



D2.1 – Universal Design Manual – Version 1

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Document Number	D2.1
Document Title	Universal Design Manual – Version 1
Version	2.0
Status	Final
Work Package	WP 2
Deliverable Type	Manual
Contractual Date of Delivery	30.06.2021
Actual Date of Delivery	30.06.2021
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Keyword List	Target-group users', aspirations and capabilities, Universal Design principles, digital mobility services, accessibility, inclusion, equity, guidelines for developers and UI UX designers.
Dissemination level	PU

INDIMO Consortium

The project INDIMO - Inclusive Digital Mobility Solutions has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875533. The consortium members are:

No	Participant Legal Name	Country
1	VRIJE UNIVERSITEIT BRUSSEL	BE
2	VDI/VDE INNOVATION + TECHNIK GMBH	DE
3	INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM	BE
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13	COOPCYCLE	FR
14	FONDAZIONE ISTITUTO SUI TRASPORTI E LA LOGISTICA	IT
15	POSTE ITALIANE - SOCIETA PER AZIONI	IT

Document change record

Version	Date	Status	Author (Unit)	Description
0.1	22/01/2021	Concept and Coordination	Floridea Di Ciommo	Draft
	05/05/2021	SOTA	Technion	Draft
0.2	15/05/2021	First draft	Andrés Kilstein	Draft
0.3	26/05/2021	First revision	Floridea Di Ciommo	Draft
0.4	16/06/2021	Second revision	Experts with cambiaMO and MBE	Draft
0.5	16/06/2021	Contributions	DBL, MBE, VUB, Erzsebet Foldesi, Romina Barra, Pedro Alvarez	Draft
0.6		Second revision	Gianni Rondinella	Draft
0.7	18/06/2021	Second draft	Andrés Kilstein, Gianni Rondinella	Draft
0.8	21/06/2021	Third revision	Floridea Di Ciommo	Final version for internal reviewers
0.9	15/06/2021	Feedback from internal reviewers	D2D, ITL	Reviewed version
0.91	29/06/2021	Quality check for submission to VUB	cambiaMO	Final version to submit to the EU
1.0	30/06/2021	Final version	VUB	Version ready for EU submission
1.1	01/12/2021	Revised version after PO comments	cambiaMO	Final version to submit to the EU
2.0	03/12/2021	Revised version after PO comments	cambiaMO	Final version submitted to the EU

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Executive summary

The objective of this document is to provide guidelines for developers and operators by compiling best-practices and lessons learnt from the previous stages of research (mainly WP1 and WP3) on accessibility, inclusivity, and usability. This deliverable explains in detail the methodological approach and decisions that led us to the recollection of user's and stakeholder's insights about the potential employment of digital platforms for digital mobility and digital delivery services. The target audiences for which these contributions can be useful are outlined. The document builds on compliance with the European Accessibility Act that establishes standards of accessibility and usability for the recognition of basic equal rights for people of all physical, cognitive and sensorial conditions, as well as the Universal Design Principles extended with social, spatial and economic inclusiveness and security and protection of data.

The first step to properly define the content for the guidelines includes the literature review, with a focus on the various target-groups of users affected by the digital divide as highlighted in Deliverables D1.2 and D1.3 and on the current concept of universal design. Then, regulations, previous guidelines and standards created by EU organizations are explored.

The document proposes to approach universal design through the idea of a spectrum of capabilities-limitations, instead of elaborating guidelines for fixed target groups of users. This implies the assumption that there is not a minority of disabled or vulnerable to-exclusion people separated from the majority tagged with "normality", but rather that there are different dimensions, where it is possible to set a spectrum of capability-limitation, and each person, according to their own judgment and self-perception, can be in a point of this spectrum.

Finally, guidelines and recommendations for Universal Design, the Universal Design Manual itself, are presented with the aim of covering both digital and physical interfaces and giving responses to the different requirements elicited by users, non-users and stakeholders in WP1 and WP3 fieldwork (D1.2, D1.3, D3.2, D3.4) that were collected during previous stages of the research process and validated within the Communities of Practice (D3.2).

