



# Methodological Paths to Achieve Inclusive Digital Mobility Solutions: Target-Group Capabilities and Limitations

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**Abstract.** Physical, digital and graphic interface requirements of digital mobility and delivery services (and target groups) are a result of a comparison between the capabilities and limitations of each target group. A summary of the main users/non-users capabilities, limitations, and requirements (hereafter CLR) identified by populations that are more vulnerable will be the basis for understanding the most relevant needs threads: space, time and human factor. While space and time are traditional threads for capturing needs in transport and mobility (i.e. origin-destination, distance, time-saving etc.), the third thread ‘human contact’ appears as a new and clear need for the use of digital mobility and delivery solutions. A relevant number of inclusiveness requirements deals with this aspect that becomes a “must” for the extension of the inclusive digitalization in mobility. This chapter will conclude with the presentation of the most important insights in terms of capabilities, limitations and requirements that deal with the human contact factor.

## 1 Introduction

The aim of this chapter is to expose the use capabilities, limitations, and requirements (CLR) to the potential use of the Digital Mobility Services (DMS) and Digital Delivery Services (DDS) hereinafter DMS/DDS that were found associated with each profile of the target groups of the INDIMO project. The concept of digital divide or digital exclusion was born, associated with the spread of digital tools for communication and organization of social life and the asymmetries of digital skills that actually exist among a variety of segments in the society. The digital divide is thus defined as the gap between those who have high access to digital tools and those who have low or no access at all, either because of not having access to the equipment, not having access to Internet connection, not having the adequate skills and capabilities or not feeling appealed by technology for doing everyday tasks in a different way (Saha 2014). A great part of the findings of the research hinges on the collective learning that was created during the

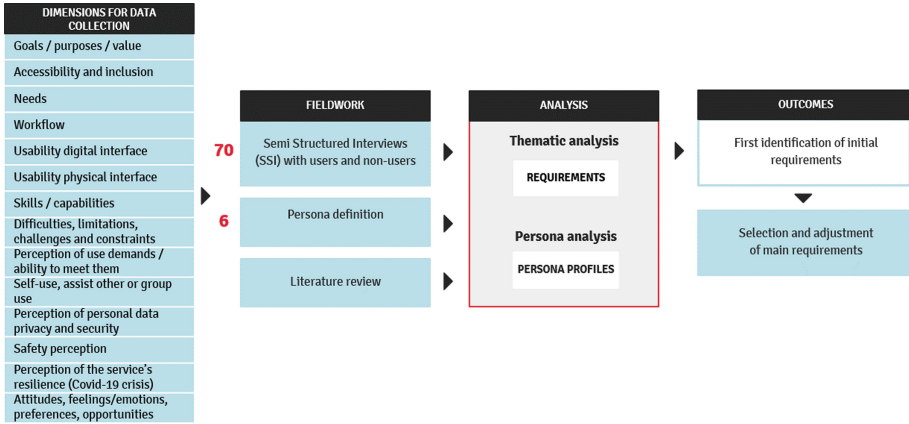
semi-structured interviews, that allowed us to get insights from various users and non-users belonging to the INDIMO target-groups such as they are specified in Table 1. The main findings explored throughout this paper show that for the five investigated pilots, digital technology, if it is not accompanied with human guidance and assistance, might be experienced as a barrier rather than as a facilitator in the use of the service. When digital applications do not address these adjustments for different target groups, traditional and learned paths to satisfy needs appear as the only alternative. It was found that certain populations have gained some familiarity with some specific apps (for instance, older people with WhatsApp, cognitive impaired youngsters with Instagram), but learned it in a very automatic and instrumental way. This does not mean that these persons are flexible in their approach to digital tools in a way that allows them to explore new domains of digital knowledge by themselves. It was found, as seems clear in the cases of Madrid and Emilia Romagna, that the lack of familiarity with digital tools leads to different concerns associated with their use. These are mainly data privacy fears, fear of the lack of orientation or aid, the feeling of getting lost in the process or not being able to cope with so much information. When users are already familiar with digital services and when they are offered the adequate tools for guidance, including the possibility of contacting human assistance, the digital service opens up a wide range of alternatives, new behaviours regarding mobility and food consumption, new paths of autonomy and of self-confidence.

The next sections of this chapter present the methodology in Sect. 2, the insights from the fieldwork are presented in Sect. 3. Section 4 regroups the CLR paths in terms of time, space, and the human contact. The conclusion (Sect. 5) includes a reflection about the relevance of human contact in the era of digitalization, when the goal is to achieve inclusive digital mobility solutions.

