Framing Digital Mobility Gap: A Starting Point in the Design of Inclusive Mobility Eco-Systems

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Abstract. Digital transport eco-systems worldwide provide great advantages to many but also carry a risk of excluding population groups that struggle with accessing or using digital products and services. The DIGNITY project (DIGital traNsport In and for socieTY) delves into the development of such eco-systems to deepen the understanding of the full range of factors that lead to disparities in the uptake of digital transport solutions in Europe. A starting point for developing digitally inclusive transport systems is to obtain state-of-the-art knowledge and understanding of where local transport eco-systems are in relation to the digital gap and digital mobility gap in terms of their policies, transport products and services, and population digital literacy. This chapter presents the methodology developed in the DIGNITY project to frame this digital gap, incorporating a self-assessment framework that may be used by public authorities to identify potential gaps in the development of local digital transport eco-systems. This framework is informed by results from customer journey mapping exercises that provide insights into the daily activities and trips of users, and larger scale surveys on digital technology access, use, attitudes and competence in the area. In the DIGNITY approach as a whole, the results from the framing phase are then used to inform subsequent work on bridging the digital gap through the co-creation of more inclusive policies, products and services. The chapter provides concrete results from the framing exercise in four DIGNITY pilot areas: Barcelona, Tilburg, Flanders and Ancona. The results clearly show that a digital transport gap exists in these areas, and that this is manifested in different ways in different local situations, requiring tailored approaches to address the gap.

1 Introduction

"Transitioning from a paper card to a chipcard to use public transport, gave me a lot of anxiety. It took me a long time to learn where to hold my card against the machine to validate my ride, which embarrassed me towards other passengers" says an elderly woman. A low-income, migrant woman mentions: "I buy tickets at the station, because I

don't have an online account to buy them. I don't like to pay by mobile because I'm not very tech savvy". Visually impaired man states: "With apps, you cannot zoom in and I do not always carry glasses with me. Then I use voiceover. I can use it, but I do not like it personally". An elderly couple share their experience: "I would rather do it by phone because I'm afraid I'll make a mistake and give them too much money; I am not confident enough on the computer. I just prefer to speak to someone" (Nesterova et al. 2021). While digitalisation of different economy sectors and transition to smart cities are becoming our everyday reality, there is also a growing concern that the fast digitalisation pace leads to disparities in the uptake of digital transport solutions within different population groups in Europe, becoming a new risk factor for transport poverty. Public authorities are faced with a challenge to combine the opportunities from the digitalisation of the mobility eco-system with problems arising from this process. Banister (2019) says: "As with many innovations that have huge potential to benefit all society, it is the rich and those with the necessary knowledge and supporting infrastructure who are the main gainers. However, if the objectives of transport policy are to reduce levels of relative and absolute inequality, then priority needs to be given to providing the means by which all members of society can benefit from innovation". A starting point for the development of the digitally inclusive transport systems is to obtain state-of-the-art knowledge and understanding of where local transport eco-systems are in relation to the digital gap and digital mobility gap in terms of their policies, transport products and services and population digital literacy.

The DIGNITY project (DIGital traNsport In and for socieTY) delves into the development of digital mobility eco-systems and contributes to the better understanding of the full range of factors that lead to disparities in the uptake of digital transport solutions in Europe. Financed under European Union's Horizon 2020 research and innovation programme, DIGNITY brings together the partners from 6 countries, to analyse the digital transition from user and provider's perspective and to design, test and validate a novel concept for development of the digital inclusive travel system. DIGNITY approach is developed and validated within four pilots:

- The pilot in Ancona, the capital city of the Marche region (Italy) with less 100000 inhabitants.
- The pilot in Barcelona, embracing a population of 1.7 million inhabitants.
- The pilot region of Flanders, with population of around 6.5 million inhabitants.
- The pilot in Tilburg, a city located in the south of the Netherlands, which counts 217595 inhabitants.

This chapter provides an overview of the methods available for the public authorities to frame the digital mobility gap in their region, as a starting point in the development of the inclusive mobility eco-systems.

2 Framing the Digital Gap

Design of the inclusive mobility eco-system requires an integral approach that brings together needs, attitudes and requirements of the transport stakeholders on micro, meso and macro levels:

- The Micro level of the DIGNITY comprises all citizens and all possible users of digital mobility products and services.
- The Meso level of the DIGNITY is about the digital mobility products and services available within a region.
- At the Macro level, the institutional structure of a region is considered (political administration, as well as other forms of political regulation, network governance and the interdependence of political decision-making levels).

Integrating these three levels into one holistic DIGNITY methodology, it proposes to take a three-phase approach (Fig. 1). Within this approach the "framing phase" creates an understanding of how much the digital divide contributes to the mobility poverty of different population groups; "bridging phase" focuses on co-creation of the solutions for design of more inclusive transport policies, products and services; and "evaluation phase" looks at impacts of the overall process and ensures contribution to the formulation of the long-term strategies to fill in the gap.

Fig. 1. DIGNITY approach to the development of the inclusive mobility eco-system.

