Leaving No One Behind: Involving Users in Creating Inclusive Digital Mobility

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Abstract. With a shift towards the digitisation of mobility services, user involvement is vital for success. Especially critical is the inclusion of groups vulnerable to exclusion, so they can equally benefit from such services. In this respect, the Inclusive Digital Mobility Solutions (INDIMO) project established a multidisciplinary perspective on digital mobility services by considering the needs and concerns of vulnerable-to exclusion groups such as those who lack digital skills, belong to an ethnic minority or have reduced mobility.

Using data collection methods such as interviews and surveys targeted at vulnerable persons in five pilot locations, we collected information about user needs, intentions and preferences when using a digital mobility service. In this paper, we provide insights into the user recruitment process for this study and share tips for working with groups vulnerable to exclusion. Not to be forgotten are the lessons learnt from conducting this research during the COVID-19 pandemic.

1 Introduction

Digitalisation has produced many opportunities in the mobility sector, offering new services such as ride-sharing and journey planning, as well as services that provide more flexibility and access to real-time travel information. However, these digital services are not equally accessible to all members of society, especially to those part of groups vulnerable to exclusion such as people who lack digital skills, belong to an ethnic minority or have reduced mobility. User involvement is therefore vital to the success of any digital mobility service, so that these users are not left behind in an increasingly digitalised world.

The Inclusive Digital Mobility Solutions (INDIMO) project established a multidisciplinary perspective on digital mobility services by considering the needs and concerns of groups vulnerable to exclusion such as those who lack digital skills, belong to an ethnic minority or have reduced mobility. Through interviews and surveys targeted at vulnerable persons in five pilot locations, we intended to derive user needs, intentions, and preferences when using a digital mobility service.

Since groups vulnerable to exclusion are often hard to reach (Tovaas and Rupprecht Consult 2020), we focus in this paper on engagement with these groups who are often forgotten in the design of digital tools. We explore strategies for this purpose, and describe

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the methods used for recruiting participants and collecting data in the INDIMO interviews and surveys. Lastly, we highlight the results and lessons learnt of these engagement activities.

2 An Increasing Digital Divide

Digital technologies have quickly become part of everyday life and have changed how society functions on a daily basis. No exception to this digital evolution is the mobility sector, which has been considerably impacted by technological advancements (Durand et al. 2022, p. 33). There are many clear advantages to the digitalisation of mobility services that allow for easier and more flexible travel, like real-time and location-based information (Kuttler and Moraglio 2021). However, the risk exists that these digital services generate inequalities because they may not be available or accessible to all members of society. Digital services impose new requirements on potential users, and people who lack resources, skills, autonomy, or a willingness to use new technologies may be disadvantaged (Durand et al. 2022).

As digitalisation becomes more and more common and important in the modern World, these inequalities become far more worrying for the future of our societies. The digital divide can push groups into deeper levels of inequality and exclude them from social participation. The term "*digital divide"* illustrates this inequality and concerns the gaps formed between different societal groups in accessing and using information and communication technology (ICT) (Saha 2016). Many factors can contribute to exclusion from using digital mobility services like age, income, education, ethnicity, gender, and even location (Durand et al. 2022). People with higher income, for example, often have more access financially to digital tools as compared to people with lower income. They often have access to the modes of payment required for these applications and they are more likely to be able to afford these new services. Similarly, varying education levels and cognitive impairments can also affect people's intellectual ability to utilise digital technologies (Norris 2001). For example, digital mobility applications do not often take into account neurodivergent user perspectives and even though, in the long-run, they might create improvements to accommodate this group's needs, these add-ons might not be as intuitive or user-friendly as needed for their actual use.

These factors do not act alone and often intersect to create even more vulnerable situations. It is not uncommon to see older people who live in more remote areas, having lower income and lower technological skills. In this scenario, we can see that they will struggle not only from a lower offer of mobility (due to the remoteness of their homes) but they will also have increased difficulties in using digital services that could possibly increase their mobility options.