## 2 Methodology

The data collection has been performed via in-depth semi structured interviews (SSI) that have been developed upon the INDIMO identified dimensions recalled in this section. The following figure provides a framework of data collection and analysis, through qualitative data gathered at each of the 5 pilots (Fig. 1).

The target-group respondents of users and non-users were the ones identified and included in the following user profiles corresponding to each pilot (Di Ciommo et al. 2022) (Fig. 2):



**Fig. 1.** Framework of data collection and analysis

**Table 1.** Pilots’ names and user profiles

| Pilot name and location   | User profiles (and characteristics)  |
|---|--|
| <b>P1.</b> Introducing digital lockers to enable e-commerce in rural areas ( <b>Emilia Romagna, Italy</b> ) | Older people and migrants/foreign people who receive/send parcels (lack of digital knowledge; residing in peri-urban or rural locations; lack of digital services; lack of dedicated network infrastructures; language barriers; low income) |
| <b>P2.</b> Inclusive traffic lights ( <b>Antwerp, Belgium</b> )   | Vulnerable pedestrian (older people; people with reduced mobility; people with reduced vision)   |
| <b>P3.</b> Informal ride-sharing in ethnic towns ( <b>Galilee, Israel</b> )                                 | Informal ride-sharing users (ethnic minority; women; residing in villages or rural areas; language barrier)  |
| <b>P4.</b> Cycle logistics platform for delivery healthy food ( <b>Madrid, Spain</b> )                      | Delivery users (people with reduced mobility; people with reduced vision; people with mental health impairments; socially isolated-unwanted loneliness; not-connected people; low income; COVID-19 confined)                                 |
| <b>P5.</b> On-demand ride-sharing integrated into multimodal route planning ( <b>Berlin, Germany</b> )      | On demand ride-sharing users (caregivers of children/ impaired/elders; women; lack of services; lack of digital skills, residing in peri-urban locations)  |

To enhance our knowledge and understanding focusing on users with physical impairments, the INDIMO partner MBE (Budapest Association of the Physically Impaired), conducted in Budapest, Hungary, a qualitative fieldwork of complementary interviews

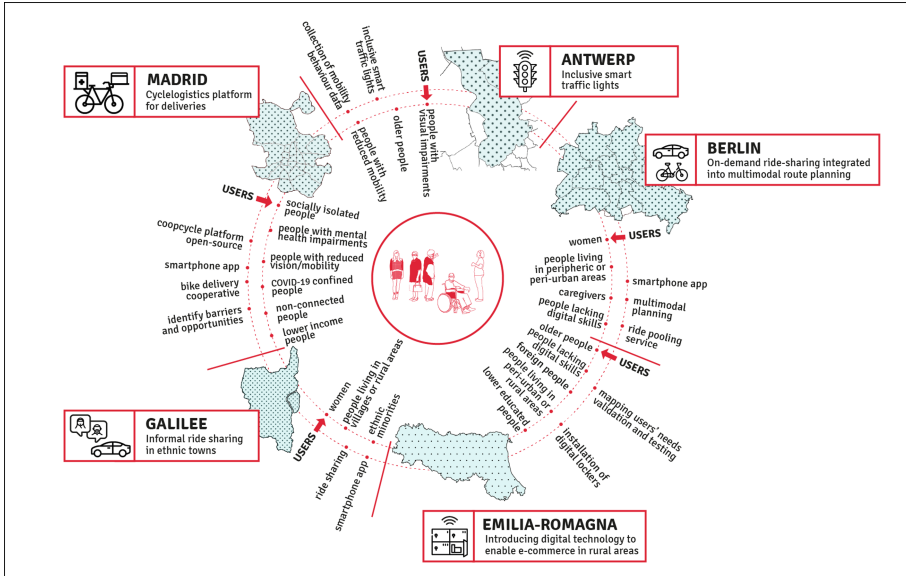


Fig. 2. The INDIMO pilots

to collect information about the public transport use of people with physical disabilities. This improved the focus on the specificities of impaired people with disabilities already included in the pilots in Antwerp and Madrid. Three user groups were selected: people with reduced mobility, people with reduced vision, and caregivers of people with disabilities.

Furthermore, to better understand the capabilities, limitations, and requirements of some of the addressed populations, it is sometimes needed to interview stakeholders, which are community organisations that work closely with the target population. Two different questionnaire templates were elaborated for both users and non-users interviews and a third one for stakeholder interviews.

For each interview, a debriefing document was filled in by interviewers based on a provided template. In the debriefing document the relevant fragments of each interview were included. In this way, the debriefing behaves as a summary with the highlights of the testimonies of the respondents. Afterwards, this text was used for the coding process and for moving forward with the thematic analysis (Rosala 2019).