This chapter presents the "framing phase" of the methodology. It suggests to start with the self-assessment framework that allows public authorities to identify potential gaps in the development of local inclusive digital transport eco-systems. Framing phase looks at how many people are at risk of being excluded in the mobility sector and why. By analysing how and why target groups are using (or not) existing products and services, a more detailed understanding of vulnerable users and their needs is created. Thus, the objective of the framework is to support public and private mobility providers in generating a knowledge; where current digital transport systems risk leaving some population groups behind, and 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. The framework is informed by results from customer journey mapping exercises that provide insights into the daily activities and trips of users, larger scale surveys on digital technology access, use, attitudes and competence in the area, and focus groups zooming into the needs and attitudes of the specific population groups, further detailed in the following paragraphs. Results from the framing phase provide an overall understanding of the digital gap in mobility, allowing to

zoom into the different stakeholder groups and getting a more in-depth knowledge about challenges of each. Within DIGNITY approach as a whole, the results from the framing phase are then used to inform subsequent work on bridging the digital gap through the co-creation of more inclusive policies, products and services.

3 Building Blocks of the Framing Phase

DIGNITY framing phase includes four distinctive methods:

- The digital gap self-assessment
- Customer Journey Mapping
- Large Scale Surveys
- Focus groups.

3.1 The Digital Gap Self-assessment in Mobility

The digital gap self-assessment framework provides cities and regions with a clear representation of the digital gap in mobility in their region. It includes:

- the knowledge about digital abilities and mobility of citizens;
- an overview of the current market supply of digital mobility products and services;
- and the policy readiness to act on digitalisation in mobility.

Performing the digital gap self-assessment helps public authorities to identify focus areas in their policy making processes.

The method combines in one comprehensive framework the state of mobility digitalisation at three DIGNITY levels (Fig. 2). Each of these levels is further detailed in the groups of indicators (composed of the detailed indicator set):

- Micro level indicator groups are: digitalisation in mobility; population; mobility; digital ability.
- Meso level indicator groups are: usage by vulnerable groups; stakeholders; digital transport provision.
- Macro level indicator groups are: government structures; regulatory framework; budget and outreach programs.

The self-assessment method offers a description of these indicators, possibilities for data collection methods and provides an Excel-sheet to fill in the collected information. The methods for data collection are, for example, the use of national or local statistics, population surveys (micro-level), cross-department working or focus groups within public authorities, questionnaires towards mobility providers (meso-level); interviews within public authorities and focus groups (macro-level).

Establishment of the links between micro, macro and meso levels (Fig. 2) allows to identify the areas where potential gaps in the inclusive mobility eco-system exists. For example, combining micro and meso level data makes visible the supply (or lack
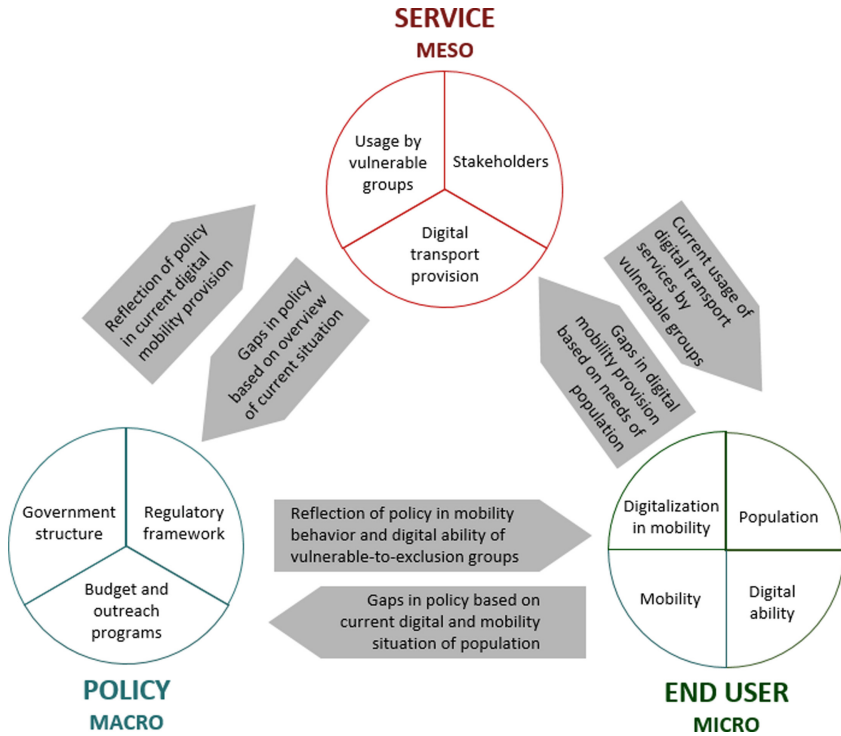
Fig. 2. DIGNITY self-assessment framework

of it) of digital mobility products/services to specific vulnerable to exclusion group. It becomes clear if a group is underrepresented in the use of a product/service and where inclusive design has a potential to improve it, making it accessible to larger population groups. Bringing the information of meso and macro level together, can help to identify the gaps in policy and regulation necessary to create an inclusive mobility eco-system. Finally, the micro level data provides important information for local authorities at the macro level. Combining data from these two levels allows to identify which vulnerable to exclusion group experiences mobility poverty the most, how big is this problem and where a dedicated regulative and institutional support is the most urgent.