3 User Involvement: A Critical Step for Inclusivity

With the increasing shift towards digitalisation, (digital) mobility services must adapt to the needs and requirements of all user groups, otherwise they risk further marginalisation of already vulnerable groups. For this reason, their involvement in service design is critical to ensure that these groups can access and use the services without facing any barriers (Goodman-Deane et al. 2021).

One such process for ensuring that services benefit end-users is co-creation. This concept originates from the business and marketing sectors, as a method to collaborate on the design and production of products and services so that they better align with people's needs and wants. It has since reached global popularity for tackling challenges in many different sectors, through facilitating the active contribution of users (Puumala and Leino 2020). Though only recently applied to transport research, the co-creation process often combines different methods like interactive workshops and living labs, interviews, and even tests (Pappers et al. 2020). By involving users, these activities can help understand the barriers and challenges that they face in utilising a service or product.

Nevertheless, a first step not to be forgotten in this process is participant recruitment. Groups vulnerable to exclusion can be hard to reach for their involvement in such activities. "Hard to reach" groups tend to be underrepresented and are difficult to engage in public discussion (McCulloch 2020). This can stem from various characteristics including but not limited to:

- Demographic: such as place of residence, age or gender;
- Cultural: such as language or the lack of knowledge about how to become involved in these processes;
- Behavioural or attitudinal: such as the unwillingness to participate or distrust in government agencies;
- Structural: such as the lack of information in relevant languages or print sizes (Brackertz 2007).

Therefore, strategies for recruiting members of groups vulnerable to exclusion, that also take into account these characteristics, can help facilitate the co-creation process. Quite often, a tailored approach for each of the groups, that considers factors such as where to find them, which organisations they trust, and which networks they have contact with, can benefit the recruitment process and better engage potential participants (Brackertz 2007).

The INDIMO project funded by the Horizon 2020 programme of the European Union considers the needs, requirements and concerns of people who currently face barriers in accessing and using digital mobility services due to limited physical, cognitive or socio-economic factors. Subsequently, INDIMO utilised co-creation as a general tool for cultivating ideas and input from groups vulnerable to exclusion across five pilot locations[1]. The pilots and their different contexts are described below:

- **Pilot 1, Emilia-Romagna, Italy:** This pilot aimed to enable e-commerce (digital lockers) in rural areas and targets older people, foreigners and people with a low level of digital knowledge and education.
- **Pilot 2, Antwerp, Belgium:** This pilot created a Proof-of-Concept application that supports people with reduced mobility and visual impairments to safely cross intersections that are not equipped with accessible pedestrian signals.
- **Pilot 3, Galilee, Israel:** This pilot tested users' experiences and needs related to the ride-sharing mobile application, SAFARCON and focuses on people with limited

[1] For more information on the INDIMO project's analysis framework, consult the public deliverable Kedmi-Shahar et al. (2020)

access to mobility services due to their residence in the periphery or in areas with insufficient public transport. This pilot also targets people who lack digital skills or experience language barriers.

- **Pilot 4, Madrid, Spain:** This pilot tested users' experiences and needs related to the food delivery cycle logistics platform Coopcycle-La Pájara. It focuses on the needs of people with low-income, reduced mobility or vision impairments, as well as socially isolated and COVID-19 isolated persons.
- **Pilot 5, Berlin, Germany:** This pilot focused on an integrated ride-pooling service in Berlin. This pilot tests the experience of women and care giver users, while also considering the requirements of planning and booking multimodal journeys.

(Re)designing digital mobility services to take into account the specific needs of persons vulnerable to exclusion requires intensive field research, in addition to targeted strategies for recruiting participants. This paper therefore focuses on one aspect of the INDIMO co-creation process, a series of interviews and surveys which aimed at understanding the needs, intentions and preferences of people using a digital mobility service[2]. We report on the engagement behind these interviews and surveys, looking specifically at the strategies used for recruiting participants and collecting data, as well as the lessons learnt from these activities.

