friends are all digital natives, as such they believe technology will solve all problems and struggle to understand or have empathy towards laggards. To assist with this, the project developed a model, based on a wheel of 3 concentric discs, the TInnGO Intersectionality Mobility Indicators (TIMI) (Figure 4). This can be used to enable transport policy makers and practitioners to visualise the overlapping (intersectional) nature of individual characteristics and structural aspects of transport poverty, and how they relate to smart mobility and mobility patterns. The origins of the tool came from the principle that transport is the glue that holds many facets of everyday life together. Where you live, work, go to school, shop or socialise is influenced by transport. We have symbolised this as the strands of a fibre optic cable all wound together.

Figure 4 - TInnGO Intersectional Mobility Indicators (TIMI) (Bridgman et al, 2021)

The TIMI model draws attention to the overlapping nature of smart mobility. The outer, orange ring contains structural and political factors of transport poverty and social role, and the blue circles highlight intersectional characteristics on a more individual level which are traditionally associated with excluded groups (such as gender, ableness, ethnicity).

Lastly the cyan circle represents the 5 gender smart dimensions (effective, attractive, affordable, sustainable and inclusive) which need to be considered in the design of gender and diversity sensitive smart mobility products. The [tool]… highlights how all systems need to be read together to foster equity-based policy solutions and the wider context in which smart mobility is placed." (EU funded project TInnGO – Transport Innovation Gender Observatory)

3.2 Hypothesis

The study considers the limitations of identifying women as a homogeneous group vulnerable-to-exclusion because of a lack of digital skills. It is well known that present transport systems do not meet women's mobility needs and that prejudices still prevent a full female participation in ICT. However, the assumption that digitalisation is a barrier to mobility for women as a uniform group hides substantial differences due to other intersectional factors, such as for example age, education, and income.

It is assumed that a different approach will lead to different outcomes. For example, Figure 5 shows that the data referring to "women" as a group *per se* do not differ significantly from the data referring to the total population. In contrast, a closer analysis of disaggregated data by other vulnerable-to-exclusion groups (Figure 6) highlights the very low use of digital services by the elderly. It is also interesting to note how confidence in IT services does not always correspond to the actual use of these services. It confirms what is stated in the literature (see 2.3): women tend to underestimate their own capabilities.
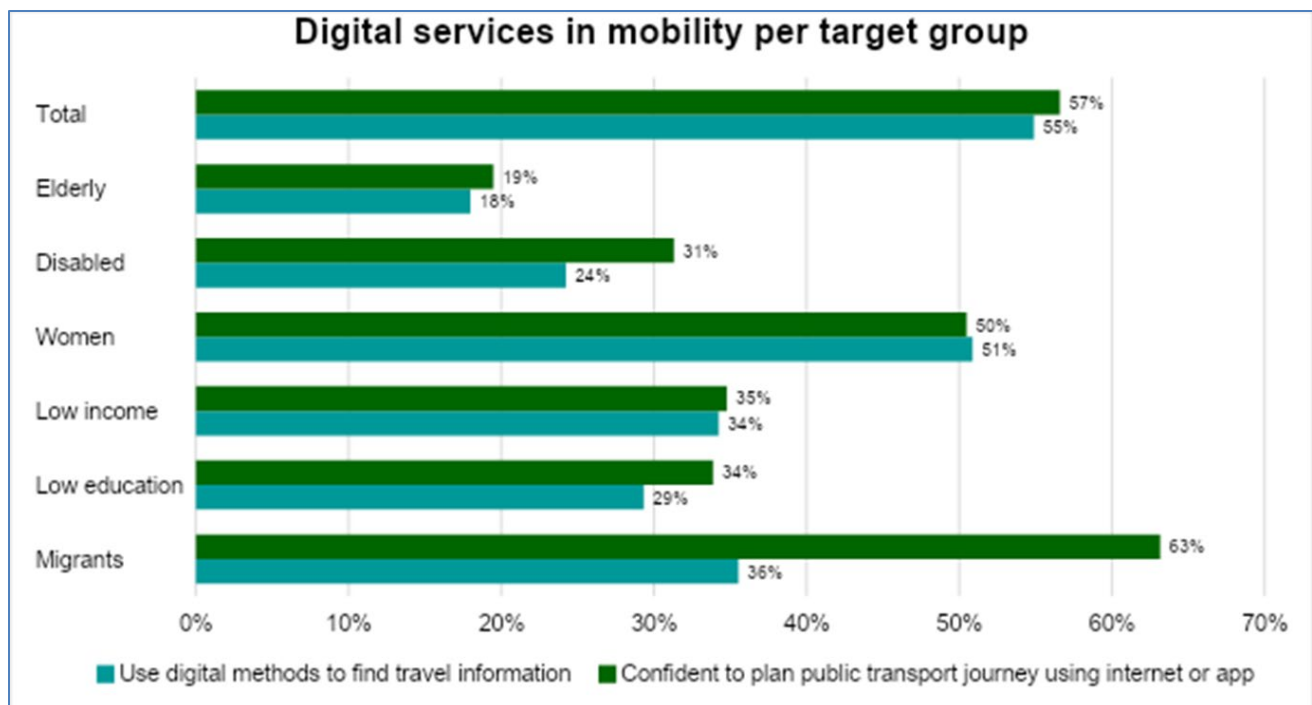

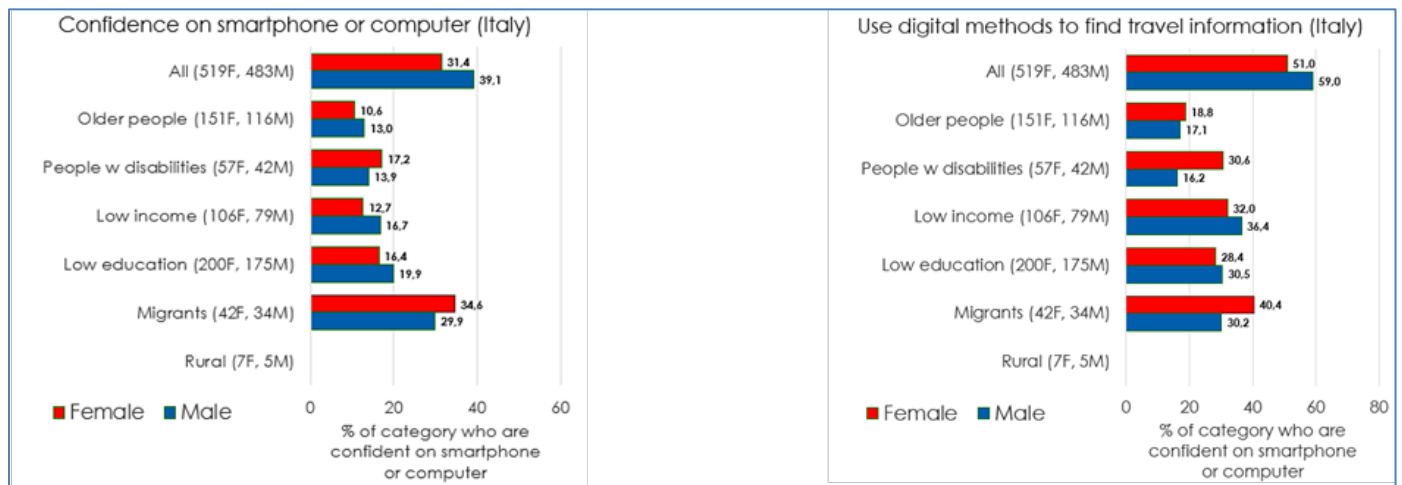*Figure 5 - Use of digital means per target group.*

Figure 6 - Use of digital means by men and women in each users group

Recognising the overall vulnerability of the elderly group, elderly women have been assumed to be one of the most vulnerable-to-exclusion groups of population. The ageing of population is a worldwide issue so it is considered important to investigate the attitude towards digital mobility of the elderly and elderly women in particular. This generation of elderly has changed over the years. They travel more frequently for leisure and other purposes than the generation before them. Compared to younger people, the elderly use more frequently the car, that gives them a feeling of independence. However, in time driving becomes difficult as age increases. To keep the feeling of efficiency it is important to easily access public transport and other active modes. This trend puts pressure on the current and future mobility systems where digitalisation will play an even more significant role than it already does.

The study will provide a set of variables that can be used for intersectional analysis focusing on specific subgroups; it will demonstrate the effectiveness of the intersectional data analysis, and identify relevant aspects to be considered to ensure inclusiveness in digital mobility solutions.

4. Methodology

The hypothesis presented above has been tested via a quantitative analysis of the data collected for the DIGNITY national surveys in WP1 (D 1.2) and a qualitative analysis based on the outcome of the Customer Journey Mapping (D 3.1.2) and the Framing of the digital gap in mobility at local level (D 3.1).

4.1 Quantitative analysis

The quantitative approach taken in this task aims at demonstrating that the differences between men and women change when more variables are added and at confirming the hypothesis that digital skills are not the most important factors for gender discrimination.

The national surveys were performed in the four areas of the project pilot activities: the Netherlands, Italy, Barcelona and Flanders. The Flemish survey was conducted at a regional level, and for Barcelona only the metropolitan population has been surveyed. The Dutch national survey was still under revision at the time of this analysis. For this research only the Italian data set has been used, as it was the most complete and representative at national level (1002 respondents, 51,8% women and 48,2% men, reproducing the gender percentages of the Italian total population).

For each exclusion criteria (availability, ability, affordability, appetite) an analysis has been carried out by combining other vulnerability variables in relation to gender. In particular, age, education and income were considered the most relevant and the most reliable and robust in the national data set.

All the statistical analyses in this research have been tested using a Chi-square test for independence which is used to determine if there is a significant relationship between two variables and not that the distribution is just a simple coincidence. All the produced graphs have been split between female and male to show if the problem is gender-related or if there are more evident indicators of exclusion.

4.2 Qualitative analysis

The qualitative analysis focuses on the hypothesis that elderly women are highly vulnerable-to-exclusion and aims at identifying the main limitations encountered by this user group.

Data used in this study were gathered from four previous works performed in the DIGNITY project: the Customer Journey Mapping and Focus group, both using qualitative analysis of the

population involved, the Digital gap self-assessment and the national survey dataset providing quantitative data to check and support the qualitative results.

It is crucial to stress that the findings of the qualitative analysis do not represent the total population. This analysis was completed by primarily using a small sample, and was based on surveys and interviews not conducted in the same way in all pilots. However, the literature review also recognised some of these experienced limitations and was used to confirm the findings in this analysis.

The Italian data set met the requirements of sufficient representativeness of participants of both genders and that is why only quantitative data referring to the Italian pilot have been used. This also for easier comparisons with the outcomes of the quantitative analysis.

The first analysis focused on the limitations and needs of the elderly in adopting digital mobility solutions.

The second step was to assess the impact on gender of the barriers to digital mobility services. This was conducted on the total population group.

Lastly, the third step investigated the impact of gender within the sub-group of older people who experienced limitations in using digital mobility services. A further comparison between elderly women and the total women population highlighted which gender-related barriers impact elderly women the most.

5. Outcomes

5.1 Quantitative analysis

The quantitative analysis aimed at demonstrating the hypothesis that gender is not the main exclusion factor in digital mobility. Comparisons between gender-disaggregated data and other assumed exclusion factors, such as age, education, social grade, have been conducted for all indicators referring to the four inclusion criteria as defined in 2.4: availability, ability, affordability, appetite.