All DIGNITY pilots have performed the self-assessment for their municipality/region as the first step in the framing phase. Within the evaluation phase they expressed that this method was very structured, detailed and sometimes too complex. Improvement can be achieved in better guiding the stakeholders in the data and information to collect and in the advice on how to combine different information sources. A more flexible and less structured method would be more beneficial in some cases. Overall, the self-assessment data collection process allowed to realise what data types are missing in local context to create a full understanding on the scope and size of the digital mobility gap problem.

Results for this self-assessment methods provide public authorities an overall understanding of the size of the digital gap in mobility, allowing to zoom into the different

assessment levels and getting more in-depth information for each of the levels. With this, potential gaps in policy and supply of mobility services can be derived. The Fig. 3 below shows the data, collected by large scale surveys, from the use of digital services in Flanders among different vulnerable-to-exclusion user groups (micro level). In this graph, elderly, people with disabilities and people with low education can be considered as the less confident to plan a public transport journey using internet or an app. This, for example, provides a clear insight for policy makers that this group needs another than digital approach (or support in digital approach) within this activity.
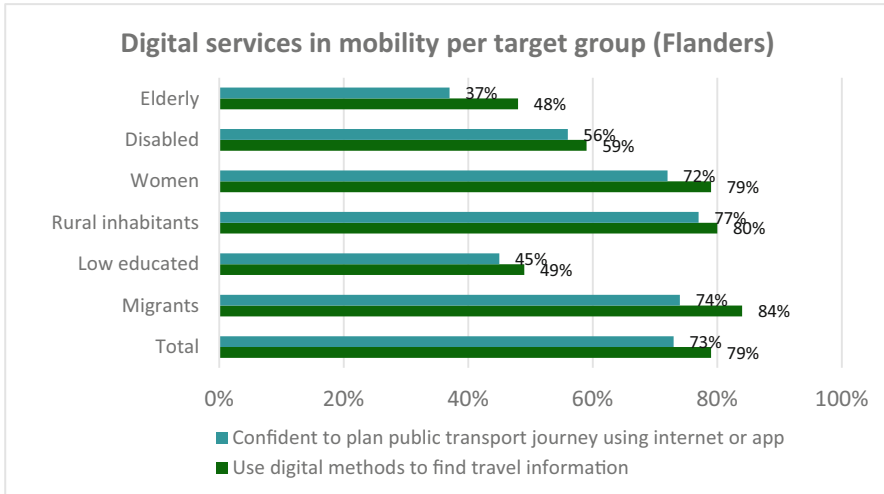

Fig. 3. Example of the self-assessment result: digital services in mobility per target group in Flanders.

Another example is shown in Table 1 where the list of main mobility services and products in Barcelona are identified (meso level). This shows the diversity of the market supply of digital mobility products and illustrates that alternative to the digital version is not always available on the market, meaning that some vulnerable to exclusion user groups are partially excluded from this mobility option. Combination of interviews; literature review and media review was used to collect this information.

On the macro-level, self-assessment framework results have indicated the pilots the readiness or unreadiness of the institutional and regulatory system for the digitalisation in mobility. For example, it was even difficult to find specific references to digital mobility in policy documents, showing unexplored potential for departments to be involved in the digitalisation of transport. In Tilburg, cross disciplinary collaboration is already taking place and vulnerable-to-exclusion groups are involved in policy developments. However, it is acknowledged that the complexity of the government structure results in a barrier for certain groups in Tilburg to be well involved and represented in the decision-making process on inclusive mobility.

Table 1. List of main mobility services and products in Barcelona.

Category of digital service or product	Number of services and examples	Non-digital alternatives for product or service
Trip planning	Around 10: City trips, google maps…	Static information of bus lines
Navigation	5 to 10: HERE, INRIX, Garmin…	Paper maps
Parking payment	5 to 10: Wesmartpark, Via-T, Smou,…	Non-digital parking payment
Consumer car sharing	Less than 5: Ubeeqo, Virtuo	No non-digital alternative
Personal car sharing	Less than 5: Social Car, Getaround	No non-digital alternative
Corporate car sharing	Less than 5: Ubeeqo	No non-digital alternative
Ride splitting	Less than 5: Blablacar, Amovens, Journify, RACC Hop	No non-digital alternative
E-hailing (taxis)	Less than 5: Cabify, Social Car	Taxi
Demand responsive public transport	Less than 5: Shotl, Ne-MI	No non-digital alternative
Bike sharing	Less than 5: Bicing, Donkey Republic, Mobike	No non-digital alternative
Other vehicle sharing	Scooters around 5: Yego, Cooltra, SEAT MÓ, Acciona, Movo, Gecco Kick scooters less than 5: Reby	No non-digital alternative
Vehicle information	10 to 15: Google maps, apps of mobility services…	No non-digital alternative
Parking information	Around 5: Parkopedia, Parclick, Telpark, Wesmartpark	No non-digital alternative
Facility information	Charging station apps 5 to 10: AMB-electrolineres, Charge Map, Plug share. Bike stations less than 5: Google maps, City trips	No non-digital alternative
Travel information	5 to 10: Waze, Mou-te, RACC…	No non-digital alternative
Roadside assistance	Less then 5: RACC assistència	No non-digital alternative

3.2 Customer Journey Mapping

Customer Journey Mapping (CJM) is a method known in marketing to map and measure the experiences of users in the form of micro-scale qualitative data. In DIGNITY, it is used to understand mobility challenges of selected vulnerable to exclusion groups.