4 Involving Vulnerable Persons in the INDIMO Pilots

The activities described in this paper are part of a larger research project which has the goal of improving the understanding of users' needs in digital mobility services. The five pilots in the INDIMO project perform as an overarching platform for experimentation and applied co-creation as a general method. Through relying on the creative ideas and input of participants, we ensure that the project's results are based on real user needs, which will increase the rate of user acceptance in relation to digital mobility services.

The following sections focus on one part of this research; interviews and surveys in the five pilot locations that intended to understand how users would receive the introduction of new or redesigned digital mobility services in their communities. More specifically, we highlight the methods used for engaging participants for these purposes[3].

4.1 User Recruitment

As a starting point for selecting participants for the interviews and surveys, we referred to the INDIMO user personas created earlier in the project. Personas are a popular method for user-centred design, since they give more 'identity' to a user, as if they are real people (Harley 2015).

[2] For more information on this study, consult the public deliverable Marlier et al. (2021)

[3] All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee of the Vrije Universiteit Brussel, the lead partner of the INDIMO project consortium (Ethics Commission in Humane Sciences of VUB, Reference number ECHW_238.02).

One user persona was created for each of the five INDIMO pilots, with the goal of representing the most relevant characteristics and profiles of potential end-users. The INDIMO personas were the results of co-creation activities within each pilot, like workshops with end-user representatives, end-users, policy makers and developers (Vanobberghen et al. 2021)[4]. A common characteristic of these personas is that they are all women, which acknowledges the fact that gender is an important factor to consider when designing inclusive digital mobility services. We especially put emphasis on the special requirements of women, because when new mobility services are developed and designed, they still often focus on men. An overview of the personas can be found in Fig. 1.

It is important to note that the INDIMO pilots recruited participants in the period of February – April 2021, during the second wave of the COVID-19 pandemic. For this reason, it was even more difficult to reach out to people belonging to the target groups for the surveys and interviews. These activities were normally going to be face-to-face activities, but because this was not allowed in that period, the researchers had to look for alternative methods. It forced some pilots to take more time to recruit citizens or to make the necessary online arrangements instead. For the Galilee pilot, the main challenge in finding participants was the limited use and exposure to the informal shared-ride app due to COVID-19. For the Emilia-Romagna pilot, it was difficult to reach the community of Monghidoro online. For the Antwerp pilot, response was limited because it was hard to find older people and persons with limited vision to participate in an online interview.

Furthermore, because most pilots found it challenging to reach the required number of 10 to 15 participants, we held a training session to support the recruitment of participants and to provide strategies for this purpose. During this session, they were provided with a number of concrete tips, including:

- Which channels the pilots can use to reach out to their target group;
- Which external parties/organisations can help with the recruitment;
- Which methodologies they can apply (e.g. snowball methodology)[5];
- Which incentives could be given to the participants;
- How they could shape the recruitment message (e.g. the importance to emphasise what is in it for them).

Table 1 displays an example of the strategies that were defined for the pilots.[6]

[4] For more information on the INDIMO persona creation process, consult the public deliverable: Vanobberghen, W., Vermeire, L., Giorgi, S., Capaccioli, A., Di Ciommo, F., Rondinella, G., Gabor Banfi, M., Tu, E., Lamoza, T., Spector, M. (2021). D1.2- User needs and requirements on a digital transport system. INDIMO project deliverable.

[5] In the snowball method, a participant or respondent is asked to identify other relevant persons to be involved in the research. See www.nsf.gov/bfa/dias/policy/hsfaqs.jsp#snow for more information.