5.1.1 Availability – access to Internet and/or smartphone ownership

As far as access to the Internet is concerned, Figure 7 below shows there is almost no difference between female and male internet access. In the age groups of 16-39 and 65+ females actually have a higher percentage of internet access than males in the same respective age categories.
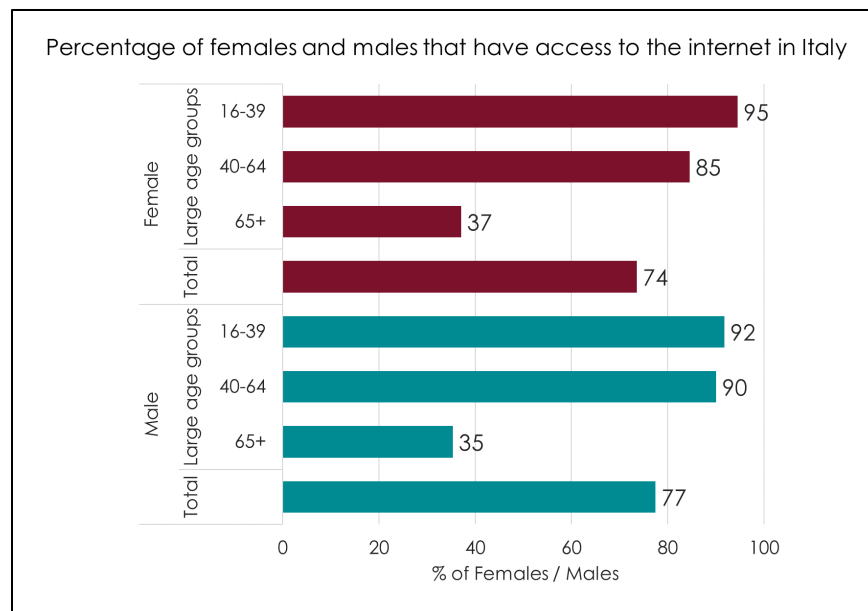

Figure 7 - Internet access, gender and age (in Italy) by age groups

The graph highlights differences based both on gender and age. A big difference can be noted between the elderly age group of both female and male compared to the younger age groups. This indicates that **age has a bigger impact on internet accessibility than gender**.

The same effect can be noticed in Figure 8 if we consider education levels. Men and women only have minor differences in percentages: 2% for low-educated men and women and 3% for high educated men and women. The real difference can be observed between the low and high-educated females and males: high educated people of both genders present a percentage of access 40 points higher than low educated ones.
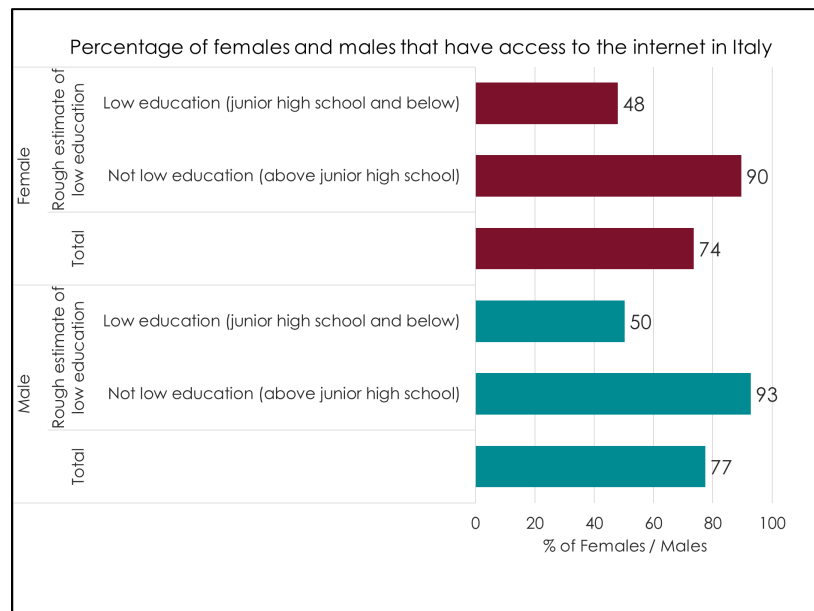

Percentage of females and males that have access to the internet in Italy

Female — Rough estimate of low education	Low education (junior high school and below)	48
	Not low education (above junior high school)	90
Total		74
Male — Rough estimate of low education	Low education (junior high school and below)	50
	Not low education (above junior high school)	93
Total		77

% of Females / Males

Figure 8 - Internet access, education and gender (in Italy) by education level

Another comparison of the variables of gender, age and education has been conducted as far as smartphone ownership is concerned.

In Figure 9 below smartphone ownership is compared to age and gender. It shows limited difference between females and males: only a small percent between the different age groups, with an average difference of 5 percentage points.
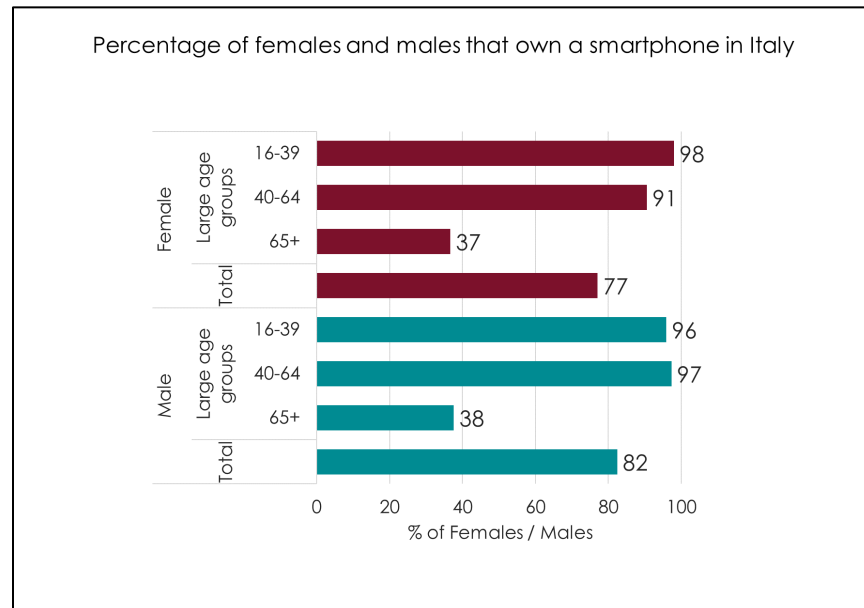
Figure 9 - Smartphone ownership, age and gender (in Italy) by age groups

Age is not the only discriminating factor in smartphone ownership, but also, education level plays a more important role than gender, as shown in Figure 10.

Both low and high educated people only have a 5 percentage point difference between males and females in their respective education level groups, whilst there is a 40 percentage point difference between low and high educated individuals in both groups.
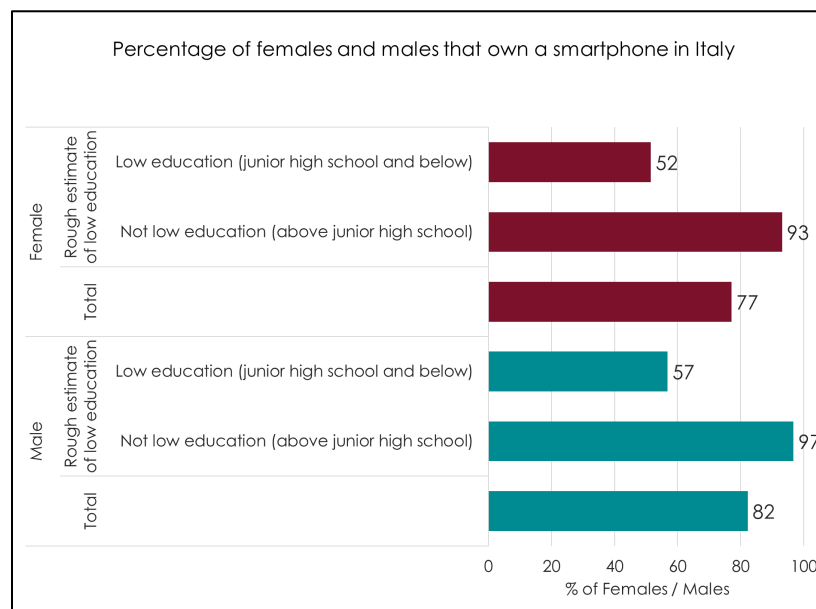

Figure 10 - Smartphone ownership, education and gender (in Italy) by education level

Evidence referring to Availability

In conclusion, **gender is in none of these comparisons the excluding factor**. No significant differences between females and males could be found in the comparisons carried out on availability (access to Internet and smartphone ownership). Significant differences are evident when looking at age and education.

For the four conducted analyses, there is little difference between females and males but a big difference between the elderly age group and the younger one. Similarly, low educated people experience more limitations than those with a higher education level, with no significant differences between genders.

5.1.2   Ability – Limitations due to digital skills and confidence

Assessing the abilities of men and women it can be noticed that there are differences between females and males and between the different age categories, the latter being noticeable for both genders. The older the age category, the lower the percentage of both females and males that are ''Not at all limited''. It can also be noticed that for females the percentage of ''Slightly limited'' stays roughly the same in all age groups (about 25%) whilst the percentage of ''Very limited'' increases for the older age categories (40% versus 7% of the youngest group). For males the percentage of both ''Slightly limited'' and ''Very limited'' increases for the 40-64 and 65+ groups.
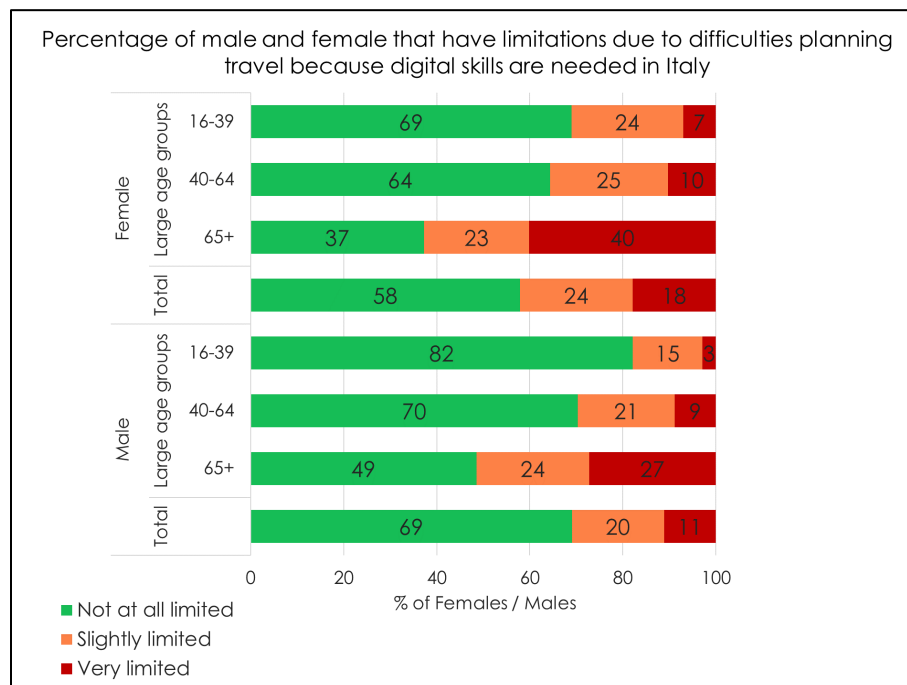

Figure 11 - Difficulties in planning travel because of digital skills by gender and age

Also, there is a distinct difference between low and high educated people. Both highly educated females and males are likelier to be ''Not at all limited'' than low-educated females and males, as seen in Figure 12. The difference between low and high educated women is 24 percentage points; for men, the difference is 23 percentage points. Higher educated females and males are also less likely to be ''Very limited'' compared to low educated individuals.
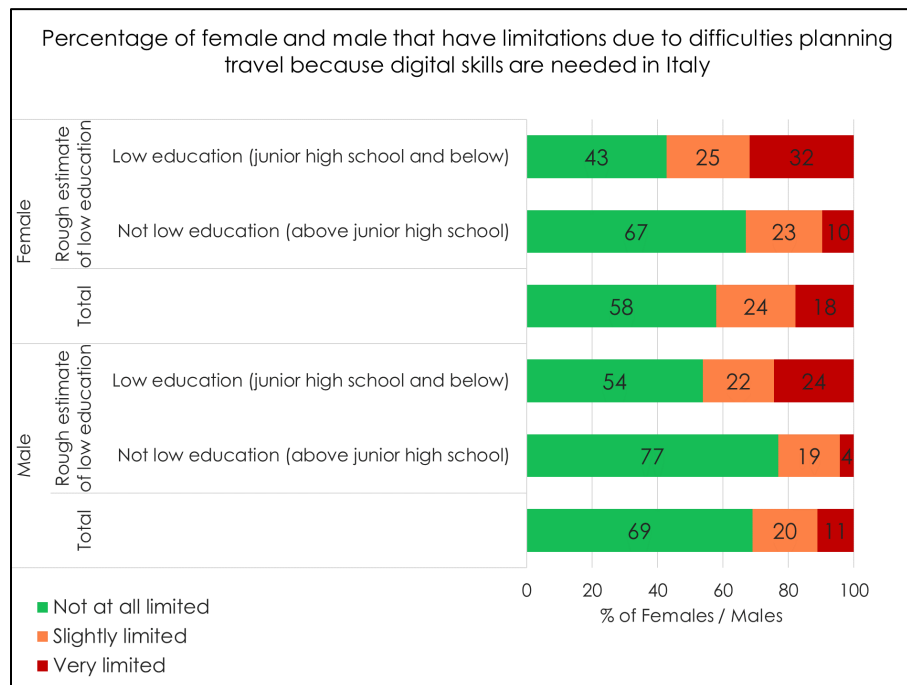
Figure 12 - Difficulties in planning travel due to digital skills by gender and education

In Figure 13 it can be noticed that the lower the social grade the greater the percentage of individuals that are ''Slightly limited'' or ''Very limited''. In this test 2 social grades have been left out of the graph: UPPER rich and LOWER poor. This is because the number of respondents for both groups was too low to be representative. This would have falsified the results.