The process from carrying out the interviews to coding and to identifying relevant themes included:

- the **coding process**: in which relevant verbatims from interviews are labelled with appropriate codes to identify and compare segments of text that are about the same thing. These codes allow us to sort information easily and to analyse data in terms of similarities, differences, and relationships among segments. The coding process has been conducted with the help of Quirkos CAQDAS (Computer Assisted Qualitative Data Analysis) software (<https://www.quirkos.com/index.html>)

- the **thematic analysis** is a systematic method of breaking down and organizing the identified codes for identifying and constructing significant themes (Rosala 2019).

### 3 Insights from the Fieldwork

The semi-structured interviews were focused on the problems and participants were eager to contribute and to find common solutions to common problems. The future approaches us at a high speed to face challenges regarding new social practices within the acceptance and usability of digital mobility services and digital delivery services.

We followed the CLR path (Capabilities, Limitations and Requirements), as the path that allows us to identify the requirements such as the difference between capabilities and limitations. These requirements are the inputs for the ulterior construction of the Universal Design Manual for digital mobility services. We organised the fieldwork and their instruments with the dimensions in accordance with the guidelines from INDIMO framework (Kedmi-Shahar et al. 2020), included in the below list:

**Accessibility:** Search for autonomy, reducing the dependency on relatives, friends or unknown passers-by in the street. Anticipation and control on the graphic interface are key elements to reduce the anxiety associated with orientation or excess of information in a digital environment. Real time input for users contributes to the feeling of continuous feedback and reassurance.

**Inclusiveness:** Human contact and assistance are a strong and constant element of this category of requirements. Human contact contributes to the warmth of relations as well as the feeling of flexibility and adaptation. The inclusion of different levels of digital competence, experience, language skills and socioeconomic status imply a strong need for adjustments and flexibility in the treatment. The availability of language options, but also a simple and familiar wording (using icons and images as part of this language) is also part of the requirement.

**Additional Options:** The DMS/DDS are seen not only in their current status, but also in their potentiality. Users pointed out the benefits that an extension of the delivered products, functionalities and services, including the covered geographical area, could bring.

**Workflow:** Most of these requirements address the simplicity with which the information is exposed, highlighted and treated. Requirements in this category deal with the ease of the navigation of the interface and the aids that this navigation may have for people who are not familiar with apps or who have specific difficulties. Be it the completing bar, the calculator and the error detection, these requirements target the feedback that the user has during the navigation process in order to ease the anxiety and reinforce the orientation.

**Physical Interface:** The interaction with the couriers or drivers generates a new layer of interface that is populated with its own reinforcements and barriers. The manners, help, offer and general friendliness of the service agents are highlighted. The way they express

themselves, the introduction, the knowledge of the user's name and their identification contribute to the feeling of safety and trust building are key elements of these requirements. Also, new concerns arose about risk exposure in times of COVID-19 pandemics. In this context, an oriented training or the human contact availability can be useful.

**Privacy and Data Security:** This group of requirements is triggered by the sensitivity that some information (mainly bank and credit card information, address, phone number and personal identity) hold for the users. Transparency about the data that is stored and clearly conveying conditions of how the data can or will be used lay out the direction of these requirements.

**Security and Safety:** Especially sensitive for women, there are physical integrity concerns related to the interaction with rider/drivers, with the spatial setting and with the other users that may be part of the service. The requirements in this group tackle the effective response of the service to unforeseen situations of harassment, violence or assault specially related with gender.

**Communications:** Requirements in this category are related to the service exposing clearly their benefits and the target audience, expressing their social and environmental values in any, and facilitating the adoption and use through pieces of communication such as manuals, tutorials and lessons or the contact with facilitators.

**COVID-19 Related:** This category addresses the relevance in current times of working with clear protocols regarding the operation, which is especially relevant for people who feel more at risk in the face of pandemics, such as older people. These protocols should not only be in place but also actively communicated.

The main findings of the fieldwork could be grouped in the below categories (Giorgi et al. [2021](#)):

**Digital Gender Divide.** A good part of the research on women and mobility focuses on the threats and the violence they face moving around in the public space. An important finding of our research shows that when women were parenting, their identities of mother stood above other identities, and their main concern was related to their children's safety, and about the interaction of others with their children. A main insight of our study shows that regular mobility services address a "male individual" user and do not contemplate the specific needs of caregivers in charge of dependents. This is an aspect of mobility that sometimes is obscured: transporting with others, either children or older people imply special requirements (type of vehicles, equipment, on-boarding and off-boarding spots etc.). Finally, women, especially when they are socially isolated, feel less comfortable with unproven technology.