[6] For more information on INDIMO's strategies for user involvement and co-creation activities, consult the public deliverable Royo (2020)

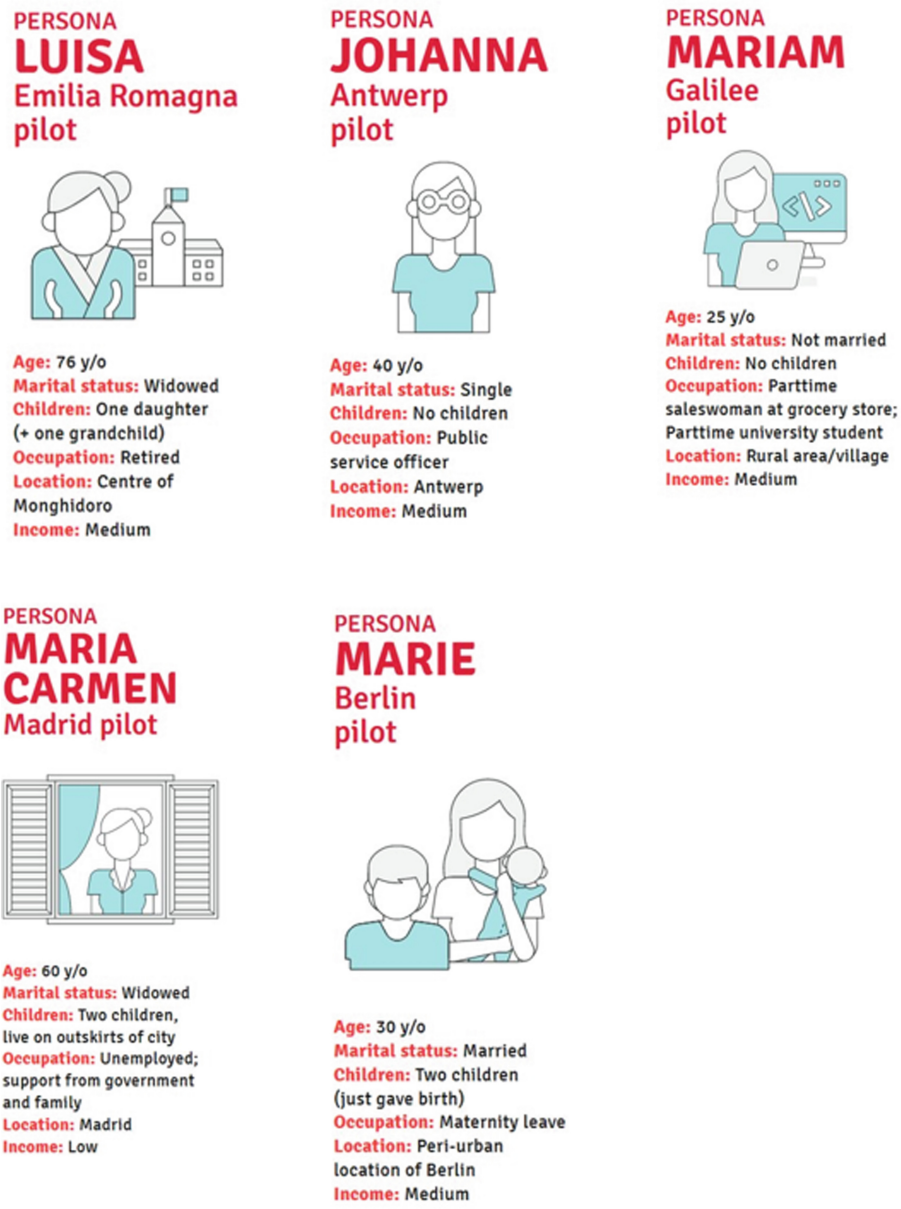

Fig. 1. INDIMO user profiles

In the INDIMO project context, we targeted people who find it difficult to use digital services. Therefore, to further help with the recruitment, visuals and social cards were created that could be customised for each pilot location. By using this type of targeted communication, we aimed to address the people to whom the situation applies. Figure 2