The method allows to pinpoint specific problems and issues in a predefined journey that the user will make. Collecting these insights for a specific situation or journey results in a clear improvement potential for the mobility products/services that are needed to increase the overall journey experience of the end user.

The CJM method consists in several steps:

- Define the journey;
- Define the target group;
- Define activities and touchpoints of the journey;
- Prepare research: recruit participants and prepare questions;
- Execute the research and analyses the data.

The chosen journey can be derived from the outcomes of the self-assessment method (e.g. potential gaps identified from meso and micro data) or be suggested by local industry or policy-making stakeholders. This can, for example, be a bus trip from home to the train station; the use of a new mobility service (e.g. a shared car); the use of a navigation app or buying a ticket at a ticket machine. The CJM method focuses on the moments that the participant interacts with the mobility product/service, measuring the experience of the participant during these moments. The moments are identified in advance and are divided into three different levels:

- activities; part of the journey with a specific purpose;
- touchpoints: possible aspects of the activity where the participant can receive external information from mobility provider or government;
- dimensions: aspects of the activity that might influence the experience of the partic- ipant during the activity such as availability of a seat, waiting time, perceived safety and availability of information.

These activities and touchpoints create the basis of the CJM research and help to pinpoint the opportunities for improving travel experiences of the target group. The data that is collected by the CJM research consists of a survey before the journey, questions and observational data during the journey and interviews after the journey. The survey before the journey is meant to get an overall picture of the participant focusing on digital skills, mobility behaviour and use, and experience with the journey that is part of this CJM research. The observations and questions during the journey give insights in where (touchpoint) participants experiences problems or issues and which activities or touchpoints need attention in order to improve the total journey experience of this user group. During the journey the participants are asked to score their experience for each activity using a 1 (very uncomfortable) to 10 (very comfortable) scale. The interview after the journey elaborates on this and dives into the emotions and reasons behind the experience of the participant. The overview of the DIGNITY pilots customer journey parameters are summarised in Table 2.

The outcomes differed a lot per pilot. For example, in Tilburg, elderly participants mentioned the difficulties they experience when exiting the bus or train and that it is challenging to find the right direction, especially at larger central stations. Clear signages would be helpful for them. Other participants expressed that they sometimes

Table 2. DIGNITY pilots Customer Journey mapping overview

DIGNITY pilot	# participants	Target group	Defined journey
Ancona	11	Elderly, people with disabilities	Use of local bus service and digital planning app
Barcelona	10	Low income, woman	Local bus trip to work
Flanders	7	Elderly in rural areas	Use of dial-a-bus service (it is called Belbus); a service that helps people travel by bus in less populated parts of Flanders. Reservation can be made upfront via phone or internet
Tilburg	9	Elderly, low income	Bus trip from home to train station (including preparation)

feel alarmed or uncomfortable with fellow passengers in the bus. Representatives of the low income group indicated that their preferred payment method was cash over digital methods; and that they are more often using smartphone than a computer for the digital operations. In Flanders pilot, participants appreciated possibility to use the phone for making reservations of the dial-a-bus service. Especially for people with low digital capabilities this service is very successful. In Ancona, almost all participants mentioned it was easy to find the ticket validator machine inside the bus. But when they needed help, only 5 out of 11 participants perceived the bus drivers as friendly and helpful to assists the process.

Figure 4 illustrates the scores that participants gave for each of the journey activities in the CJM research in Ancona. Each line represents a participant and each number corresponds to the feeling participants had during that activity: 1 means very uncomfortable and 10 is very comfortable. Some of the scores of participants are the same and therefore are not visible in this graph. The activity with the lowest scores has the potential to be improved which will be beneficial for the overall experience of the journey.
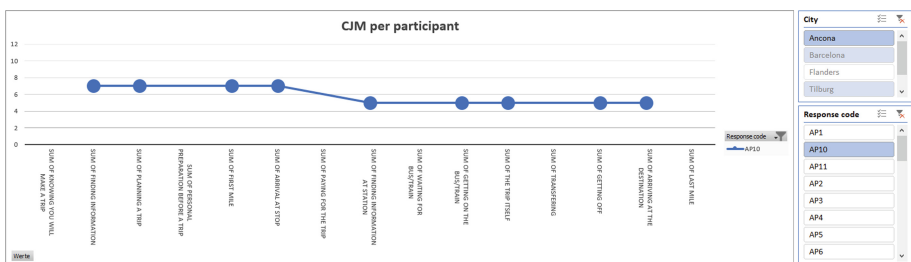

Fig. 4. Ancona pilot CJM participant scores.