As lessons learnt and conclusions of these guidelines, first, it is important to think the digital design with a universal perspective, contributing to the evolution and compliance of universal design principles. Firstly, this universal approach implies that 1) the features of a service/product should be usable and accessible by the greatest possible number of people and by the widest possible range of functional diversity; 2) if some features cannot be accessed or used by a specific group of population, design must provide an equivalent use. The second important learning is that this manual should cover different uses and axes without stigmatizing target-groups of users, since this does not comply with the principle that a same functionality of a digital mobility or delivery service can be of special interest of different profiles of users, such as in the physical mobility infrastructure a

levelled kerb is useful for people in wheelchairs, caregivers with baby strollers, people on a bike or older people who find a swift path to the street.

In Annex A4, a separate concise document is provided that summarises the concrete guidelines and recommendations for developers and operators in an easily accessible way including

The principles of Universal Design in digital mobility: a short introduction to the concept and how it can be applied to digital mobility services.

Analysis of the capabilities and limitations of users: a method to identify which capabilities of users a digital application or service should account for.

User requirements and design guidelines: validated requirements and a proposed path for UI|UX designers, developers and operators to deal with them, linking requirements, details of development and design examples.

Checklist for the assessment of digital mobility services: a checklist to ensure that not only the digital interface but also the infrastructure, the vehicles and the personnel are inclusive and accessible.

General recommendations: a list of general recommendations for developers and operators on how to approach an inclusive design process for digital mobility services.

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Acronyms

Acronym	Meaning
CoP	Community of Practice
CCC	Co-Creation Community
DDS	Digital Delivery Services
DMS	Digital Mobility Services
EAA	European Accessibility Act
ETM Forum	European Transport and Mobility Forum
ETSI	European Telecommunications Standards Institute
EU	European Union
FAQ	Frequently Asked Question(s)
GPS	Global Positioning System
ICT	Information and Communications Technology
IT	Information Technology
MBE	Mozgasszerultek Budapesti Egyesulete
NGOs	Non-governmental Organizations
PT	Public Transport
PTS	Public Transport Services
SSI	Semi Structured Interviews
UD	Universal Design
UDM	Universal Design Manual
UDM-V1	Universal Design Manual Version 1
UI	User Interface
UIL	Universal Interface Language
UNCRPD	UN Convention on the Rights of Persons with Disabilities
US	United States

UX	User Experience
W3C	World Wide Web Consortium
WCAG	Web Content Accessibility Guidelines
WP	Work package

1. Introduction

1.1. The INDIMO project

The main objective of the INDIMO project is to extend the possibilities and benefits of the new scenario of digital on-demand transport to those groups that currently face barriers to access and feel excluded from these new usages. Physical, cognitive, geographical, and economic accessibility and inclusion are challenges posed by digital interfaces, that hinder the potential of the new technology in the field of transport. There is a risk that new digital mobility and logistics services will not be available and accessible to all members of society. 22% of all European households still do not have access to broadband Internet, especially in rural areas. Mobile broadband penetration also shows a high variation within Europe with 70 subscriptions per 100 persons in Hungary as a lowest value. In some EU Member States, over 25% of the population still does not regularly go online. Almost 10% of EU citizens have never used the internet, with a high number of non-users among those with low education levels, aged over 55, retired or inactive (European Commission, 2020). These data show that internet-enabled mobility is not an obvious choice for millions of Europeans although internet access is just one of the reasons why they may be excluded. This work aims at extending the usability of digital mobility services and digital delivery services to the app-based systems in order to bridge the existing usage gap. The project aims at having a wide variety of people covered by personalized mobility options that satisfy their needs.

INDIMO's main goal is to expand the use of existing and emerging digital mobility services to target users-groups that are currently excluded due to physical, cognitive, cultural or socio-economic barriers. Fulfilling this goal requires a holistic approach that takes into consideration a variety of digital services and an extensive data collection from end-users, developers, operators, and policy makers to establish policies and guidelines for developing digital information systems and applications for inclusive transportation. The outcome of the project will be a comprehensive digital mobility deployment toolkit, which will be comprised of:

- A universal design manual for digital mobility services in version 1 and version 2;
- Guidelines improving the design of interface between transport users and digital mobility systems (i.e. universal interface language) in version 1 and version 2;
- Guidelines for cyber security and personal data protection;
- A policy evaluation tool and recommendations for policy makers.