Table 1. User recruitment strategies

Involvement strategy	How to implement it
Requesting support from institutional service agencies	Verify with the local administration which association could be involved to reach more people, preferably those institutions which have a relationship of trust with the target group. Share regular updates with administration and technical offices
Partnering with citizen groups, community and voluntary organisations	The number of associations in this area is limited. They could be contacted to verify their interest in involvement and then a suitable strategy could be applied (participate in their meetings, act as testimonials)
Activating snowball referrals	Select a first wave of users and ask them to spread the message to their peers
Announcing through media calls and advertisements	Verify what media our target users use and conduct a strategy accordingly. End-user representatives can help with pointing out the right dissemination channels
Engage through social media interaction	Verify if social media is a channel used by our target groups and study which interaction is most effective (campaign, ads…) to eventually implement it
Inviting a convenience sample through emails, newsletters, local papers and phone calls	Prepare a newsletter or email-template to be distributed. Municipalities can help with reaching out to their citizens, do not forget to involve them
Distributing flyers in places where users lie (shops, bars, pharmacies, etc.)	Leave leaflets in key points of the municipality, including the Post Office and City Hall
Ads on local classified websites (like subito in Italy)	This type of channel is more suitable for interactions among privates
Banner ads on most used apps by those groups	Verify which apps are most used by the groups, and implement an advertisement accordingly
Announcements on specific vulnerable groups magazines/newspapers/podcasts/radio programmes	The possibility to use these channels will be verified and a strategy devised accordingly

shows an example of a visual from the Antwerp pilot, which targeted older people, people with reduced mobility, and people with reduced vision. Figure 3 is an additional example from the Emilia-Romagna pilot.

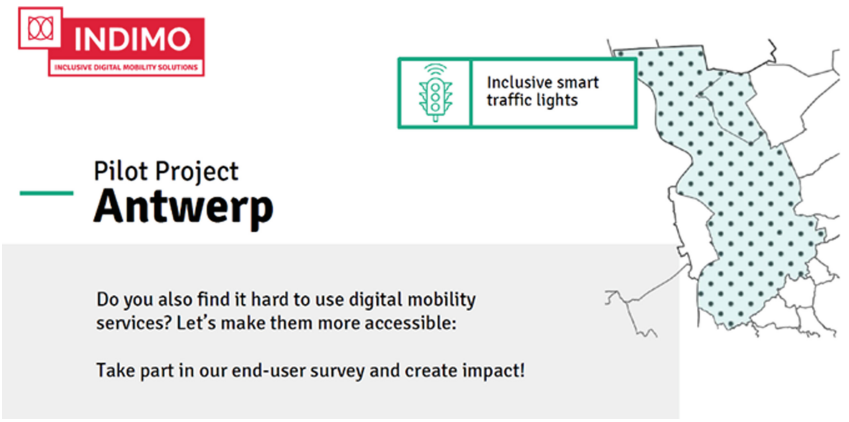

Fig. 2. Example of a visual created to help with the recruitment in Antwerp

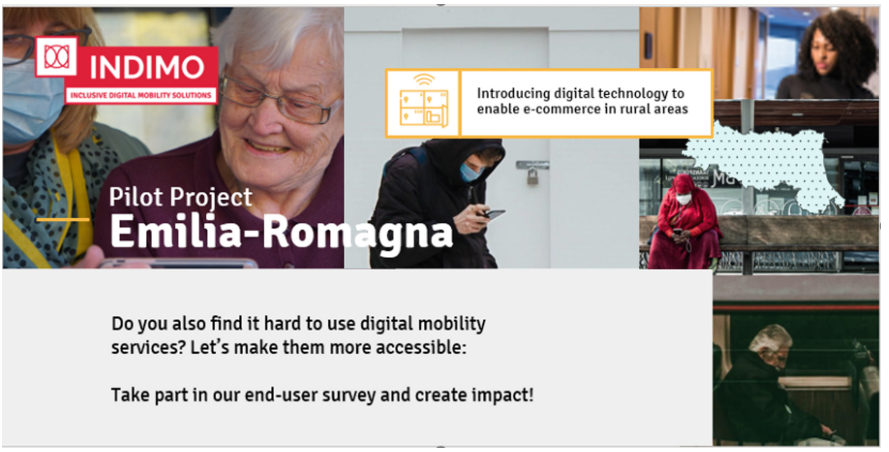

Fig. 3. Example of a visual created to help with the recruitment in EMILIA-ROMAGNA

These materials could then be used on social media and on the partners' websites. Afterwards, each pilot team contacted the stakeholders or organisations needed for reaching potential survey participants in their local context. Some pilot teams also used their own communication channels to reach more people.