The information gathered with the CJM method provided a detailed and clear insight on the experience of the participants. It enriches the quantitative data that is collected in

the self-assessment tool and shows specific examples of how the participants experience the journey. Conclusions need to be carefully drafted and interpreted, since the method involves the experiences of a limited group of people. Overall, pilots expressed that using this method gave them new information about the experience of the product/service. Both the product/service developers and public authorities appreciated it for the insights on the usability of product or service by a specific user group, allowing to get information for potential improvements in order to increase the user experiences of the user group.

3.3 Large Scale Surveys

The understanding of the digital mobility gap can also be informed by large scale surveys. As part of the DIGNITY project, a questionnaire was developed to support this, examining a range of factors that affect the use of digital mobility systems. It was based on an earlier survey conducted in the UK in 2019 (Goodman-Deane et al. 2021) and covers technology access, technology use, limitations in travel, attitudes towards technology and basic digital interface competence. Most of these were assessed using multiple-choice self-report questions. The exception was digital interface competence which was measured using a simplified paper prototyping method. Participants were shown paper mock-ups of smartphone interfaces and indicated on the mock-ups what they would do next to achieve eight simple tasks. The questionnaire was initially developed in English and then translated into the local survey languages by professional translators.

Surveys were conducted using this questionnaire in five countries or regions, including four related to the DIGNITY pilot areas (the Barcelona Metropolitan Area, the Netherlands, Flanders and Italy) plus Germany. All of the questionnaires were administered in face-to-face interviews, to enable the inclusion of people without Internet access and obtain a better picture of the digital mobility gap. The surveys were conducted at different times in 2020 and 2021, as was possible under local COVID-19 restrictions. All surveys were conducted in a manner compliant with these restrictions, maintaining social distancing and wearing face coverings as appropriate. Quota sampling, area sampling and stratified sampling methods were used in the different surveys. Ethical approval for the surveys was obtained from the University of Cambridge Engineering Department ethics committee. More information on the surveys is available in (Goodman-Deane and Waller 2022), the German dataset is available open access at (Goodman-Deane et al. 2022) and the remaining four survey datasets will also be made available open access on the UPCommons repository by the end of 2022 (UPCommons n.d.). The questionnaire itself is provided in (Goodman-Deane and Waller 2022) so that others can use it to examine the digital mobility gap in other regions and areas (Table 3).

The surveys provided important quantitative information about the end-users and their needs and characteristics. The pilot partners all described the survey data as very important for an exhaustive analysis of the digital mobility divide and to deepen their understanding of the targeted groups at risk of exclusion. In some cases, the DIGNITY surveys were the only obtainable data sources about the topics and vulnerable-to-exclusion groups of interest to the pilot.

In general, it is important to try to achieve as representative a sample as possible and compare the survey demographics with those in the general population to help understand sample biases. The recruitment and sampling in the DIGNITY surveys were particularly

Table 3. Summary of DIGNITY survey data.

DIGNITY pilot	Survey location	Date	# parti-cipants	Weighting	Gender distribution (unweighted sample)	Age distribution (unweighted sample)
Ancona	Italy	Nov 2020	1002	By age, gender and region	Male 49% Female 51%	Age 16–39 26% Age 40–64 50% Age 65+ 24%
Barcelona	Barcelona Metrpolitan Area	Nov-Dec 2020	601	None	Male 48% Female 52%	Age 16–39 35% Age 40–64 42% Age 65+ 22%
Flanders	Flanders	June-Sep 2021	418	By age, gender and region	Male 49% Female 51%	Age 16–39 42% Age 40–64 36% Age 65+ 22%
Tilburg	The Netherlands	Sep 2020, July-Sep 2021, Nov 2021	423	By age and gender	Male 49% Female 51%	Age 16–39 37% Age 40–64 37% Age 65+ 25%
N/A	Germany	July – Sep 2020	1010	By age, gender and region	Male 48% Female 52%	Age 16–39 33% Age 40–64 41% Age 65+ 20%

affected by the COVID-19 pandemic. In particular, some potential participants may have been wary about taking part in a face-to-face interview due to the risks of infection. This is likely to disproportionately affect older people and those with underlying health conditions or disabilities. Both of these groups have lower levels of technology use and competence (Goodman-Deane et al. 2022). In addition, people who are less interested in technology may have been more reluctant to take part in a survey about technology. As a result, the surveys may underestimate levels of digital exclusion.

Some participants had difficulties understanding some of the technological concepts and experiences mentioned in the questionnaire. This could hamper statistical analysis

as it is difficult to determine whether a response of "don't know/prefer not to answer" can be attributed to a lack of knowledge/confidence or to the interviewee being tired or confused. In the surveys, this was addressed by the interviewers working to encourage the participants to collaborate and to keep their attention, so that the interviews could be completed successfully. Some extra explanation of technological aspects could also be added to the questionnaire.