1.2. The aim of the deliverable

1.2.1. What does the Universal Design Manual – Version 1 (UDM-V1) consist of?

This report - ‘**Universal Design Manual – Version 1**’ is the first deliverable (D2.1) of Work Package 2 (WP2) (Figure 1).

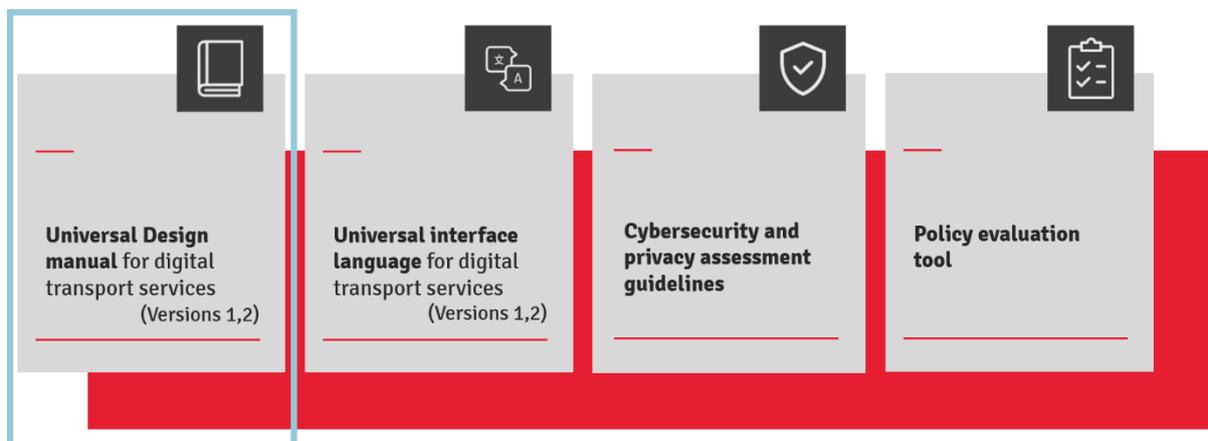


Figure 1 - The INDIMO Inclusive Digital Mobility Toolbox

The main objective of the Universal Design Manual Version 1 is to provide **developers, graphic designers, UX/UI designers, transport operators** and policy makers the **first draft guidelines** to eliminate the existing barriers to the navigation through digital mobility and delivery services used in the current INDIMO pilots in order to develop the **UDM Version 2 (Deliverable 2.2)** due in Month 34 of the project. The focus is on the interaction between users and the digital transport system through **user interfaces on multiple devices** (e.g., mobile, desktop, interactive equipment or information display). The UDM-V1 targets the architecture of the various digital mobility and delivery services (DMS & DDS) to proportionate an adaptive and responsive interface design, to facilitate their flow of navigation, to consider the contrast and shape of the fonts and visual aids, to define the general layout and organization of elements, communication channels and aspects of engineering such as the adaptation to external readers or other external aids.

1.2.2. How did we develop it?

The UDM-V1 is based on the assessment of user and non-user requirements and feedback from real-life applications in the five INDIMO pilots. The manual has been constructed following the seven principles of universal design complemented by security and protection of data and the concept of equitable use to social, spatial and economic inclusiveness (see Section 2).

The guidelines for developers and operators have been derived from the user requirements identified through the semi-structured interviews (SSI) with users and their representative

organisations carried out in WP1 (see Deliverables D1.2 and D1.3 for details). The requirements were afterwards prioritized within the Communities of Practice (CoP) of each pilot attended by developers, users and non-users of the pilots' DMS/DDS, civil society organizations representing target groups users, operators, policymakers, researchers, and other relevant stakeholders (see Deliverable D3.2 for details on CoPs).

The UDM-V1 has been validated at the second INDIMO co-creation workshop involving the INDIMO Co-creation Community. On this occasion, the UDM-V1 contents were presented and discussed with policy makers, developers, user organisations, service operators and UI|UX designers. At this workshop the approach of the spectrum of capabilities-limitations was tested.