**Mobility and Physical Disabilities.** A new insight of our study is that many people with reduced mobility are eager to show that they can have things done by themselves and may visualize the services of an app (for example, a service of food delivery) as an assistance that undermines their autonomy and their ability to solve issues on their own. Assistance appears as a two-fold aspect: as favouring autonomy or intruding in it; both as empowering and as a non-considered assistance. This has been long developed

in our theme for Madrid, “Search for autonomy” and brings the focus on what levels of assistance are desired by different segments of the target-groups population.

**Smart Traffic Lights and People with Impairments.** The studies reviewed focused on smart traffic lights for the fluidity of vehicle circulation and there are not many articles that view smart traffic lights from the point of view of pedestrians. This way of thinking about the traffic is so rooted that, like it was found in the present research, vulnerable users incorporate this view when recognizing feelings of guilt for “stopping or delaying the traffic”. This is a new insight that the present study casts light on. It was also found that there is no accessibility solution that is only a technological solution. In the case of Antwerp, if smart traffic lights were not accompanied by repairing and maintenance works in the surroundings of the crossing, the innovation would be perceived as “just another gadget”. This is a reminder to avoid the excessive techno-optimism and to bear in mind that digital approaches to problems always have a physical interface which has an important weight on the nature of the problem.

**Foreign People as Central Public Users of DDS.** The new insight of the present research is to identify the potentials of foreign people as central users of the locker system of parcel delivery. It was seen in the elaboration of the Emilia Romagna pilot that there is an unmet need of foreign people regarding the simplification of their exchanges with their families in their hometown. DDS offer a possibility of simplifying and enhancing this operation that is part of the life of someone settling down in a foreign country. Foreign people are presented in this way as potential users and participants of a new experience.

**Non-connected People.** One of the ways the present research goes beyond the bulk of the literature is that it does not consider all older people as a homogenous group. We found that many of the characteristics of low connectivity ascribed to older people were in fact idiosyncratic elements of specific contexts. This is the case of the examined rural areas where old mobile equipment (which blocks the possibility of a successful download of a new app) was associated with a more traditional mindset and the attachment to the “old way” of doing things. An idiosyncratic resistance typical of an environment goes far beyond the age cohort.

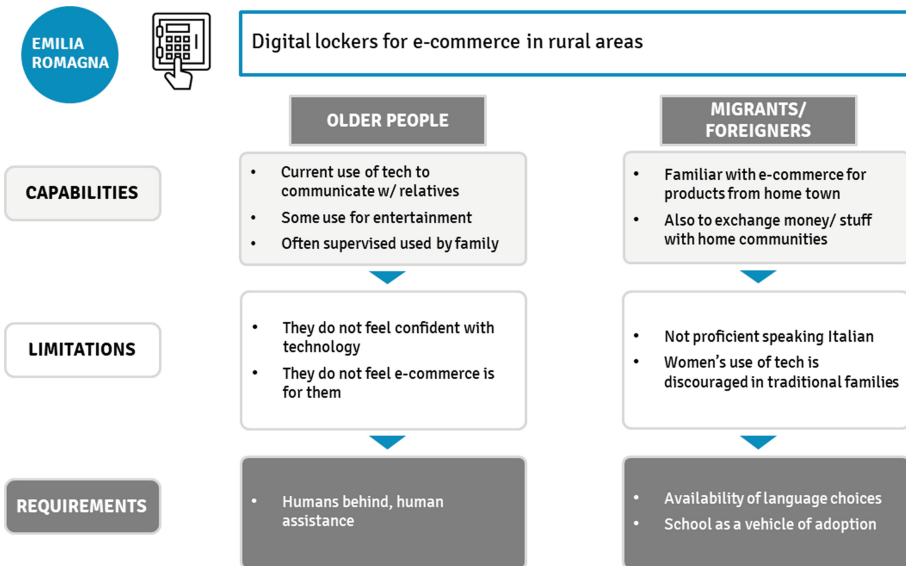
Most of the literature on user-centred approaches to include these groups mainly covers the feedback given by the app (through sounds, tones, pop-ups) but does not emphasize sufficiently the importance of the humans behind the digital interfaces, the need of direct contact with other humans, to give confidence and empower the user.

## 4 The Capability-Limitations-Requirements Paths for DMS/DDS

This section focuses on the identification of CLR paths. Given the specificities of each pilot and the fact that the services proposed are different in nature, this identification is provided pilot by pilot. Therefore, a summary of the CLR paths is presented. The organisation of the requirements per pilot and their target population profiles among various pilots and their points of contact concludes this section. Extensive work, both

across time and space, allowed us to collect inputs from users, non-users and stakeholders of the target-group population associated with the design of digital mobility and digital delivery services (Di Ciommo et al. 2021a, b).