Furthermore, to incentivise people to take part in the study, we used:

- Gift vouchers
- Recyclable bottles
- Vouchers for drugstores/pharmacies

Specific strategies varied, based on factors like cultural inclinations or the limited penetration of digital communication methods. These are summarised in Table 2 below, along with the number of recruited participants, which were 90 in total.

Table 2. Applied user recruitment strategies

Pilot 1: Emilia-Romagna, Italy	
Pilot target group	Older people and migrants/foreign people, residing in peri-urban locations; lack of digital services; lack of dedicated network infrastructures; language barriers; low income, …)
Applied user recruitment strategy	The survey was published on two Facebook groups where many people living or interested in Monghidoro are updated on the local news; on the local partner's website; and was distributed by local stakeholders and organisations As an incentive for taking the survey, participants were given a gadget, which was sent in agreement with those who left their email contacts
Result	15 people participated. 40% were between the ages of 61 and 65 years old and 80% were women. 100% owned a smartphone and 86% owned a laptop. 66% could count on a strong social network and 66% had access to the bus or tram
Pilot 2: Antwerp, Belgium	
Pilot target group	Vulnerable pedestrians (i.e. older people; people with reduced mobility; people with reduced vision)
Applied user recruitment strategy	Stakeholder organisations that regularly work with the target audience of the survey were contacted and asked to help with the dissemination To incentivise the target audience, three participants could win a voucher for an online store if they completed the survey and registered for the lottery
Result	44 people participated; 80% were above 60 years old. 90% of the participants owned a smartphone and 80% owned a laptop. 79% had access to the car as a driver and 39% had severely limited support from care keepers
Pilot 3: Galilee, Israel	
Pilot target group	Informal ride-sharing users (ethnic minority men/women; residing in the periphery; language barrier; lack of digital skills)
Applied user recruitment strategy	A local feminist organisation directly reached out to participants via phone calls Participants volunteered to take part in the survey and did not receive any incentive for doing so
Result	5 people participated; all women ranging from 18–65 years old. All obtained a university degree or higher, owned a smartphone, and had access to the bus or tram

(*continued*)

Table 2. (*continued*)

Pilot 4: Madrid, Spain	
Pilot target group	Delivery users (people with reduced mobility; people with reduced vision; socially isolated-unwanted loneliness; not-connected people; low income; COVID-19 confined)
Applied user recruitment strategy	The questionnaire was distributed among participants in a locally-organised co-creation meeting Participants did not receive any incentives for taking the survey
Result	10 people participated. Most were in the 45 to 54 and 55 to 64 age groups. All participants had access to a smartphone as well as access to either a desktop PC, a laptop or a tablet. Most had access to a car as passenger
Pilot 5: Berlin, Germany	
Pilot target group	On-demand ride-sharing users (caregivers of children/impaired/elders; women; lack of services; lack of digital skills, residing in peri-urban locations)
Applied user recruitment strategy	A local partner offered support in contacting women with low incomes. As this is sensitive info, they could not pass the contact details to the INDIMO-partners. That is why they reached out to them themselves We offered participants a 30-euro gift voucher for their participation
Result	16 participated; all of which were women ranging from 18 to 60 years old. Many participants indicated having a good social network and most owned smartphones and laptops. 93% had access to the train or metro