1.2.3. Who benefits from the UDM-V1?

The end-users who will benefit from this manual include intersectional profiles of INDIMO target groups indicated in D1.3 and specifically interviewed for each pilot (See Annex A3 in Deliverable D1.3 and Di Ciommo et al. 2022). The target groups are presented in Table 1 and represented by the related iconographies. The exact definition of the user characteristics is included in Annex A1.

Table 1. Pilots' names and user profiles (Source: INDIMO Deliverable D1.3)

Pilot name and location	User profiles (and characteristics)
<p>P1. Introducing digital lockers to enable e-commerce in rural areas (Emilia Romagna-Italy)</p> 	<p>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)</p>
<p>P2. Inclusive traffic lights (Antwerp-Belgium)</p> 	<p>Vulnerable pedestrian (older people; people with reduced mobility; people with reduced vision)</p>
<p>P3. Informal ride-sharing in ethnic towns (Galilee)</p> 	<p>Informal ride-sharing users (ethnic minority; women; residing in villages or rural areas; language barrier)</p>
<p>P4. Cycle logistics platform for delivery healthy food (Madrid-Spain)</p> 	<p>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)</p>
<p>P5. On-demand ride-sharing integrated into multimodal route planning (Berlin-Germany)</p> 	<p>On demand ride-sharing users (caregivers of children/ impaired/ elders; women; lack of services; lack of digital skills, residing in peri-urban locations)</p>

1.2.4. Who is the UDM-V1 for?

The UDM-V1 target audiences include:

- *NGOs or associations representing target-group profiles.* These are organizations that gather and represent people with impairments or their families. They tend to work and to construct a high level of expertise on the matter and have a direct contact with the target audience. Improvements in the apps could also act as facilitators of their work or complement it.
- *Developers including Graphic designers, UX/UI Designers, IT experts, programmers and network architects.* This category is populated by several professions that develop similar tasks within a digital project, such as Computer programmers, Computer Engineers, System Analysts, Information systems Managers, Computer Network Architects. They oversee creating, testing, coding and programming digital mobility services for computers, mobile phones, tablets and other devices. The manual will generate awareness and orient the implementation of functionalities and their characteristics.
- *Operators of mobility/delivery services.* The category of operators refers to those executive and management positions within organizations in charge of deploying digital mobility services or digital delivery services. Those who direct, execute and monitor the operation of ridesharing, ride-hailing, cyclo-logistics and other services are included in this group. The guidelines will contribute to generate awareness and guide the decision-making process relative to the digital and physical interface through inclusivity principles.
- *Policymakers in charge of regulations.* Public officers, either in executive positions or working as lawmakers or regulators who elaborate, deploy or execute policies, or shape laws and regulation that directly address digital mobility and delivery services.



The following figure synthesises the relationships that the construction of the UDM-V1 has with other activities along the project layout.