The Emilia Romagna Pilot 1 (P1) shows the differences of capabilities between both profiles of older people and migrants. The limited digitalization of older people makes them less confident with technology, while the low proficiency of migrants in speaking Italian and the discouraged use of tech for women by the patriarchal families represent a strong limitation for the adoption of this DDS, especially in the rural areas. While older people’s requirements are oriented towards human assistance, migrants who have a strong need of the e-commerce service for exchanges with their home community, are asking for the availability of language choices in the digital lockers service. In both cases, the target populations have to overcome a cognitive limitation for using the services. Therefore, the solution will be focused on some specific training for both target populations. The below figure shows the CLR paths for pilot P1. The CLR paths, and concretely the requirements have been transformed in a clear recommendation of considering a human assistance for universally designing the digital mobility and delivery services in the future (Di Ciommo et al. 2021a, b) (Fig. 3).



**Fig. 3.** Requirement path for the Emilia-Romagna pilot



The Antwerp Pilot 2 (P2) targets older people and persons with reduced vision and-mobility for the main limitations are related to the need for assistance when going to some unexplored place and the bad conditions of the public space, including road infrastructures. All three target populations require an extension of the duration of green light, while persons with reduced vision are asking as well for traffic lights with auditive signals and the communication of the status of lights (red/green). These two key requirements are at the basis of the recommendations for the INDIMO Inclusive Digital Mobility Toolbox including the Universal Design Manual for digital mobility and delivery services, the Universal interface language for digital transport services, the Cybersecurity and privacy assessment guidelines, and the Service and Policy Evaluation Tool. This pilot showed that the actions of policy makers in planning traffic lights and organizing public space infrastructure are equally relevant just like the digital app design development for satisfying the needs of end-users with some impairments. A consistent change of traffic and public space policy is required for shifting from a “car mandate” to a “care mandate” in mobility policies implementation. The below figure shows in detail the CLR requirements (Fig. 4).

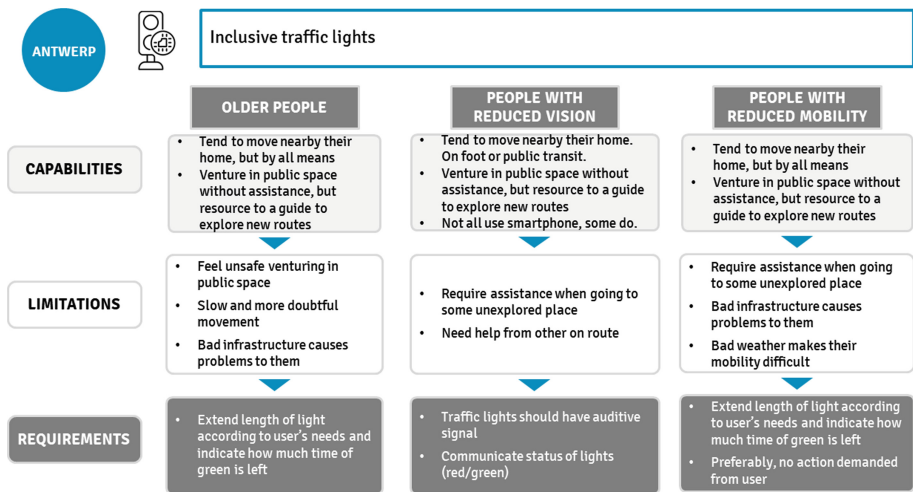


Fig. 4. Requirement path for the Antwerp pilot

The Galilee Pilot 3 (P3) shows that the DDS are already integrated in the life of Arab women in rural areas who already use the route planners and use the DDS for getting to work and school and gaining autonomy within a community with traditional ties. These capabilities are limited by the difficulty in reading a digital map, lack of coherence between the digital map and the real geography of the village, and the pressure of social mandates. Therefore, the women living in Arabic villages are asking for a stronger coherence between the digital map and languages, and the real-world geography and languages that will increase the community’s confidence in the ride sharing digital mobility service. The below figure shows the CLR path for Pilot P3. The main recommendation for the universal design of the informal ride-sharing service deals with the

community’s confidence that can be increased if two key factors (i.e. ease to understand digital maps and coherence between digital maps and the real geography of the village) are considered. App algorithms should be based on an idiosyncratic development of the digital mobility service. Geography and space matters and should be considered in the digital development of the service (Fig. 5).