The study used a paper prototyping method for assessing basic digital interface competence. This is in contrast to the self-report methods commonly used in large scale surveys and provides a more reliable and direct insight into participants' technology competence. However, it is less reliable than tests carried out on live interfaces, where participants can explore the interface and try out different actions. This limitation was mitigated by selecting straightforward tasks in which success was largely dependent on a single tap of something currently visible on the screen. Another issue is the sampling variation between countries which makes cross-country comparison difficult. For example, Germany and Italy had large samples that attempted to be population-representative while the other surveys had smaller, less reliable samples.

The results from the surveys indicate that substantial numbers of people in all the surveyed countries lack access to or do not use digital technology. For example, between 6.0% (in the Netherlands) and 19.7% (in Italy) of the sample had not used a smartphone in the previous 3 months (see Fig. 4). Digital mobility services requiring the use of a smartphone app are likely to be particularly exclusionary because the user needs to know how to install an app as well as use a smartphone. Furthermore, many people have low levels of basic digital interface competence, ranging from 18% in Flanders to 33% in Italy. These figures indicate that there are large numbers of people who use technology but are still likely to struggle with several aspects of a basic smartphone interface (Fig. 5).
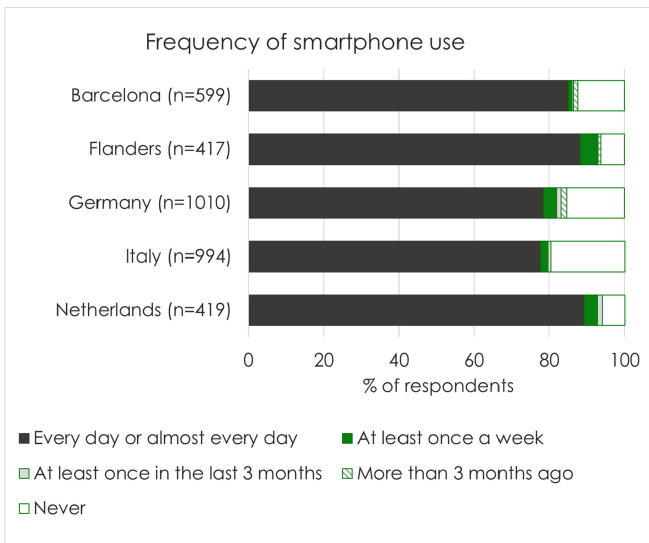

Fig. 5. Frequency of smartphone use.

The use of digital mobility services was low. Between 35% in Flanders and 87% in Italy had never used *any* of the services examined in the survey (car sharing, carpooling, digital taxi services, on-street bike hire, scooter/motorbike hire and mobile phone parking payment). However, it should be noted that differences between regions may be due in part to different levels of roll-out and availability of these services. The findings indicate that there is a long way to go before these services truly become mainstream, and it is important that service providers do not assume that users have familiarity with how they work.

There were also high levels of travel limitations: those reporting being very limited in their regular travel in the region ranged from 27% in the Netherlands to 45% in Germany. The main reasons for these limitations varied between regions. Common reasons were the cost of travel, limited availability of transport services and transport infrastructure and safety concerns. In addition, substantial numbers reported limitations because digital skills were needed to plan the travel or use the transport.

3.4 Focus Groups

A focus group brings the DIGNITY framing methodology to its conclusion. Building on a long tradition of social science research, focus groups are organised to facilitate discussions within a carefully selected small group of people. Interaction between the participants is the key distinctive characteristic of a focus group. A focus group provides insights in group dynamics, on how people form their opinion and help to better understand the perspective of the group that is being studied.

Within DIGNITY framing phase, it allows to take into account the perspectives of the vulnerable-to-exclusion end-users of the digital mobility products and services. This specific knowledge provides an added value to other data collection methods deployed in other DIGNITY framing methodology steps (Bracke et al. 2021). With this method, there is no ambition to collect a lot of new data. It enables the collection of in-depth, qualitative data on a micro level, with the goal to contextualise and better understand the already collected data. For this reason, the focus group is an ideal method to discuss and validate the results of the previous steps in the DIGNITY framing methodology.

Each DIGNITY pilot city or region were responsible for organisation and moderation of one focus group, with the number of participants ranging from 7 in Flanders to 21 in Ancona. Since the target group were people who are vulnerable to digital exclusion, a face-to-face setting was aimed for. Table 4 gives an overview of the focus group organised in each pilot. In all four focus groups elderly were represented and a gender balance was achieved. Recruiting participants from vulnerable-to-exclusion groups for a live discussion proved to be difficult, especially during the COVID-19 pandemic. Still, three out of four pilots managed to organise a (partly) face-to-face focus group, while only Ancona had to switch to an online alternative.

Given that the focus group builds on the results of the customer journey mapping and the survey mainly, the content was not fixed in advance. The topics and specific questions depend on the data and insights from these previous steps. Table 4 therefore also lists the topics discussed in each DIGNITY pilot city or region. In line with the focus of DIGNITY, two topics were discussed in all pilots: how the participants experienced limitations in their daily travel due to digital reasons; and if they think there is too

Table 4. Overview of the focus group organised in each pilot.