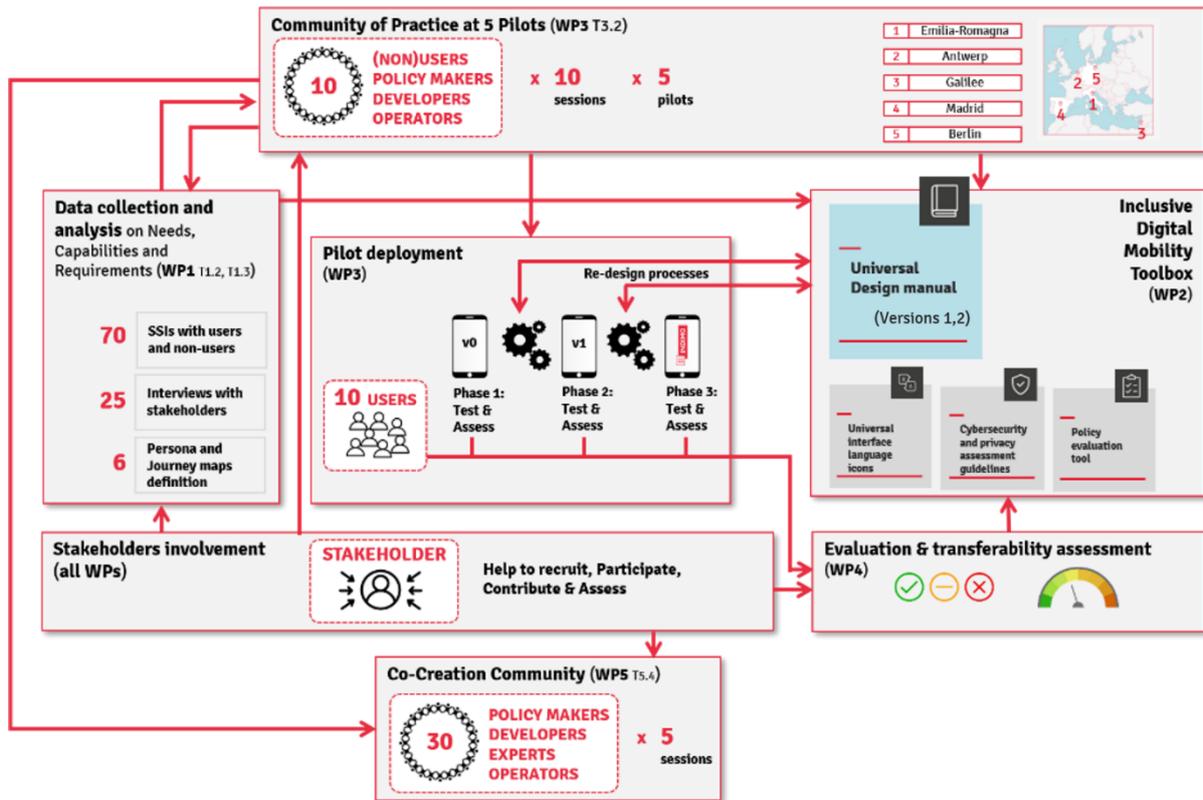


Figure 2. Relationships between UDM-V1 and other INDIMO activities

1.3. Task participants and responsibilities

Task 2.1 to which this deliverable relates to is led by cambiaMO with the support from MBE, DBL, Technion and VUB who have contributed respectively to section #3 and 6, #4, #2 and #4, while Polis and VDI-VDE-IT have contributed to the identification of stakeholders and the organisation of the co-creation workshop. Local pilot partners (e.g., ITL and Poste Italiane, IMEC, Technion, VIC, CoopCycle, and Door2Door) carry out the Communities of Practice for the UDM-V1 requirement validation. EPF and Polis have contributed with the mobilization of users and providing the cities’ perspective. The task closely interacted with tasks T1.2 and T1.3 in WP1, the CoP implementation sessions in WP3 (D3.2) and the co-creation workshops (T5.4) in WP5. Hence, collaboration with all partners has been essential.

We have received support from a target groups representative and expert in Universal Design (Erzsebet Foldesi, person with reduced mobility and former vice-president of the European Disabled Foundation, honorary director of the Universal Design Centre in Hungary), a UX/UI designer (Romina Barra Annibale, UI|UX designer) and a person with reduced vision (Pedro Alvarez González, developer for the product design studio focused on civic engagement, Populate).

1.4. Structure of the deliverable

This deliverable is subdivided into 8 sections. Section 1 introduces the topics that will be covered and deal with the main problems this document tackles; Section 2 presents the concept of Universal Design in the field of digital transport and covers the UDM-V1 compliance with the Universal Design principles and the European Accessibility Act; in Section 3 the approach of the spectrum of capabilities-limitations is presented and justified; Section 4 presents the methodological approach for building users' requirements and develops the draft guidelines for a design for social inclusion; Section 5 elaborates the checklist for digital mobility and delivery service assessment; Section 6 presents the main recommendations and section 7 elaborates the lessons learnt related to the development of this UDM-V1. Section 8 concludes the document outlining the next steps.

In **Annex A4**, a separate concise document is provided that summarises the concrete guidelines and recommendations for developers and operators in an easily accessible way including

1. **The principles of Universal Design in digital mobility:** a short introduction to the concept and how it can be applied to digital mobility services.

Analysis of the capabilities and limitations of users: a method to identify which capabilities of users a digital application or service should account for.