Percentage of females and males that experience limitations due to the need of digital skills because of a difficulty to plan travel in Italy
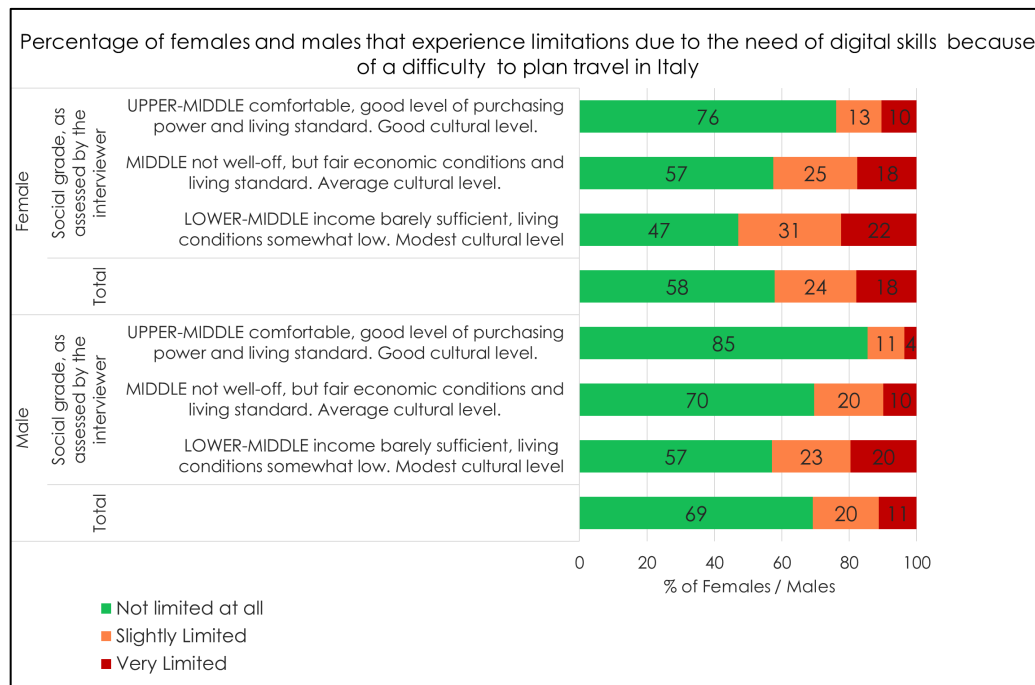
Figure 13 - Difficulties in planning travel because of digital skills by gender and social grade

Figures 11, 12 and 13 above present a noticeable difference between females and males in their declaration of ability to plan a trip with digital systems. The reason for this can be referred to the effect reported under 2.3, that women tend to underestimate their own digital skills, whereas men use to overstate theirs. This cannot be proven statistically but is heavily dependent on the cultural behaviour of the respondents, confirming gender differences in attitudes towards technology and innovation.

Confidence is also an important indicator of exclusion although representing a subjective statement by the respondents, not strictly related to actual capabilities. Looking at confidence levels compared to gender and various other exclusion indicators, it is possible to sketch a picture of the real problem and demonstrate that gender is not the main excluding factor.
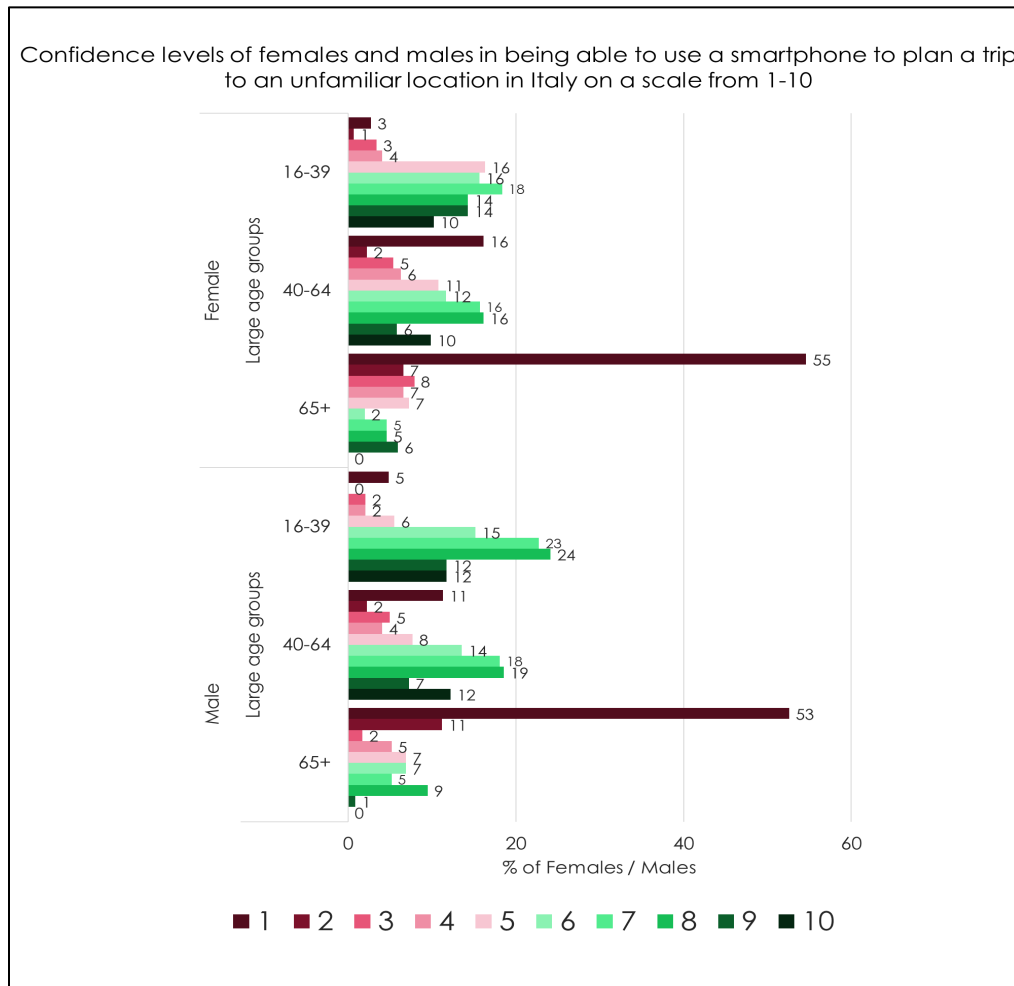
Figure 14 - Confidence levels to plan a trip with a smartphone by age and gender

Figure 14 highlights something noticeable: In the 65+ age group of both males and females, a significant portion of elderly give themselves a 1 on the confidence scale from 1-10, which means that more than half of the 65+ group thus has no confidence at all in planning a trip to an unfamiliar location using a smartphone. In the 16-39 group, males tend to be more confident than females about their ability to plan a trip using a smartphone. This, however, does not say anything about their actual performance. This indicates that there is not only a difference between the various age groups and their confidence but also a small but noticeable difference between males and females.

Regarding basic skills, there are no differences between females and males in the age category under 55. In the category above 55, there is a 6 percentage point difference between males and females.

Looking at advanced digital skills, women under 24 actually have better digital skills compared to men in the same age category. Other age categories still have a negative gender divide where women are less skilled than men.

Also looking at education in Figure 15, there is a very high percentage – over 40% - of both men and women with a low level of education that give themselves a 1 in confidence. Another noticeable thing in figure 12 is that both low and high educated men rate their confidence levels higher than low and high educated women. Yet, as already highlighted, that does not indicate their actual abilities to plan a trip using a smartphone (see chapter 2.4 of this report for references to previous research).
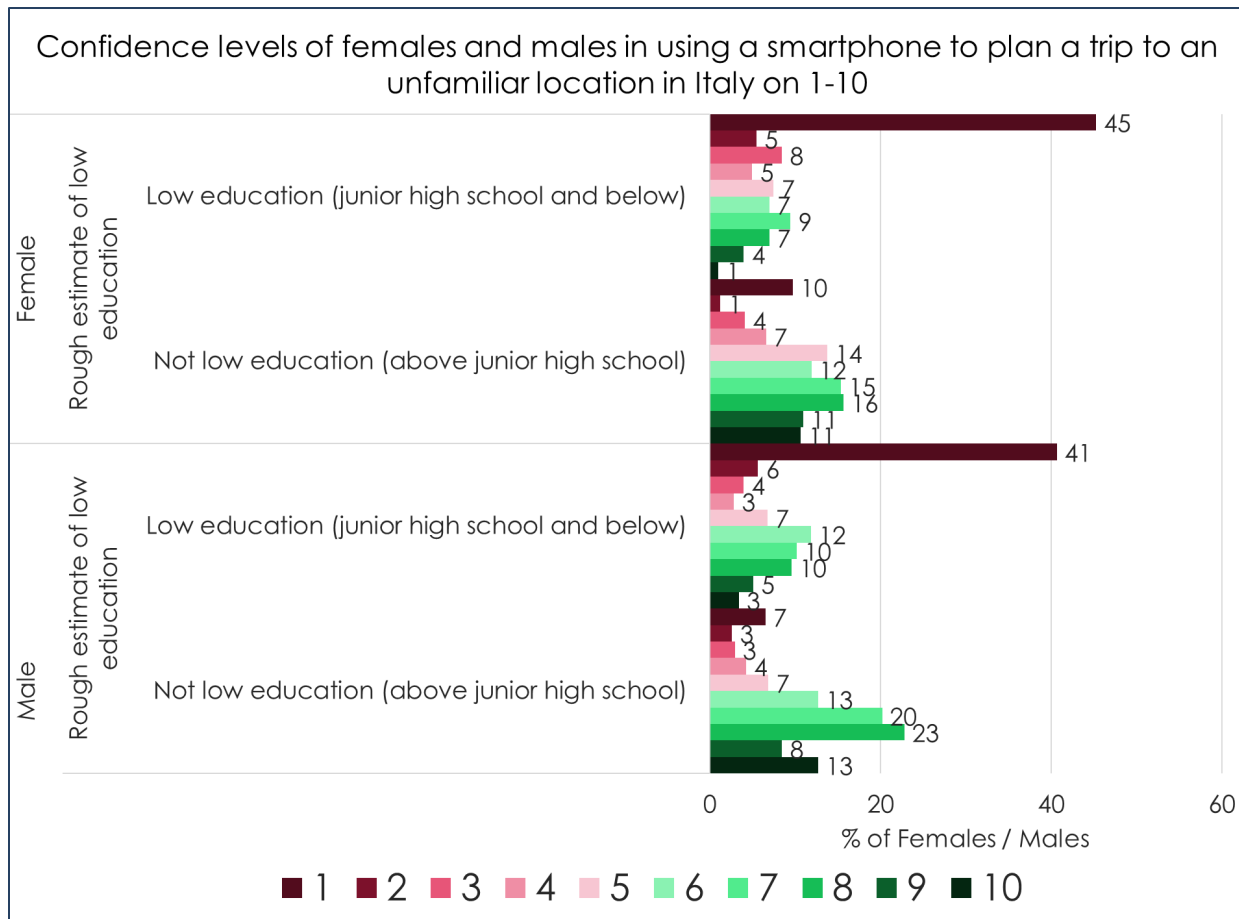