4.2 Data Collection

After various meetings with the pilots and research partners on how to contact and engage the identified target groups, it became clear that there was no one-fits-all solution that we could apply to collect the necessary information. That is why various research methods were also used for the data gathering, with each method adjusted to the target group and the context of the specific pilot. An overview of the research methods used in the different pilots can be found in Table 3 below:

Table 3. Applied data collection strategies

Pilot target group	Applied research method for data collection
P1. Older people and migrants/foreign people, residing in peri-urban locations; lack of digital services; lack of dedicated network infrastructures; language barriers; low income, …)	Customised online survey in Italian Tool used: Survey Monkey Two versions were created: - One for people having used digital locker systems before - One for people that had never used such a service
P2. Vulnerable pedestrians (i.e. older people; people with reduced mobility; people with reduced vision)	Customised online survey in Dutch Tool used: Survey Monkey Two different versions of the survey: - One for people already using digital applications that assist them when they are travelling - One for people not making use of digital applications when they are moving around - Surveys had voice over function, so people with a visual impairment were also able to fill it in
P3. Informal ride-sharing users (ethnic minority men/women; residing in the periphery; language barrier; lack of digital skills)	Face-to-face interviews in Arab conducted by a local feminist organisation that focuses on empowering women Two different versions of questions were developed: - One for participants who have already used ride-sharing services in the past - One for participants that have never used a ride-sharing service before
P4. Delivery users (people with reduced mobility; people with reduced vision; socially isolated-unwanted loneliness; not-connected people; low income; COVID-19 confined)	Customised online survey in Spanish Tool used: Google forms One version was developed for people that are currently using a food/grocery ordering service

(*continued*)

Table 3. (*continued*)

Pilot target group	Applied research method for data collection
P5. On-demand ride-sharing users (caregivers of children/impaired/elders; women; lack of services; lack of digital skills, residing in peri-urban locations)	Use of paper format, so questionnaires could be filled in on-the-spot Local partner in Marzahn who offers support for low-income women, conducted the interviews. Later, the responses were integrated in the online tool 'Typeform' to enable the analysis Two versions were developed: - One for participants that already used ride-sharing services before - One for participants that have not used ride-sharing services before

We analysed the outcomes per pilot and formed connections to make overarching conclusions related to user engagement and data collection. The following section presents an overview of our results, including the lessons learnt.

5 Discussion

Collecting responses for this study was not always easy due to the COVID-19 pandemic, the holiday period, and limited digital exposure by some members of the targeted groups. For these reasons, it was challenging to get in touch with vulnerable groups and reach the target of 10 to 15 participants in each pilot. However, we still managed to recruit 90 participants with a diversity in age, education, and digital skill level. We collected data related to the following aspects (among others):

- Socio-economic status;
- Access to different mobility modes;
- Support from their social networks.

In the following sections, we highlight some lessons learnt from these activities, which can provide insights and helpful tips for engaging groups vulnerable to exclusion in similar data collection activities.

5.1 User Recruitment

In general, groups vulnerable to exclusion are often hard to reach (Tovaas and Rupprecht Consult 2020). The COVID-19 pandemic made it even more difficult to engage with and recruit groups vulnerable to exclusion in the INDIMO study, especially older people and people with a migration background. Some pilots required more time to recruit participants or to make online arrangements for an interview. For the Galilee pilot, for example, the main challenge in finding participants was the limited use of and exposure

to the informal ridesharing app due to COVID-19. For the Emilia-Romagna pilot, it was difficult to reach the community of Monghidoro online. For the Antwerp pilot, response was limited at first due to the Easter holiday.