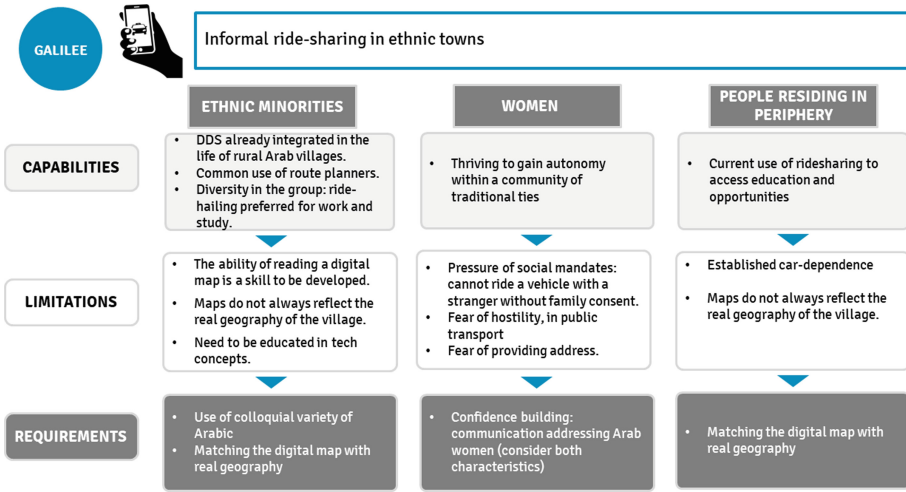


Fig. 5. Requirement path for the Galilee pilot

The Madrid pilot 4 (P4) shows that persons with impairments defend their level of autonomy and prefer to not focus on their physical conditions to justify mobility and delivery choices. However, the physical impairments constitute a limitation to access stores for people with impairment who need some human assistance. The current “non-connection of people” in respect to the digital tools increases the concerns about privacy and security that can be decreased through the simplifications of terms and conditions and the possibility of viewing user’s ratings. The COVID confinement determined the need of establishing a COVID protocol for the DMS and DDS for avoiding the risks of exposure to the virus. The main recommendation for the inclusive and universal design of food delivery services is the simplification of the platform language in all its aspects from the terms and conditions to the words users need to understand to order the food. For example, common English words such as “courier” should be translated in the local language “repartidor”. A total inclusive language approach should be adopted, as well as the possibility to reach human contact directly with the courier to arrange place and conditions of delivery (Fig. 6).

The Berlin pilot 5 (P5) shows the positive approach of women caregivers to the possibility of using this service when it has the right equipment and makes women feel comfortable and safe. Therefore, the main requirements include the possibility to have human contact and to arrange a place of pick-up or clear doubts. The geographical coverage of this service is a key requirement to be able to use it in a proper way. If digital ride-sharing services would shift from a male-oriented service to a universally accepted