Figure 15 - Confidence levels to plan a trip with a smartphone by education and gender

In figure 16, the same phenomenon is evident: the lower the social grade the lower the confidence, with more than 30% of the lower-middle income group giving themselves a 1 in

confidence. Focusing on the middle class it can be seen that women are also more likely to give themselves a 1 in confidence (23%) compared to men (15%). There are some small differences between females and males in this graph; however, it is clearly visible that there are significant differences between the various social grades.
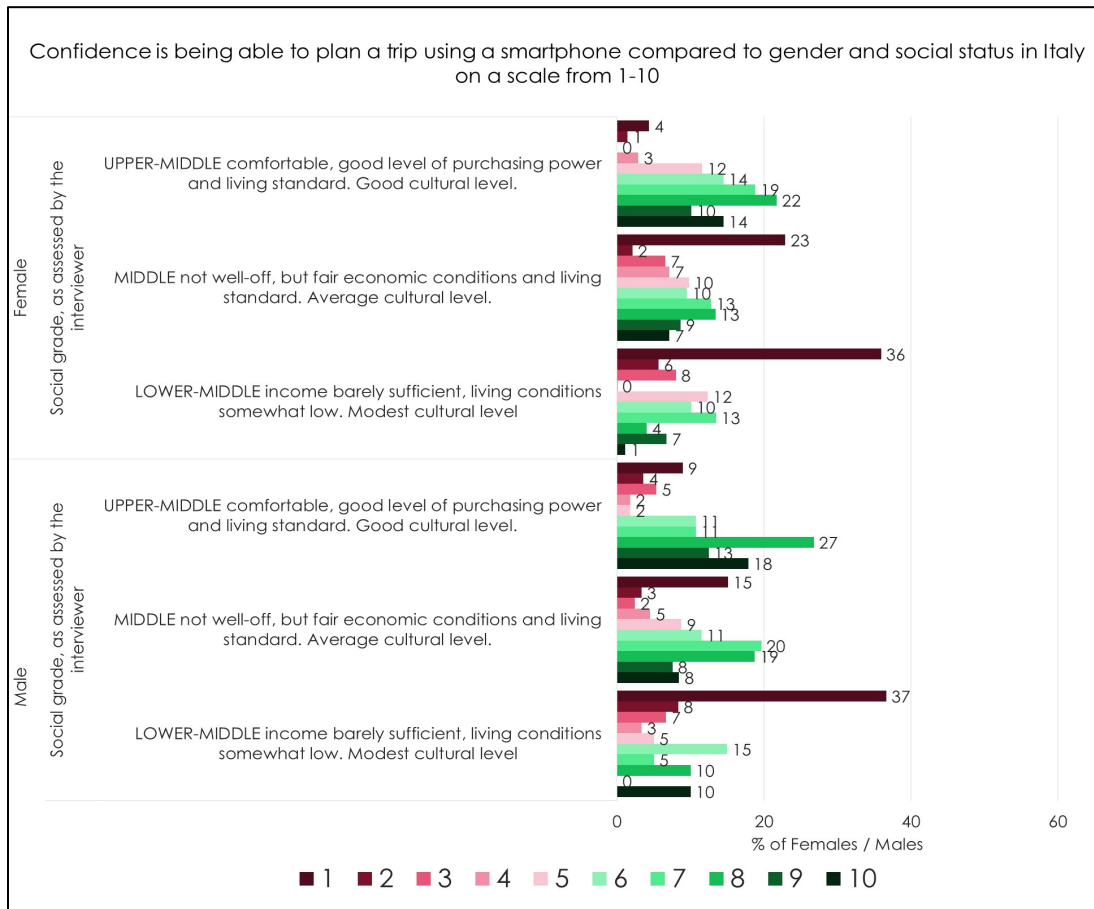
Figure 16 - Confidence in planning a trip using a smartphone by social grade and gender

Evidence referring to Ability

There are some differences between the declared different levels of limitations of males and females regarding the ability to plan a trip to an unfamiliar area because digital skills are needed.

Using a correlation analysis, it has also been demonstrated that the relationship between the level of education and social grade is not straightforward. As social includes also education data, it should be researched and analysed separately.

Literature and the data show that there is a difference between the confidence levels between female and male. Women still underestimate their skills and abilities whilst men overestimate both (Barbieri, et al., 2020) even though very few differences are found in the actual performances of men and women. Women aged under 24 actually outperform men in the same age category regarding advanced digital skills (Tarin Quiros, et al., 2018). Gender is not the only factor that influences ones' confidence. Age, education level and social grade have a bigger influence as exclusion indicators. For elderly men and women, over 50% of the group population gives themselves the lowest level in confidence.

For low educated people and people with a low social grade there are also large percentages of people (over 35%) that give themselves a level 1 in confidence. More males give themselves a higher confidence than females in the same categories. It can be concluded that both gender and the other indicators of exclusion (age, education level and social grade) play a role in inequality. Due to the high amounts of both females and males in the elderly age, low education and lower-middle social grade categories that give themselves a 1 in their level of confidence it can be concluded that those variables play a more important role than gender in exclusion.

5.1.3 Affordability – limitations due to cost

Looking at Figure 17 below it can be observed that there is some difference between the different age groups regarding cost limitations. The 40-64 age group has the least limitations compared to 16-39 and 65+. This can be logically explained by the fact that in the 16-39 age category there are also high school and university students whose income is not stable. The 40-64 age group includes the highest percentage of productive people earning money. In the 65+ group are mainly retired elderly who usually have a lower income than working individuals making it more likely for them to be ''slightly limited'' or ''very limited''.

Differences between males and females have been identified. The cost of ICTs have impacted women and girls more than men and boys. The digital gender divide increases when it comes to the use of digital platforms, such as bike and car-sharing and MaaS, which can be considered non-gender-neutral digital mobility solutions. A credit card is often necessary to use these new mobility services, which excludes women who cannot afford this, or rely on the use of their husband's one. Also, the lack of public internet connection (Wi-Fi) seemed to restrict women from using digital tools like travel apps.
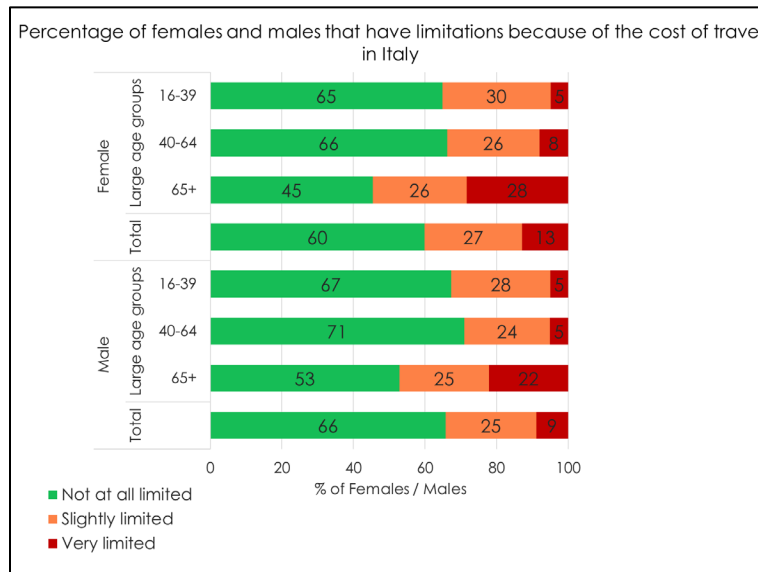
Figure 17 - Cost limitation by age and gender

The analysis of the variable Education (Figure 18) shows a big difference between the low educated and high educated groups regarding their limitations due to travel costs. Especially in the percentage of people that say that they are ''very limited'' is significantly bigger in the low educated category, whilst in the ''slightly limited'' section the differences are lot smaller between low and high educated men and women. There is a bigger difference between low and high educated women (25%) than between low and high educated males (14%).

Figure 18 - Cost limitation, education and gender

In Figure 19 below no significant difference between males and females can be observed. On the other hand, there is a big difference betw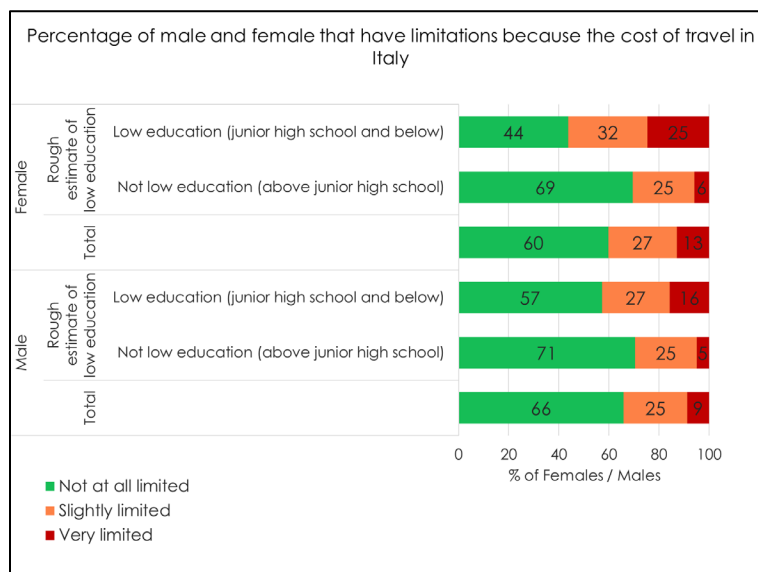een the various social grades: the lower the social grade the higher the percentage of people that experience limitations travelling due to costs. The difference between upper-middle and lower-middle is 37 percentage points for women and 43 percentage points for men which is significant.
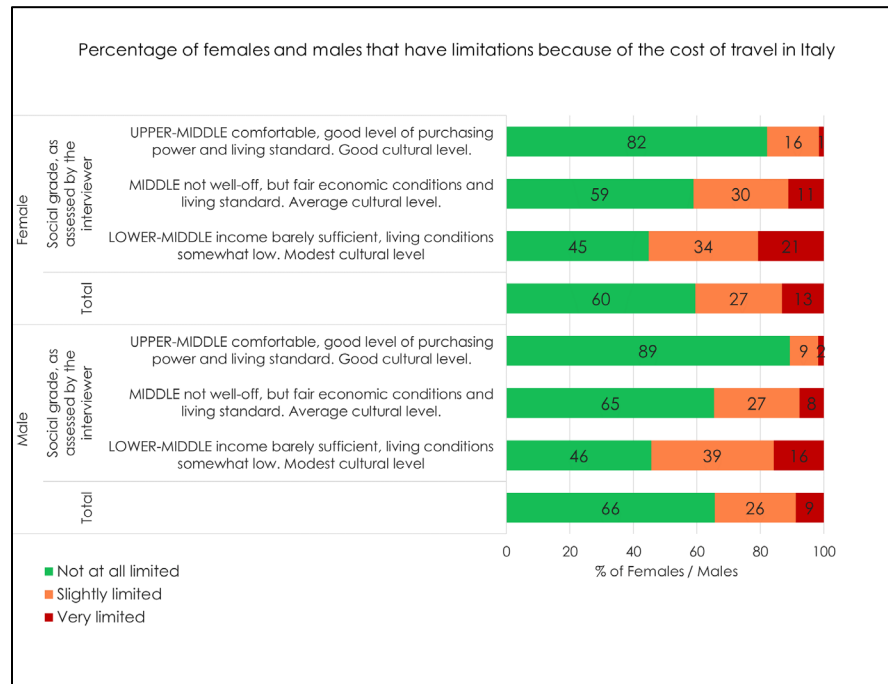

Percentage of females and males that have limitations because of the cost of travel in Italy

Figure 19 - Cost limitation, social grade and gender

Evidence referring to Affordability

When looking at gender as an indicator of exclusion there are some small differences in the limitation of costs between men and women of different age categories. Further analysis shows that age plays a much bigger role than gender. When cost limitation is compared to education, it is easily noticeable that people with a low education experience more limitations than those with a higher education. In the low education category, there is also a substantial gender difference. The reason for this could be that the level of education is linked to the occupational level; low educated women often have lower remunerated jobs than men, and more often these are part-time jobs. Comparing cost limitation to social grade a similar conclusion emerges: the lower the social grade the higher the percentage of individuals that experience limitation, with women being affected more than men.