DIGNITY pilot	Format	# partici-pants	Target group	Topics discussed
Ancona	Digital	21	None specifically targeted, elderly, migrants and visually disabled were present	Use and trust in local mobility app, asking others (bus drivers, fellow passengers) for help during a trip, information at bus stops, personal safety
Barcelona	Face-to-face	10	Low income, migrants, elderly	Information needed to plan a trip and how to look it up, asking social network for help when digitally planning a trip, financial limitations, information at bus stops, personal safety
Flanders	Hybrid	7	Elderly in rural areas, disabled	Information needed to plan a trip, availability of travel services in the neighbourhood, reasons to opt non-digital solutions, attitude towards "Belbus" (demand responsive transport)
Tilburg	Face-to-face	8	Elderly, physically disabled	How to prepare for a trip, asking social network for help when digitally planning a trip, coping with unforeseen circumstances during a trip, use of a chipcard, financial limitations

much focus on digital solutions in mobility and whether a balance between digital and non-digital services should be aimed for.

To structure the method, a template with specific questions for each pilot was prepared. This template was completed by the pilots and further analysed by the DIGNITY research partners. A more collaborative way of designing the template with questions and the analysis might be recommended for future use, e.g. building on the pilots understanding of the local situation and the research partners knowledge could lead to a more

applicable and relevant topic list for each city or region. Being responsible for the organisation and moderation, pilot representatives were the only project partners who attended the focus groups. Therefore, a more direct involvement from them in the analysis, which was now done exclusively by the research partners, can also improve the analysis part of this method.

The focus groups were very well perceived by the pilot partners as well as from the representatives from the vulnerable to exclusion groups, who greatly appreciated the chance to be heard on the topic. Especially the face-to-face organisation, which enabled direct contact with the target group of the project, was very much appreciated. This showed the value of face-to-face, live research, even during the pandemic. Given that only one focus group in each pilot already delivered very interesting and valuable results, it is recommended to organise more than one focus group, as was the case now.

The focus groups provided extra insights into the experience of vulnerable-to-exclusion groups with digital mobility. Despite the questions being specific to the local situation, there are some commonalities in the results. These help to better understand the digital gap in mobility. First, the representatives of the vulnerable-to-exclusion groups, especially the elderly, confirmed that digitalisation might hinder them in their daily mobility. According to the Flanders focus group, working with digital services or products is often too complex, while the requirement of digital ways to buy a ticket or find information might be a reason to postpone or even cancel a trip. Participants in Ancona were worried they might do something wrong and cause the digital service to break. They therefore advocated to simplify procedures that users have to go through when using digital services. Next, in all focus groups, participants stressed the importance of personal contact for help. Both in preparing a trip as during a trip, participants indicated they often have to ask others for help, because they lack the necessary digital skills. During a trip, this mainly means turning to fellow passengers or staff, if they are present at all. In Barcelona, this is thought of as a last resort, since bus drivers are often not perceived as helpful or they don't seem to know the answer. If people need help looking up information or buying a ticket in preparation of a trip on the other hand, most participants need to rely on their social network. In Tilburg, elderly participants most often turn to children and grandchildren if digital actions are necessary. They indicated that this is not always easy, as they do not want to disturb their social network. Without a proper social network assistance for digital actions becomes more difficult, which might lead to further social isolation. Lastly, in several focus groups there was also optimism about the possibilities that digitalisation might bring about. In Flanders, for example, it was mentioned that digitalisation could add efficiency to the transport system and lead to a better integration of services. But for this to properly work and be inclusive, it is essential to involve users from all parts of society in the design of mobility products and services. Participants in Ancona mentioned another possible solution by organising easy, accessible trainings so the most vulnerable users can learn how to use digital mobility solutions.

4   Discussion

The implementation of the DIGNITY framing methodology has been concluded by all the pilots at the end of 2021. Methodological soundness and applicability of these

methods were further evaluated and validated through the DIGNITY validation approach (Lazzarini B. 2022), which provided detailed feedback on each method from the variety of the involved stakeholders. The objective was to assess the usefulness and effectiveness of individual methods deployed as well as an added value of the overall framing phase to different local/regional context. The evaluation of the framing phase has been carried out using a set of evaluation criteria, further detailed with indicators. Evaluation criteria were: effectiveness; efficiency and resources; participation and collaboration; expectations & social learning/capabilities acquired'; relationship with other DIGNITY tasks.

Overall, all the methods proposed within the framing phase were considered useful by pilots. Figures 6 and 7 illustrate it: pilot partners placed themselves on the right upper quadrant of the scheme, which describes their overall satisfaction with the framing phase. For example, pilot partners described without exception that the activities of the framing phase were very important for raising awareness of the problem of the digital divide related to mobility. It also enabled the collection of essential information for the implementation of local initiatives (Lazzarini B. 2022). Data collected through the variety of methodologies, allowed to contextualise the digital gap in a specific geographical context and to better identify the vulnerable to exclusion groups for the further policy focus.