As a result, some pilots had a **bias in participants**. While this can be partly explained by the COVID-19 pandemic, it can also be explained by the fact that only one recruitment channel was used in some cases. By only utilising online channels for example, there is a good chance that only people with digital skills will be reached. Similarly, recruitment conducted via one main organisation, will also engage a homogeneous group of people. In the case of older target groups, participant recruitment via email generally reaches people with (at least some) digital skills, meaning that results are not always representative of the entire elderly society. That is why it is always important to **conduct recruitment through a variety of channels**, both on- and offline and to collaborate with different organisations. In the Antwerp pilot for example, participants were recruited through the channels of user representative organisations. These organisations have a network of people providing care to the target audience or have members that belong to the target audience because they provide services to support them. Because the recruitment message came from an organisation they trust, people were more willing to participate. In a similar light, the snowball referrals method for recruiting users can also be helpful to diversify participants, since the first wave of engaged users can spread the message to their peers.

Similarly, providing incentives, such as vouchers, discounts or small gifts, can also facilitate the recruitment process and increase the level of interest in participation. In this way, groups less likely to participate will be more inclined to do so, such as people with low income (Berlin et al. 1992).

Attractive images, visuals and storytelling techniques are also useful instruments for participant recruitment. Storytelling, for example, is a powerful tool that should be applied more often. As a popular trend in communication activities, storytelling can create emotional connections with an audience, which can increase engagement and even motivation (Love 2008). It can similarly attract attention to a research activity and provide context in a way that is relatable to the target group (Mathews and Wacker 2008). Looking for and using an element that is recognisable to the target group or audience helps them identify themselves in the situation being conveyed. In the INDIMO project, we used images of our targeted groups, like older people, in our social cards to attract and engage with them.

Furthermore, if circumstances allow, it also pays off to organise face-to-face events. By doing so, chances of obtaining more participant diversity are higher, and people feel more involved and in general are more willing to engage on a longer term.

To further empower recruitment teams, it can also be beneficial to **organise a recruitment training session** for sharing tips and tricks as well as **strategies on different user involvement techniques.** Recruitment teams will then have access to multiple methods that they can tailor to their needs and desired outcomes.

In the INDIMO context, we also found that participants and local organisations that helped with recruitment and data collection were also motivated to contribute to other upcoming research activities if we shared outcomes with them. In the Antwerp pilot, we organised a brief meeting to **share the most important findings** for the people that

participated. This meeting was warmly welcomed. Some of the other external parties involved in the user engagement also indicated that the co-creation process was a **valuable learning process** for them as well. This highlights the importance of starting to question at the beginning of participation what the participants themselves wish to get out of the co-creation process. If they can benefit themselves, they will be all the more motivated to be more engaged.

5.2 Data Collection

Before disseminating a questionnaire, especially to vulnerable groups, it can be beneficial to ask at least one person of the target group to **proof-read the survey or questionnaire**. This will help detect if questions are difficult to understand or can be misinterpreted by the respondents.

Similarly, because the INDIMO pilots have their own contexts, target groups and cultural-specific aspects, they required customised approaches. This individual support was more time-consuming than expected, because additional time was needed to develop and create customised versions of the surveys, online tools and interviews, since they were tailored to each specific pilot context. It is therefore recommended to **foresee enough time for coordination and for the data gathering activities.**

6 Conclusion

Our ambition for involving vulnerable persons in the INDIMO co-creation process was to understand the barriers and drivers related to the use of inclusive digital mobility services. More specifically, we interviewed and surveyed 90 participants across five pilot locations to gain insights into their needs and requirements regarding digital mobility services.

Despite the strong efforts of the INDIMO pilots to engage with groups vulnerable to exclusion, we did not always manage to achieve the targeted number of 10 to 15 participants in each location. Furthermore, while we aimed to include a wide range of user profiles in these INDIMO surveys and interviews, we noticed that there was a bias in participants, and that the targeted groups were not always reached. This can be partly explained by the COVID-19 pandemic, and by the fact that sometimes recruitment was too one-sided through one specific channel. For example, only utilising online channels for participant recruitment can result in only reaching people with digital skills. It is, therefore, important to consider organising dedicated training sessions to share tips and tricks on different user involvement strategies, and to utilise a variety of channels, both on- and offline for recruitment and data collection. By doing so, chances of getting a more diverse set of participants and data are higher.

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