5.1.4   Appetite – Limitations due to safety

In the case of safety there is a big difference between male and female limitations. A high percentage of women encounter limitations. For the age group 16-39 almost 50% of the females say they encounter some limitations against 35% of boys. For the elderly women the number rises to 65% (men 52%). Various reasons for this difference can be found in the literature and previous research studies.

It also deserves to be highlighted that both elderly females and males feel less safe than the younger age groups. Only 35% of elderly female and 45% of elderly male say that they do not encounter any limitations at all, with elderly females being more 'Very limited'' than elderly males.
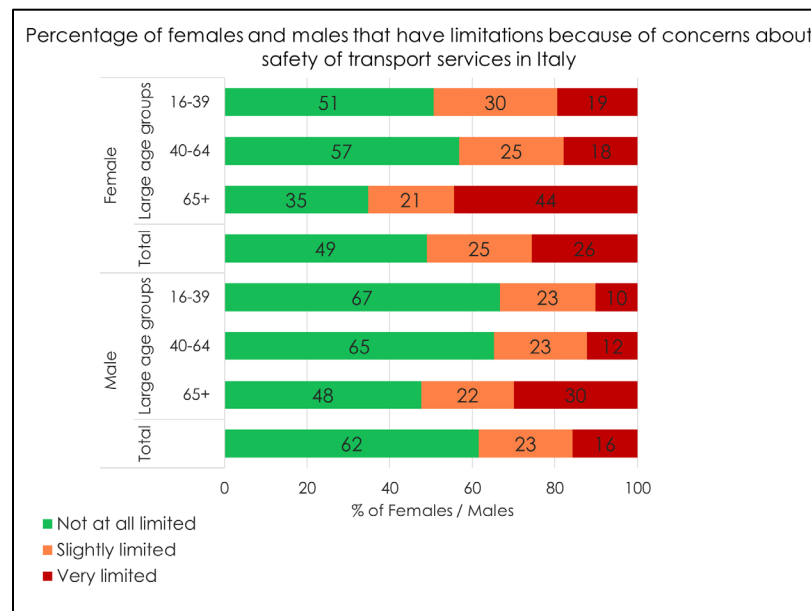

Figure 20 - Safety limitation, age and gender

Differences are also evident between different education levels: in the low educated group there is a lower percentage of individuals that say that they experience no limitations at all. The difference between low and high educated is not very large, but it can still be reported.
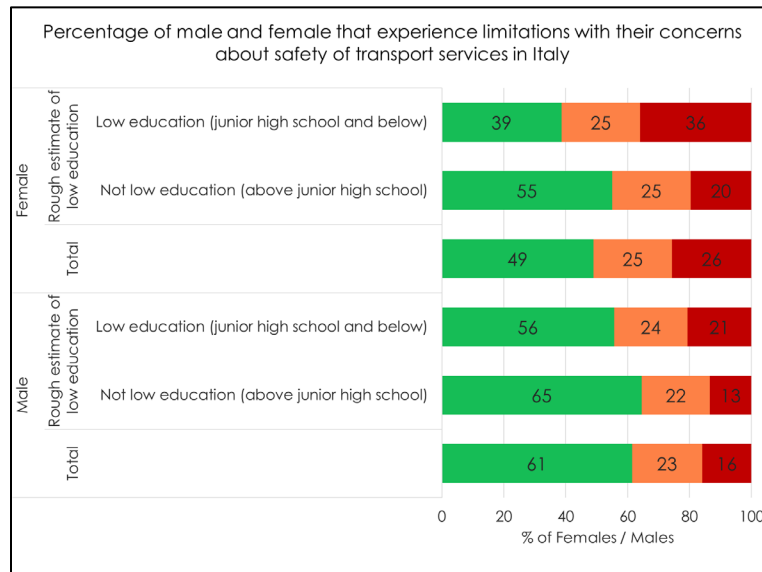
Figure 21 - Safety concerns, education and gender

A noticeable gender inequality was evident between female and male education levels compared to limitations due to safety.

A clear divide can also be seen when looking at different social grades and the percentages of people that say that they are ''Not limited at all''. The higher the social grade the higher the percentage of people that are ''Not limited at all''. The difference of 13% between the total female and male group indicates that some issues still need to be explored to decrease this difference and the respective inequality.

Figure 22 - Limitations because of safety by social grade and gender

Evidence referring to Appetite

There are some big differences when comparing the limitation of safety for men and women. Compared to all the indicators of exclusion (age, education and social grade), women feel noticeably more limited due to the real and perceived safety of transport services. This is supported by decades of research on women and transport. However, more re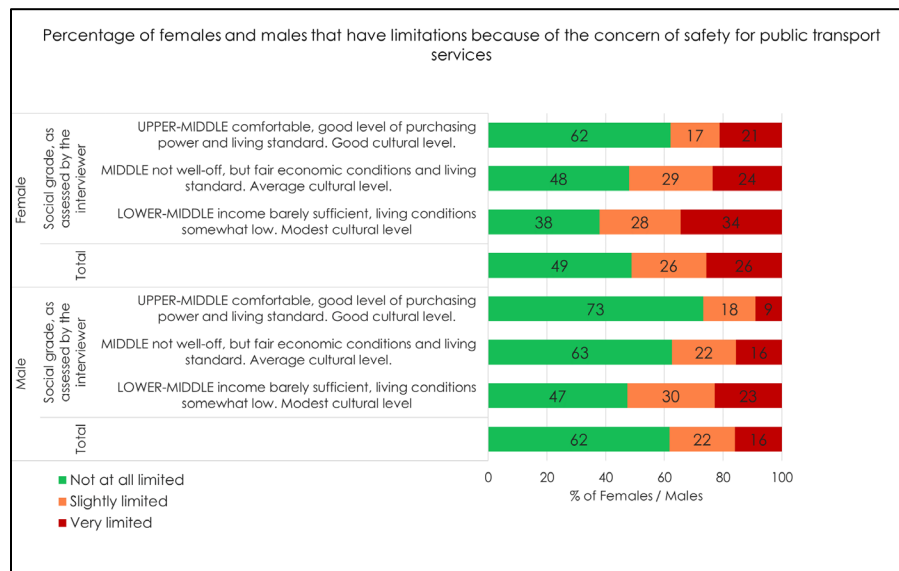search is recommended to see how digital mobility services can help mitigate and solve this problem. As with the other comparisons, age, education level and social grade are excluding factors, but in this case, **gender plays a bigger role compared to other variables.**

5.1.5   Overall limitations

Interesting observations can be derived from the analysis of data presented above. Looking at Figures 23 some similarities and differences between female and male limitations can be observed. There is a big difference between low and high educated men and women under 65 within their own gender group. The differences between low educated men and women is relatively large when looking at the limitation ''Difficulties planning a trip because digital skills are needed''. For both females and males there is a much larger percentage difference between the low and high educated individuals under 65 then there is for those over the age of 65. One element that stands out is that for both female and male the high educated 65+ actually have the most difficulties in planning trips due to lack of digital skills. Even more than the low educated 65+ age group.

For cost and safety, the differences are much more noticeable between low and highly educated men and women. The differences in percentages amongst the high educated is only a few percentage points whilst comparing it to the low educated the differences can be over 10 percentage points. Also, when comparing the difficulties that the elderly encounter compared to the younger generations, it is evident that the elderly are a lot more disadvantaged.
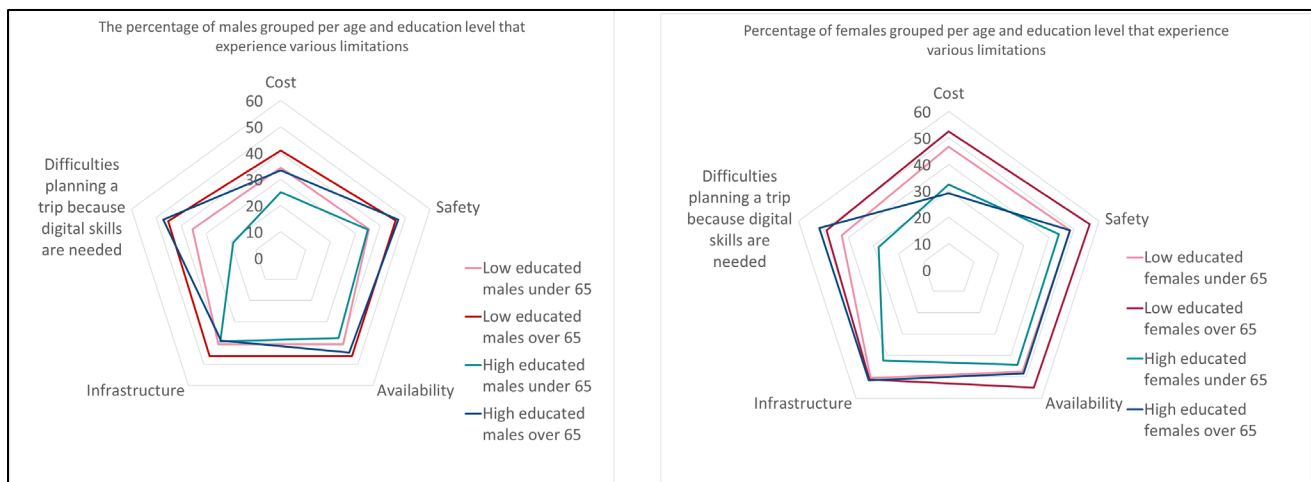

Figure 23 - Men's and Women's limitations per age and education level

A way to determine if other exclusion indicators have a bigger effect on inequality than gender is to calculate the chance for someone limited by one variable to be limited by another. Tables 2 and 3 show the total percentages of females and males that are limited by a certain variable and the percentage of limitations due to other variables.

As an example, in Table 2 it can be seen that from the entire group of females 51% is either slightly or very limited by safety. 65% of this 51% is also limited by the cost of transportation and 82% by the availability of transportation.

For all three variables (safety, cost and difficulty in planning) women have a chance between 65%-82% to be limited as well by other factors. For men this percentage is situated between 55%-84%.

It is interesting to note that women's safety is remarkably linked to cost and difficulty in planning a trip via digital devices.

Females	Total % of people that are limited	Total amount of people that are limited	Safety	Cost	Difficulty planning	Infrastructure	Availability
Safety	51	242	-	65	63	81	82
Cost	40	196	80	-	67	78	82
Difficulty planning	42	190	80	69	-	80	78

Table 2 - Probability for a woman to have multiple limitations

Males	Total % of people that are limited	Total amount of people that are limited	Safety	Cost	Difficulty planning	Infrastructure	Availability
Safety	38	186	-	56	55	84	80
Cost	34	149	70	-	62	77	76
Difficulty planning	31	143	72	65	-	76	76

Table 3 - Probability for a man to have multiple limitations

Evidence referring to overall limitations

Education level plays a big role. The differences between low educated men and women under 65 is relatively large when looking at the limitation ''Difficulties planning a trip because digital skills are needed''. This difference is reduced in the group over 65. One emerging element is that both high educated females and males 65+ have the most difficulties in planning trips because digital skills are needed, even more than the low educated in the same age group.