Improvement can be achieved in the integration of the different insights/results provided by framing methods, considering the fact that the information collected through the different methodologies is quite diverse. Next, as a result of the framing phase it became evident, that there is currently a lack of public data focusing on the digital gap in mobility of vulnerable-to-exclusion groups and the need to a systematisation of a set of standard data, ideally by public administration/entities in order to support decision making.
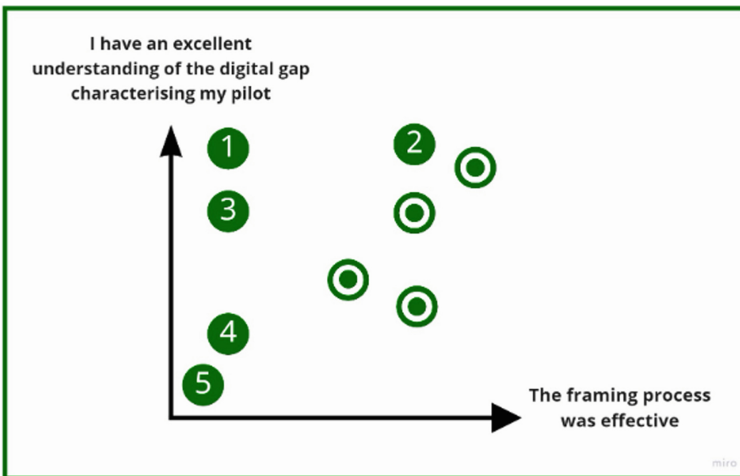

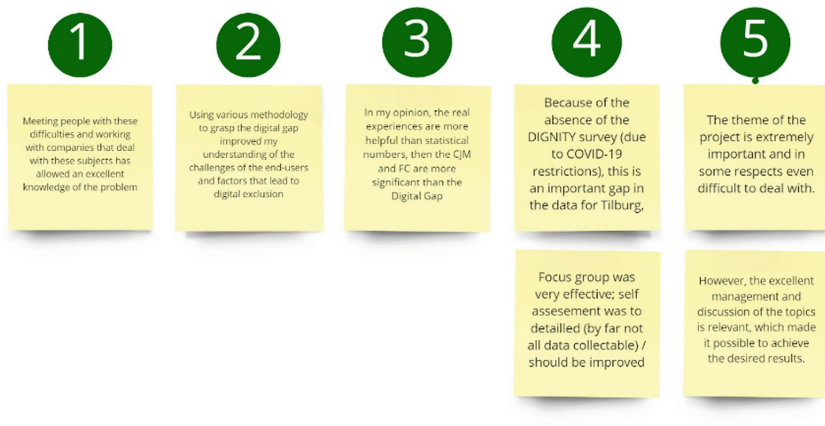**Fig. 6.** Evaluation of the framing phase by DIGNITY pilots.

Fig. 7. Evaluation of the framing phase by DIGNITY pilots.

DIGNITY framing phase proposed a portfolio of methods to assist the cities and regions in identification of the impacts that the mobility eco-system digitalisation has on different population groups. This process allows to prioritise the vulnerable-to exclusion groups to which the most attention needs to be paid on the local level within a digital mobility transition process; to identify digital mobility products and services inclusiveness of which can be improved and to distinguish the gaps in institutional, organisational and regulatory structures within public authorities allowing to build inclusive mobility eco-systems.

Building up on these results, the next steps within DIGNITY approach allows to act on those shortcomings. The bridging phase includes:

- The scenario building approach aims to analyse possible developments in the future and to present them coherently; focusing on the gaps identified at the macro levels.
- The iterative process of inclusive design wheel, offering a structured method for generating solutions to challenges, with an emphasis on creating solutions that are usable by as many people as reasonably possible, this way aiming at the gaps identified at micro and macro levels.

The outputs of the bridging phase are used to develop a robust regulatory framework and policy action plans as well as to develop more inclusive mobility products and services, addressing the needs of the variety of the users. Pilots confirmed that overall set of methods developed in DIGNITY have improved the understanding of the digital gap, at different levels and allowed to move forward in the development of the inclusive mobility eco-system.

5 Conclusions

Digitalisation is one of the current trends in society, that facilitates the connectivity between people, businesses, regions, and countries. Location and distance are no longer

a barrier to meeting and exchanging information (Hoeke et al. 2020). Digitalisation of the transport sector follows a high speed path, changing the ways people access information about transport services and products, as well as changing mobility patterns and the use of some transport options. However, not everyone benefits from these digital developments, bringing specific population groups at risk of being excluded from some mobility products or services and creating a risk of the increasing social isolation. There is no general solution that exists, as this gap manifests itself in different ways taking into account the local situations. Public authorities feel the urge of assessing potential scope of the problem and realise that specific vulnerable to exclusion groups might require growing attention. The framing methodology proposed in DIGNITY, builds on variety of individual methods that allow public authorities to develop an in-depth view on the scope, size and urgency of the problem. Methods presented in this chapter are proven to be useful as standalone activities, however their maximum impact is achieved in their joint implementation.

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