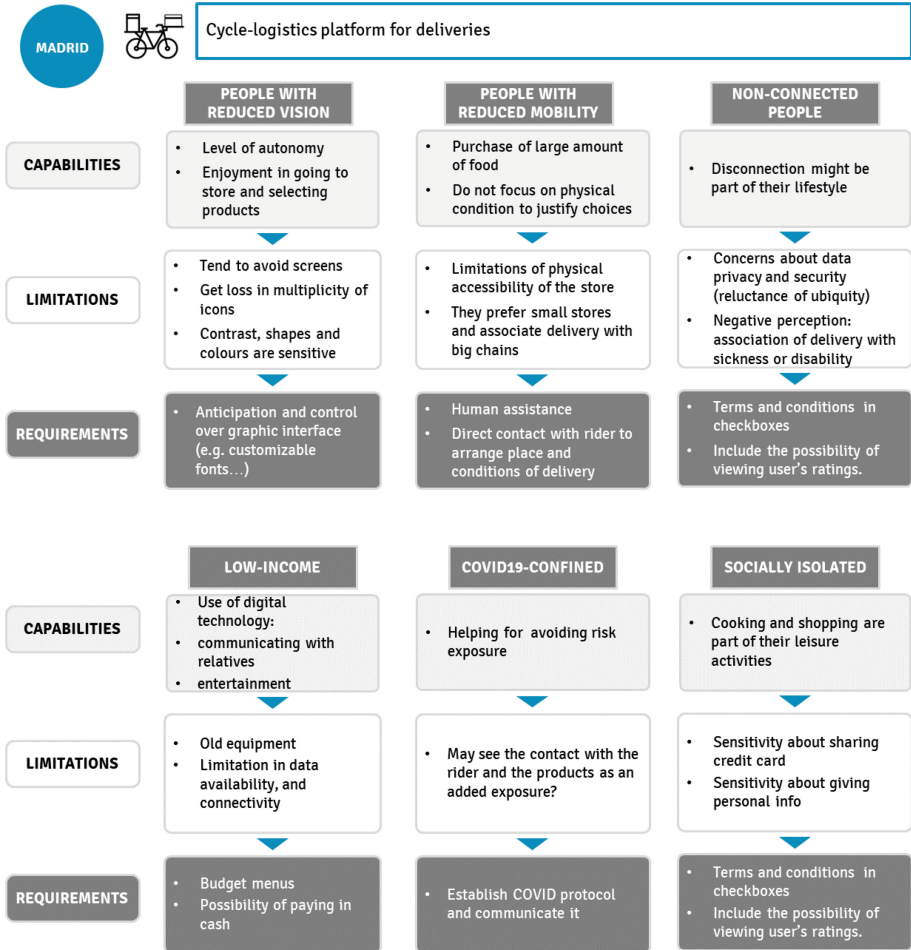


Fig. 6. Requirement path for the Madrid pilot

and adopted service by women, their “routine” and needs in terms of caregiving should be considered for universal design of the service. Time, space and human contact aspects should clearly be considered to move in this direction, as shown in the requirements included in Fig. 7.

The analysis of the capability, limitations and requirements paths show the nature of the needs for each pilot. Concretely, these needs can be grouped in three main categories: space, time and human contact, as highlighted in the table below and explained through the five different pilots. If space and time are two more classic dimensions of the mobility and delivery services, to pay attention to the human contact represents the novel factor to have a digital mobility and delivery solutions inclusive by design (Table 2).