For <u>cost</u> and <u>safety</u>, the differences are much more noticeable between low and highly educated men and women. The differences in percentages between the high educated men

and women is only a few percentage points, whilst comparing it to the low educated the differences can be over 10 percentage points.

A T-test has been conducted to confirm that the differences between men and women are significant. The differences between low and high educated people regarding safety, costs and difficulty in planning are significant and not aleatory.

As far as availability is concerned, no significant gender inequality could be found. The differences between females and males are minimal. However, what could be seen is that there are big differences between the different age categories, where the elderly experience more limitations than the younger generations. This also applies to their ability to use digital services and be confident in using them. The elderly are disadvantaged no matter if they are female or male. Another thing that could be noticed is that low educated people and people with a low social grade experience more limitations than those with high education or a high social grade. **The indicators 'age', 'education level' and 'social grade' are much more relevant than 'gende**r.

Analysing affordability and appetite it can be seen that the differences between females and males are bigger than for availability and ability.

Figures 23 clearly show a difference between females and males regarding cost and safety limitations. For almost all comparisons dependency could be confirmed by means of a Chi-square test, however, could not be proven that men's safety limitations are linked to level of education and social grade. It shows that for this variable there is a clear gender divide. This result supports the already well-known results of previous research on women's mobility. **Gender is definitely an excluding factor as far as safety is concerned**. However the other indicators of exclusion have a much bigger influence on digital mobility inequality than gender. The data and the statistical tests demonstrated that there is a link between age, level of education and social grade.

In figure 23 the combination of multiple variables clearly shows the limitations encountered by each group. High educated females and males over the age of 65 present the largest percentage of people that are limited due to difficulties planning a trip with digital devices. This group is even more limited than low educated females and males over the age of 65.

The biggest differences in limitations due to cost, safety and difficulty in planning can be seen between high educated younger people and low and high educated elderly. Low educated females under 65 are far more limited than low educated males of same age group regarding cost limitations. Low educated females over 65 are also noticeably more limited than any other female or male category regarding safety. The combination of more variables helps to pinpoint more specifically which groups are more limited. This allows a better understanding of which measures are necessary to mitigate the existing inequality.

Tables 2 and 3 show clearly what percentages of females and males feel limited by a second element. What can be seen in those graphs is that most of the people that are limited by one variable are also limited by another one. For most of them there are multiple problems that contribute to exclusion. Women are more likely than men to face multiple barriers to benefit from a seamless digital mobility.

5.2 Qualitative analysis

The quantitative analysis has shown that the elderly and women are two of the most vulnerable-to-exclusion groups, whose vulnerability is accentuated by digitalisation. The results from the Customer Journey Mapping, the Digital gap self-assessment and Focus groups were used to assess the issues referring to elderly population. These were then compared with the limitations for the total women population and those of elderly women in particular.

A reason to focus on the needs of the elderly is that Europe's ageing population is growing and is not expected to decrease anytime soon. The UN predicts that in 2050 34% of the European population will be 60 years old or older. It is noticeable that elderly women outnumber elderly men and have a higher life expectancy.
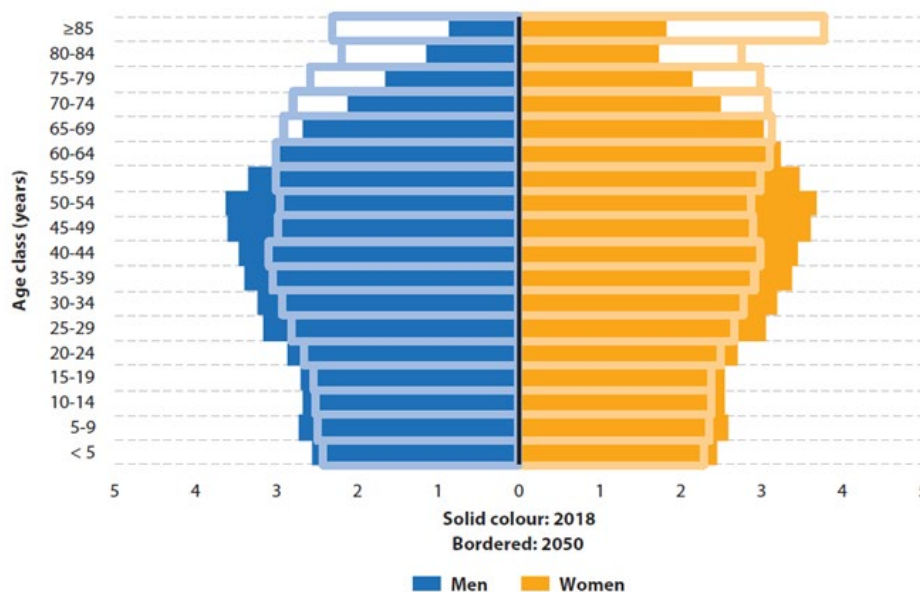

Figure 24 - Population pyramids EU-28 2018-2050 (source EUROSTAT)

Concerning digitalisation, the elderly could be referred to as "users" and "non-users" or "adopters" and "late adopters". The physical and mental barriers that occur with age could influence the adoption of digital mobility solutions. The "self-perception of age" can impact the use of digital technologies and hinder the use of digital mobility solutions. IT services often are not targeted to elderly's needs which leads the elderly thinking that these services and products are not tailored to them. Statements such as they feel "too old" or "alienated" together with an increasing fear of "breaking things" do not make it easier for the elderly to adopt digital tools in their daily lives.

The data used for this analysis are the one resulting from previous work performed in the DIGNITY project and in particular in the four pilots - Flanders (BE), Tilburg (NL), Ancona (IT) and Barcelona

(ES) – aimed to test the DIGNITY approach and its methods in order to involve local institutions, market players and end users to jointly bridge the digital gap in the specific case studies.

The first data source was the Customer Journey Mapping (CJM) (D3.1.2), a tool developed by DIGNITY to identify on "micro level" the travel experiences of the identified vulnerable-to-exclusion groups regarding the use of digital mobility services and products. The travel experiences concerned the use of public transport for most of the pilots. The qualitative research was conducted through a so-called "small survey" and "in-depth interview" in which the participants had to rate their "before- during- and after journey experiences" in an interview. The CJM only included a sample of 36 participants in total from the four pilot areas Ancona (11), Barcelona (10), Flanders (7) and Tilburg (8) and therefore cannot be considered sufficiently representative of the total population. However, it adequately served to get a detailed understanding of the daily challenges of the participants.

The second data source was the Digital gap self-assessment (D 3.1), conducted on three levels: the micro level intended to collect data from the end-users perspective on how they experienced the implementation of digital mobility services and products; the meso level, which measured the current provision of digital mobility services and products in the specific pilot area; the macro level which on a national and regional level investigated the governance structure, the regulatory framework and the budget and outreach programs.

The third source of data was the outcome of the Focus groups gathering representative stakeholders to co-create solutions to bridge the digital gap (D 3.1). In total, 46 people participated from different vulnerable-to-exclusion groups.

The last data source were the national surveys of four countries/regions corresponding to the pilots. These surveys were essential to determine who and how uses digital mobility services and products and who is potentially excluded. This was related to their skills, attitude, education level, age, or other barriers.

5.2.1   Limitations for the elderly.

The elderly in the four pilots have indicated digital but also non-digital factors that limited them in their daily travels. Some common issues between the four pilots have been identified and are reported below.

The fast pace of digitalisation.

The continuous changes and upgrades due to technology advancements was something that elderly participants indicated as challenging. Digital developments go fast and become more and more complex. The tempo at which things change is something to be more careful considered when designing inclusive digital mobility solutions.

Access to digital devices

The pilots indicated that the share of the elderly with access to digital devices (smartphones, computers or the internet) was surprisingly low. Although the elderly are becoming more familiar with digital technologies it should not be forgotten that even if they have access to devices, it does not necessarily mean that they can make full use of them.

Low digital skills

The elderly analysed in this research had low digital skills, especially looking at the results of the Digital gap self-assessment. The two regions/cities that had the most of elderly perceiving as a limitation their low digital skills were Barcelona (78%) and Ancona (71%).

The elderly of the Focus Group in Flanders gave a concrete example of what this limitation meant for them, for example not being able to scan a QR code to access travel information due to lack of ability or availability of a digital device (a smartphone in this case) to perform the scanning.

Lack of confidence

The most impressive data is the high percentage of elderly who do not feel confident in planning a trip using digital devices. The lack of confidence and the poor digital skills could also be the reason for the low access to digital devices.

Lack of trust

The lack of trust in themselves and in the digital mobility services and products became evident from the CJM in the pilots with elderly participants. The "I am too old" comment was mentioned by an elderly man in the CJM of Tilburg. He described his self-doubt in using digital methods to find travel information: "It bothers me that the information that I find is not always correct or that I simply cannot find it. However, this might also just be me… I am not able to understand the information… because of my age. If you are younger, this is probably a lot easier." This quote demonstrated the self-blame of elderly due to age, while the way travel information is communicated could also have been difficult to understand or inaccurate. Unclear information provision has been mentioned by several elderly in the different pilots. They describe the information displayed digitally as overwhelming or insufficient. These observations need to be taken into account and it should be recognised that the manner in which information is provided might not respond to the needs of the elderly. The automatization of phone calls, for examples, was experienced as a limitation by the elderly. They described getting "a robot" on the phone using unfamiliar language made it difficult to understand the information that was given.

Unreliability

The elderly in the various pilots from the CJM and the Focus groups have reported multiple experiences in which there was a disconnection between the digital travel information and the actual transport service. As a result, these digital mobility products and services were perceived as unreliable.

The use of the ATMA travel app was a specific focus for the pilot in Ancona. All the participants (elderly included) mentioned using this app and finding the information displayed clear and

coherent. However, they did note to prefer non-digital methods over the use of this travel app because they didn't trust it even though the information was perceived as accurate.

It can be concluded that the elderly do not perceive digital mobility products as helpful. If the information is unclear, too much, or too little, they blame themselves. Ageism plays a significant role in this, portraying the elderly as technological incapable. On the other hand, digital mobility products should ensure that they are accurate and comprehensible for everyone, even those who are not digital native.

<u>Reliance on other persons.</u>

Reliance on others and search for human interaction to perform a digital action before or during their trip was reported by the elderly in the four pilots. The elderly were unsure about how to use digital devices because of lack of skills but also mistrust in digital products, perceived as unreliable and confusing. In most of the answers given in the CJM and Focus groups, the elderly mentioned that they turn to their partner or family with questions concerning digital aspects such as buying a ticket online.

Some elderly do not always encounter people willing to help. This situation caused, in some cases, emotions of uncertainty and "shame". The disadvantage of relying on others is that they will not improve their digital skills because they do not have to. At the same time, improving their digital skills would only be possible if they had access to digital technologies and become confident with them.

<u>Dependency on non-digital methods to find travel information.</u>

The frequent use of non-digital methods to travel is a common issue. To stay independent, the elderly tend more towards non-digital methods and means. They prefer human interaction, a form of non-digital method, which they consider more reliable and "flexible".

Another common experience is the use of a written copy of the travel information obtained through digital means because they fear not being able to find the correct digital information during the trip.

On the basis of such surveys several measures were recognised apt to support the inclusion of elderly people in the transition period to more generalised digital abilities:

- **Combination of digital and non-digital information**. The elderly expressed the need of having easy use of digital mobility systems without reducing non-digital alternatives. Therefore, it could be detrimental to their mobility if digital methods replace completely paper or human-related information.

- **Clear and specific information**. Some elderly didn't find the information displayed on digital signs, apps or websites to be easy understandable. Less complex information, fewer technical terms and more assistance should be available.

- **Training to improve digital skills**. In spite of their low digital skills and low use of digital methods to find travel information the elderly are willing to learn. In person training sessions for example were suggested to overcome difficulties.

5.2.2   The case of elderly women

The data on the elderly in the CJM, Digital gap self-assessment and Focus groups lack of robust disaggregated data on women's mobility and their attitude towards digital mobility services and products.

The CJM was the only research method that mentioned the gender of each participant per pilot and to what vulnerable-to-exclusion group they belonged. This, however, did not allow to assess whether something was impacted by gender or not. Comparisons could not be made based on the CJM because the women and men within the different pilots did not belong to the same vulnerable-to-exclusion group and the unequal representation of men and women in the same vulnerable-to-exclusion group made it difficult to assess whether experienced limitations were due to gender or other factors.

Further research was conducted based on the results of the quantitative analysis of the national survey dataset for Italy.

Impact of gender and age on smartphone ownership

Comparing the women of the total population and the elderly women, elderly women (37%) did own less frequently a smartphone than the total population of women (77%) (Figures 26 and 27). Overall, the elderly women and men owned less frequently a smartphone than the women and men of the total population. This indicates that age has a higher impact than gender.
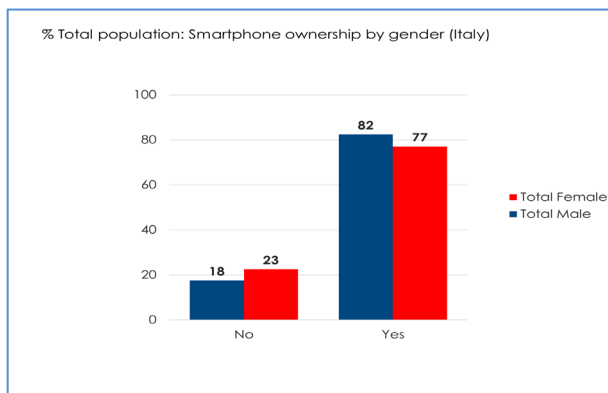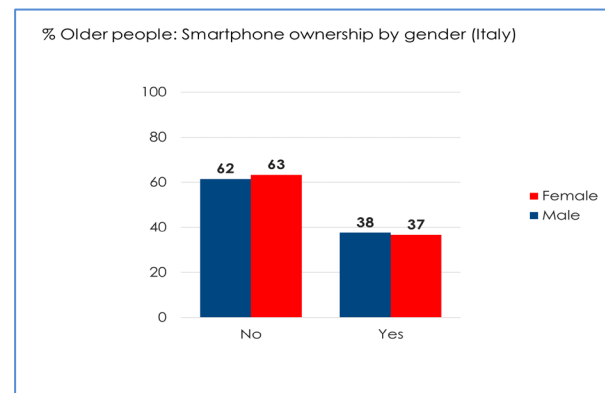

Figure 26 - Smartphone ownership by gender - Total

Figure 25 - Smartphone ownership by gender - Elderly

Impact of gender and age on internet access

There is a big difference between the access to the internet among the total population and the elderly. Elderly women have less access to the internet compared to the women of the total population group. Elderly women and elderly men are almost equally disconnected from the internet, suggesting that age is more relevant than gender. (Figure 27 and 28)

Interestingly elderly women have more frequent access to the internet than men, even if the percentage difference is small, but fewer women than men own a smartphone.
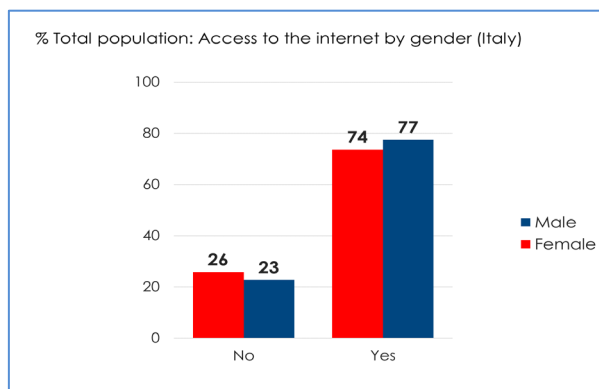

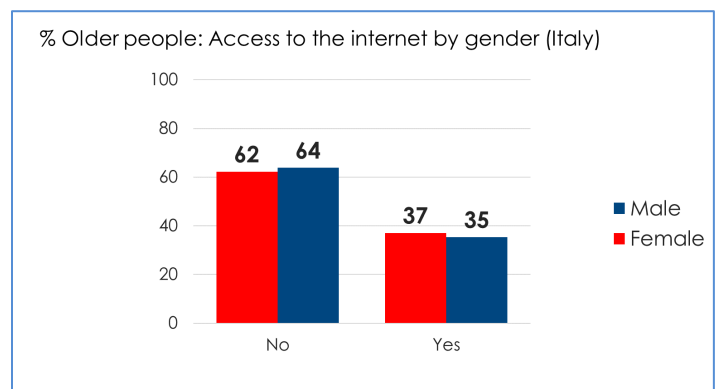*Figure 28 - Access to internet by gender – Total*

Figure 27 - Access to internet by gender - Elderly

Confidence to plan a trip using a smartphone

The elderly group was not very confident in using a smartphone to plan a trip compared to the total population group. This was assumed to be related to their low digital skills and the low reliability of these digital travel information sources, as already reported above.

Elderly women gave themselves more often a lower confidence level than the elderly men, but the percentage difference was slight: 55% of elderly women gave their confidence a 1 out of 10 compared to 53% of elderly men. It is to be noted as well that 9% of the elderly women also gave their confidence a 9 out of 10 compared to 5% of the elderly men (Figure 29). **A clear gender impact could not be identified** but being of an older age did impact the low confidence to plan a trip using a smartphone.
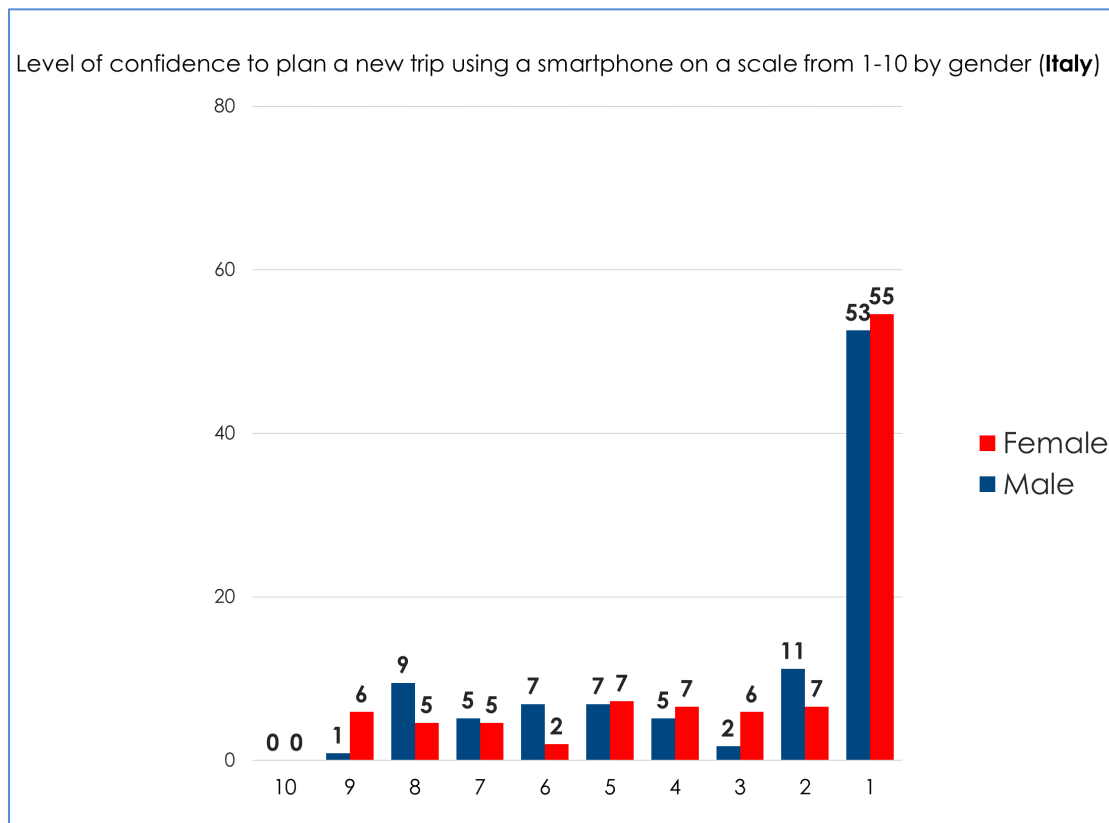
Level of confidence to plan a new trip using a smartphone on a scale from 1-10 by gender (**Italy**)

Figure 29 - Level of confidence by gender

Lack of digital skills to plan a trip

On average, men feel less limited as 69% said to be "not limited at all" compared to 58% of women.

The impact of gender within the group elderly was bigger. 40% of elderly women indicated to be more frequently "very limited" compared to 27% of elderly men.

Comparing the experienced limitation due to digital skills by the women in the total population and the elderly women (fig. 30 and 31), shows that being of older age is critical: 18% of the women in the total population experience being "very limited" against the 40% of elderly women. **The impact of age on top of gender increases the experienced limitation.**
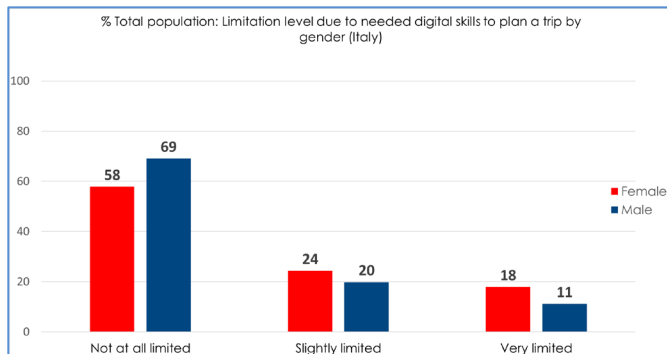
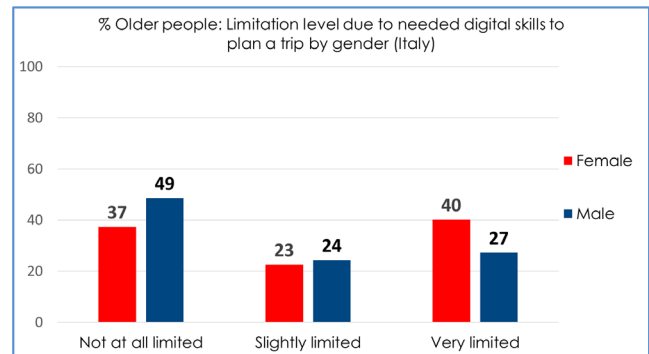Figure 30 - Limitation due to low digital skills – Total

Figure 31 - Limitation due to low digital skills – Elderly

Digital methods to find travel information.

By comparing the population that listed digital methods to find travel information with the group of elderly, it highlights that the elderly do not use digital methods as frequently as the total population. This could be related with their lower ownership of digital devices such as smartphones, which became already apparent in the first analysis of the elderly.