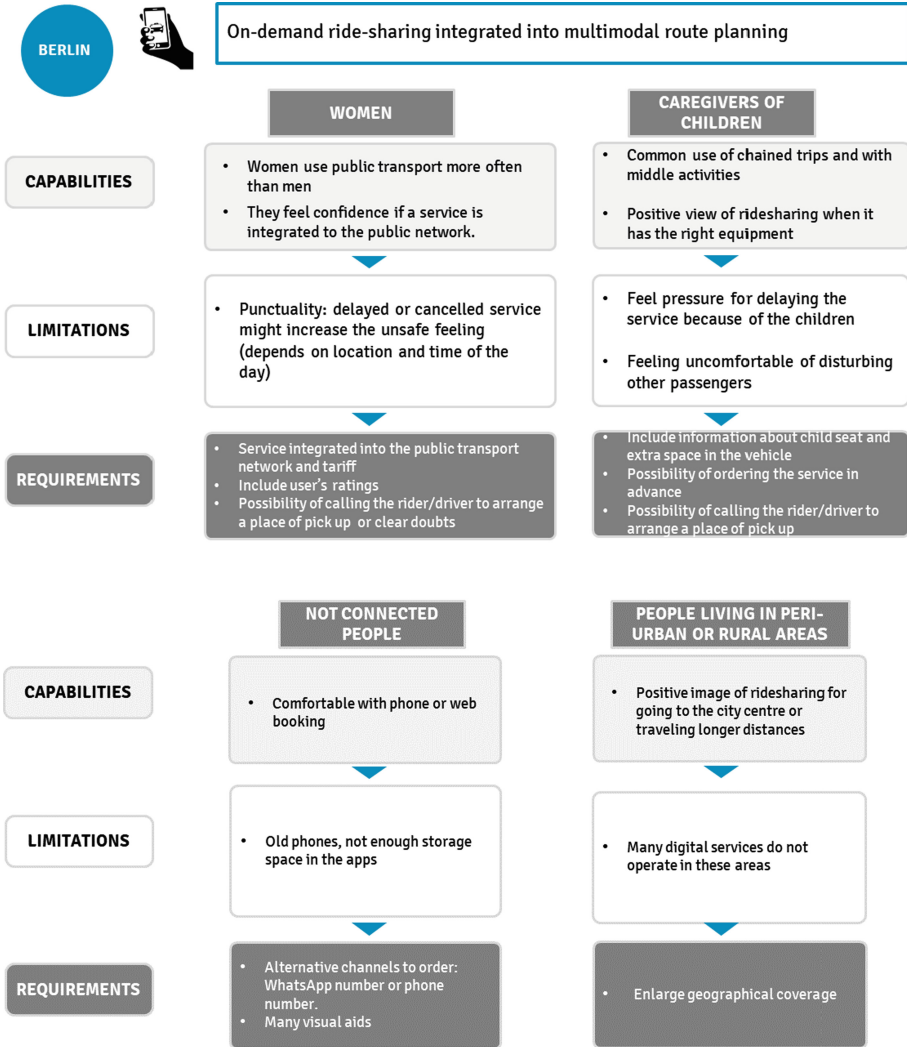


Fig. 7. Requirement path for the Berlin pilot

**Table 2.** Needs based on users' capabilities, limitations and requirements paths

| Needs threads | Characteristics  | P1 Emilia Romagna   | P2 Antwerp   | P3 Galilee  | P4 Madrid  | P5 Berlin   |
|---------------|--|---|--|---|--|---|
| Space         | Space is both a condition and a constraint to mobility<br>The overlapping of spatial obstacles is a fundamental driver of mobility choices | Environment characterized by scattered rural villages<br>Logistic problems linked to spatial configuration; involve a great amount of effort to pick up parcels: barrier to the satisfaction of needs | People with reduced mobility or vision find obstacles in the physical environment  | Lack of adequate transport modes and connectivity in the Arab rural villages<br>A hostile atmosphere prevents women to ride the public transit<br>It is difficult to match the digital mapping with the real geography by Mobility apps | There are needs related to the geographical coverage of the service<br>They affect people living in suburban areas who are most concerned with easy access to stores                   | People living in peripheral areas find problems with service coverage<br>There are also concerns about the safety and attractiveness of the routes and the spots for onboarding |
| Time          | Time is a valuable resource and the importance of making a good use of it appears in the different pilots                                  | A locker for logistics allows a flexible and efficient use of time by the users   | Extension of time to cross, the possibility of adapting time to target-group needs<br>There's a different perceived time for each person | The app gives an orientation to time allocation: for instance, it makes universities and education centers closer to women  | An app for food delivery may be time saving<br>It gives a different quality to time: time to relax instead of time to cook; a gained time instead of a time devoted to a domestic task | Time needs to be flexible: (because children's needs are more unpredictable)<br>And driver should be punctual   |

*(continued)*

**Table 2.** (continued)

| Needs threads | Characteristics   | P1 Emilia Romagna   | P2 Antwerp   | P3 Galilee  | P4 Madrid  | P5 Berlin   |
|---------------|---|---|--|---|--|---|
| Human contact | Digital tools are something little familiar for a great variety of the groups<br>Human contact is a requirement to overcome some of the fears contained in the digital domain | An assistant at the locker spot will be helpful to overcome digital-skills-related problems<br>The importance of personal training is also remarked | People with reduced vision or mobility are depending on the help of passersby<br>This assistance narrowed due to fears raised by the COVID pandemics | Having direct contact with the driver is a requirement to trust him, to overcome fears related with physical insecurity | The possibility of ordering food through WhatsApp or arranging details of delivery through a call to the rider were very frequents claims to the service | There was a request of humanity directed to the driver: women need drivers to care about the needs of a mother and to help her onboard and offboard |

## 5 Conclusions and Recommendations

Some new insights of this paper that go beyond what was proposed by previous literature are related to the identification of specific needs of women. Most of the literature about women and mobility focuses on the gender-bias of transport planning and the negative experience of threat and potential harassment of women in the public space and transport. An important insight of the study is to show that regular mobility services address a “male individual” user and do not contemplate the specific needs of caregivers in charge of dependents, who are most of time are women. Concerning physical disabilities, a new insight is that assistance appears as a two-fold aspect: as favouring autonomy or intruding in it; both as empowering or as undesired assistance. Thinking of accessibility of street crossings, many papers have connection with fluidity of vehicles circulation and there are not many articles that view smart traffic lights from the point of view of the pedestrians, especially when they have physical disabilities. Finally, we also identify foreign people and migrants as central potential users of the locker systems of parcel delivery, for satisfying some of their unmet needs.

Based on these learnings, we have elaborated a list of inputs for the INDIMO Digital Mobility Toolbox, that may assist on the development and deployment of the digital mobility and delivery services of the future, and we have produced the main requirements for the digital and graphical interface of the apps, associated to the populations sensitive to them. In light of these requirements, we have developed a list of recommendations extensively included in the INDIMO deliverable D1.3 for developing the INDIMO toolbox and synthetized below.

Since the world has been transformed by the outbreak of COVID-19 and the exceptional situations that arose with it, the response and accommodation of different users’ profiles to this anomalous situation was also explored. It was found that COVID-19 has a dual effect in most of the pilots: it may increase the need for apps to avoid a perceived mobility risk. But also, the new scenario may be experienced as a barrier to a new

exposition which is contained in the use of service. The details of these findings will be examined in the remaining paragraphs.

1. Generally, users should be involved in the design and decision process before a new service is deployed. Developers, operators and policy-makers can better understand their target population with a participatory approach, such as in-depth semi-structured interviews. Integrate target populations, from diverse profiles, in the decision-making process about accessibility and inclusiveness of the digital services and apps. Only those who are genuinely concerned about accessibility can bring about changes in this area
2. To enhance the concept of human-centred design, it is advisable to start from the identified requirements in order to develop the design, technical, and visual solutions that address the aforementioned items. The CLR path (capabilities, limitations and requirements) allows design of- concrete profiles and with real users in mind.

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