In the total population group men listed to use digital methods to find travel information by 8% more than women. For the elderly group, the elderly women (19%) surprisingly listed digital methods to find travel information slightly more than the elderly men (17%). The percentage difference is small but worth mentioning.
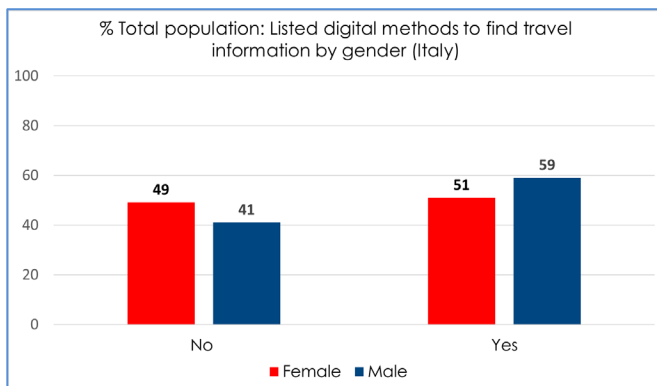

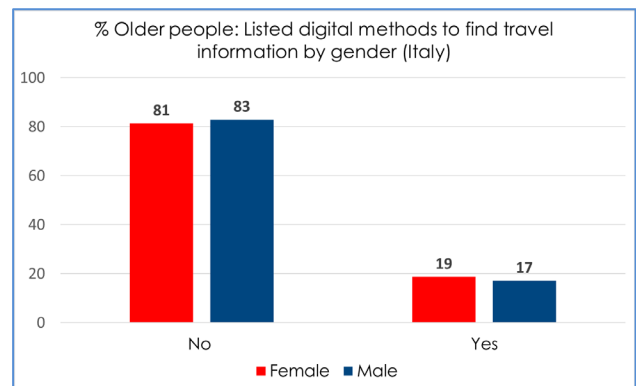Figure 33 - Use of digital methods to find information – Total

Figure 32 - Use of digital methods – Elderly

Non-digital methods to find travel information

In the total population group, women (21%) tend to list non-digital methods more frequently than men (11%). For the elderly group, the listing of non-digital methods was similar indicating that 28% of elderly women use non-digital methods, against 19% of elderly men.

It is interesting to see that elderly women listed digital methods as well as non-digital ones to find travel information more than elderly men. This could mean that they take their travel information from various sources, digital or not.
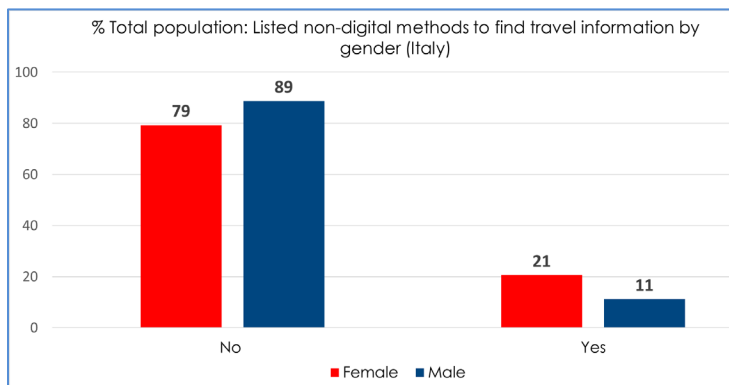

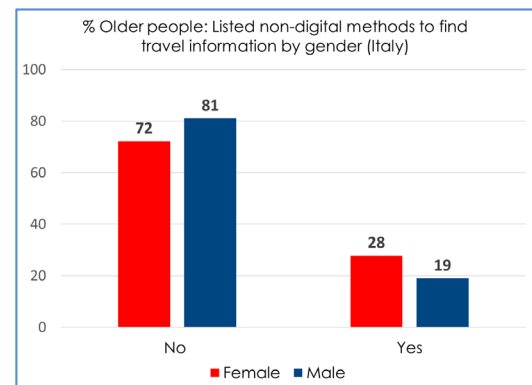Figure 35 - Use of non-digital methods - Total

Figure 34 - Use of non-digital methods - Elderly

This analysis of quantitative data showed the impact of age, gender, and the relation between these two concerning experienced limitation factors in the attitude towards ITs in mobility. Gender appeared to be much less impacting than age. Further research is surely needed, but some interesting conclusions could already be drawn based on this analysis.

It became evident that the elderly group was more limited by the assessed factors than the total population group in the sample of Italy. This could confirm that the elderly are more vulnerable of being excluded if the limited ownership of smartphone, access to the internet, low confidence to plan a trip using a digital device, and low digital skills are not sufficiently taken in consideration.

Women in general are slightly more limited by these aspects compared to men. When the elderly group is assessed, such limitations become bigger, which confirms that the combination of gender and age leads to a greater vulnerability. **Older women are the most vulnerable-to-exclusion group** if digitalisation is not properly implemented in the mobility field.

6. The role of women in digital mobility

The analysis of gender data in this report is mainly focused on women as mobility users and has highlighted some of the obstacles faced by women in their daily displacements. The non-correspondence of the transport system to women's needs is a well know issue since the 70' when research on gender and transport began. Still there is a lack of interest in gender issues by the leaders in the mobility sector, who do not mainstream questions of gender across, for example, infrastructure design or transport scheduling. There is also a lack of understanding how big is the business value of a transition towards a more integrated and inclusive system, and the consequent social equality that a more conscious technological development could bring.

Low representation of women among both decisionmakers, researchers, planners, engineers and designers in transport, and other technical sectors, combined with unconscious bias towards the average male are some of the reasons why gender-neutral and "planning for all" benefit men more than women. Several studies mentioned in bibliography have shown that when gender is not explicitly considered in the planning process the solutions are most likely to primarily benefit men, whereas the explicit consideration of gender throughout the process of planning, design, implementation, monitoring, and evaluation is more likely to create more gender equal solutions. The digitalisation of mobility requires new thinking and new interdisciplinary skills and this in turn requires radically new messages from the top. Unfortunately, transport continue to be dominated by men in a strong engineering-oriented framework.

"Gender equality in transport is still mostly understood in rudimentary terms (i.e. the need to employ or promote more women). And there is still a lot of lip service which is evidenced by the lack of granularity and detail around gender equality initiatives." ("*The Real Reason Why Mobility is Not Women-Friendly*" - 03/10/2019 | Long Reads, Urban Mobility Weekly, Blog).

The presence of women as transport administrators, planners, designers, and providers of new mobility solutions must be enhanced to ensure the effective implementation of a better mobility not only for women, but for everybody who does not fit the average male norm.
Traditional operators have little capacity or interest in assessing and understanding the socioeconomic impact of an unequal mobility system. That is why governments need to collect and use disaggregated data and incentivise collection and analysis of gender segregated data, impact assessment analysis with focus on gender, user needs and preference analysis and involve both men and women in planning and design of solutions.

The significant potential of delivering new services that can meet women's needs is often underestimated. For example, it has been proven that transport hubs, train and bus stations and bus stops, are key locations for sexual harassment of women. Yet this significant problem does not drive technology-led innovation; the sometimes-applied CCTV cameras, for example, are not perceived by women as efficient, because they cannot record verbal harassment and the lack human presence hinder the possibility to ask for immediate help if needed.

We know that women use shared services like carsharing, ride sharing, and e-scooters less than men do, but it is not because the services are digital but rather because the services do not fit their needs.

Women are more than half of the population. Women are not niche, a deviation from normal or a minority. It is urgent to consider their needs and obstacle to achieve a full transport justice that also has consequences on women's health, safety, and everyday life and mobility. Women are not "vulnerable users", it is the system that creates vulnerability for them.
It is important to enhance the presence of women among administrators, who could push forward ad hoc measures and ensure the correct budgeting for gender mainstreaming. Their role could enhance the Affordability, Availability, Safety and Reliability of the mobility system.

Women planners can fully consider the gender barriers in Accessibility and Safety and implement approaches to mitigate such obstacles. Simple measures, such as on-demand bus stop to avoid long walking in an unsecure environment, could be a first solution to this problem.

Designers and providers of digital mobility solutions should be encouraged to develop simple but innovative products to enhance Availability, Ability, Affordability and Appetite (Safety) for women and allow them to fully benefit from a digitalised mobility.
Only a few examples of women-specific digital systems are available at present and focus on safety, as the predominant factor impacting women's mobility. Among them the "W-Her" platform, the first navigator developed by women for women, where women recommend roads according to how safe they consider them to be. Women enter evaluations on the streets and, by doing so, give life to a new vision of the city (Bibl. 36).
The new share-driving systems raised some security concerns when they were launched on the market. These services posed questions about the personal safety of female passengers, faced with unregistered drivers or unknown fellow passengers. These new concerns have been studied, also under a gender perspective, to ensure the potential benefits of the services and led the industry in developing new technology. For example, the Uber Safety Toolkit, allows a new standard for safety with an in-app emergency button, makes it possible to share the trip status with family and friends, verify the ride with a unique PIN code, call the police, and much more.

The solution is not only about designing more inclusive products, it is also about if and where these services are made available and how. A close collaboration between administrators, planners, designers and users is the only way to achieve a mobility system that is fair and inclusive.

7. Lessons learnt

Several studies in the last decades have proven that women's mobility needs are not fully met by the transport services (see bibliography). There is also a gender gap in digital skills where men appear to be favoured. Introducing digitalisation in mobility systems risks worsening the inequality and enlarge the gender gap.

The data analysed in this study have confirmed the trend already presented by previous research: the digital gap between men and women is quickly closing in the younger generation and this can be seen as an evidence of stereotypes change in modern society.

It is therefore inappropriate to depict women as a single heterogeneous group of vulnerable-to-exclusion individuals because of their digital skills, as such statement would reinforce the prejudice that women have scarce technological attitude.

It is wrong to identify women as "vulnerable users", as the vulnerability does not lie in the essence of being a woman but is rather inducted by a system that does not consider specific constraints and requirements.

In the case of digital mobility, the vulnerability-to-exclusion has clearly appeared to be dependent on several socio-economic-demographic factors more than on gender. Elder age and low level of education appeared to be the reasons most affecting the improvement of digital skills. Elderly women can therefore be considered amongst the most vulnerable-to-exclusion sub-groups of population.

Intersectional approach to analyse data is essential to proper identify the indicators impacting full fruition of digital technology and to understand and consider the needs and characteristics of all end-users in the design of digital mobility solutions.

In-depth analyses are only possible if data are collected considering all requirements needed for adequate disaggregation in representative sub-groups. Pilots by their specific nature focus on a limited sample of population representative of geographical location. It would be beneficial if all pilots apply the same methodology in data collection, so to facilitate aggregations and comparisons on a larger sample of users.

The study has also confirmed that the major barriers for women's mobility remain cost and safety, as already demonstrated by previous research. These barriers are not dependent on the digitalisation of the system and are not mitigated by the digital solutions developed so far. A broader assessment of socioeconomic implications of new products and services is needed to ensure that all users will benefit from the potential improvements and barriers are removed.

A larger participation of women, and other vulnerable groups, in the design of digital mobility products and services is crucial to implement measures that will meet their needs. The DIGNITY approach and the developed Tool Kit are suitable to ensure that the mobility requirements of the largest group of users are understood and that appropriate measures are implemented.

Gender inequality in the ICT profession is also evident. The lack of women in teams developing technology has an impact on its fruition as well. Policies and initiatives aimed at increasing gender equality in the digital sector should support girls in STEM studies.

Training opportunities to increase and update digital skills for both women and men should be considered for all users in need of them, and appropriate resources should be allocated for their implementation.

8. Recommendations

Women cannot be considered as a homogeneous group: a lot of differences depending on socio-economic-demographic factors can be reported within the group. Furthermore, gender is also a cross-cutting issue in all other groups of population. It should be considered whatever group is analysed.

The DIGNITY Tool Kit should refer clearly to the need to perform intersectional analysis of gender data.

Elderly as well present a number of diversities within the group. Not only "age grouping", but also other factors like employment status, physical and mental incapacities, social grade should be considered with an intersectional approach to better define their needs.

It is also to be noted that, as far as digital technology is concerned, the present generation of elderly is a "transition" one. In a decade from now elderly will be much more digital literate than today. Leaving analogical alternatives to the use of this present generation could be an easy way to lead the transition. In any case attention should always be drawn on the pace of development of digital products, experienced by today's elderly as a major barrier possibly due to the longer time of adaptation to innovation depending on age.

Altogether the development of digital systems for mobility is not targeted to solve the limitations faced by vulnerable-to-exclusion users. Apparently the "business case" of this kind of products is not fully perceived. It is important to give impulse to designers and steer innovation towards solving obstacles that could be profitable, as it has been proven that solutions that benefit women and other vulnerable users will at the end benefit the whole population.

A last remark is the need to rethink the definition of "vulnerable" connected to women. Their vulnerability does not lie in the essence of being a woman but is rather created by a system that does not consider specific constraints and requirements. Therefore, a gender-sensitive design of the transport system and its means (vehicles and digital tools) will meet the needs of this population group and drastically reduce their "vulnerability".

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