User requirements and design guidelines: validated requirements and a proposed path for UI|UX designers, developers and operators to deal with them, linking requirements, details of development and design examples.

Checklist for the assessment of digital mobility services: a checklist to ensure that not only the digital interface but also the infrastructure, the vehicles and the personnel are inclusive and accessible.

General recommendations: a list of general recommendations for developers and operators on how to approach an inclusive design process for digital mobility services.

2. Universal Design in the field of digital transport

2.1. The principles of Universal Design

Universal design is defined as the design of products and services that may be employed by people with a wide array of characteristics, abilities, and disabilities. It also implies a type of use that does not require adaptation or specialized design, but in which the main principle is related with the inclusivity. The seven principles of Universal Design - designing for people of all ages, abilities - allow to create services whose design will:

1. be useful and marketable to people with diverse capabilities.
2. accommodate for a wide range of individual preferences and capabilities.
3. understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. communicate necessary information effectively to the user, regardless of environmental conditions or the user's sensory capabilities.
5. minimize hazards and the adverse consequences of accidental or unintended actions.
6. allow the service to be used efficiently and comfortably and with a minimum of fatigue.
7. provide by design appropriate size and space, reach, manipulation, and use regardless of the user's body size, posture, or mobility.

The seven principles of Universal Design were developed in 1997 by a working group of architects, product designers, engineers and environmental design researchers, in the North Carolina State University (Story, 1998). The purpose of the 7 Principles is to guide the design of environments, products and communications. The principles are defined as follows (Figure 3) (Story, 1998).

- 1. Equitable use.** The design is useful and marketable to people with diverse abilities.
 - 1a. Provides the same means of use for all users: identical whenever possible; equivalent when not.
 - 1b. Avoids segregating or stigmatizing any users.
 - 1c. Provisions for privacy, security, and safety should be equally available to all users.
 - 1d. Makes the design appealing to all users.
- 2. Flexibility in use:** The design accommodates a wide range of individual preferences and abilities
 - 2a. Provides choice in methods of use.

- 2b. Accommodates right- or left-handed access and use.
- 2c. Facilitates the user's accuracy and precision.
- 2d. Provides adaptability to the user's pace.

3. Simple and intuitive use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

- 3a. Eliminates unnecessary complexity.
- 3b. Be consistent with user expectations and intuition.
- 3c. Accommodates a wide range of literacy and language skills.
- 3d. Arranges information consistent with its importance.
- 3e. Provides effective prompting and feedback during and after task completion.

4. Perceptible information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

- 4a. Use of different modes (pictorial, verbal, tactile) for redundant presentation of essential information.
- 4b. Provides adequate contrast between essential information and its surroundings.
- 4c. Maximize "legibility" of essential information.
- 4d. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).
- 4e. Provides compatibility with a variety of techniques or devices used by people with sensory limitations.

5. Tolerance for error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.

- 5a. Arranges elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.
- 5b. Provides warnings of hazards and errors.
- 5c. Provides fail safe features.
- 5d. Discourages unconscious action in tasks that require vigilance.

6. Low physical and intellectual effort: The design can be used efficiently and comfortably and with a minimum of fatigue.

- 6a. Allows the user to maintain a neutral body position.
- 6b. Uses reasonable operating forces.
- 6c. Minimizes repetitive actions.

6d. Minimizes sustained physical effort.

7. Size and Space for approach and use. Appropriate size and space are provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility

7a. Provides a clear line of sight to important elements for any seated or standing user.

7b. Makes reach to all components comfortable for any seated or standing user.

7c. Accommodates variations in hand and grip size.

7d. Provides adequate space for the use of assistive devices or personal assistance.

In addition to the above seven principles, the INDIMO project also recognizes the following as principles:

8. Social, spatial and economic inclusiveness. This implies equal opportunities to access digital mobility services by all social groups, regardless of their age, gender, level of income, social background, literacy, digital literacy, ethnicity, language or location. It addresses affordability, and different aspects of general inclusivity.

9. Security and protection of data. These aspects refer to all needed practices to protect digital information from unauthorized access, corruption, or capture along its lifecycle. Also, about preventing misuse of collecting information and unsolicited communications in order to guarantee individual privacy and responsibility from the side of organizations.

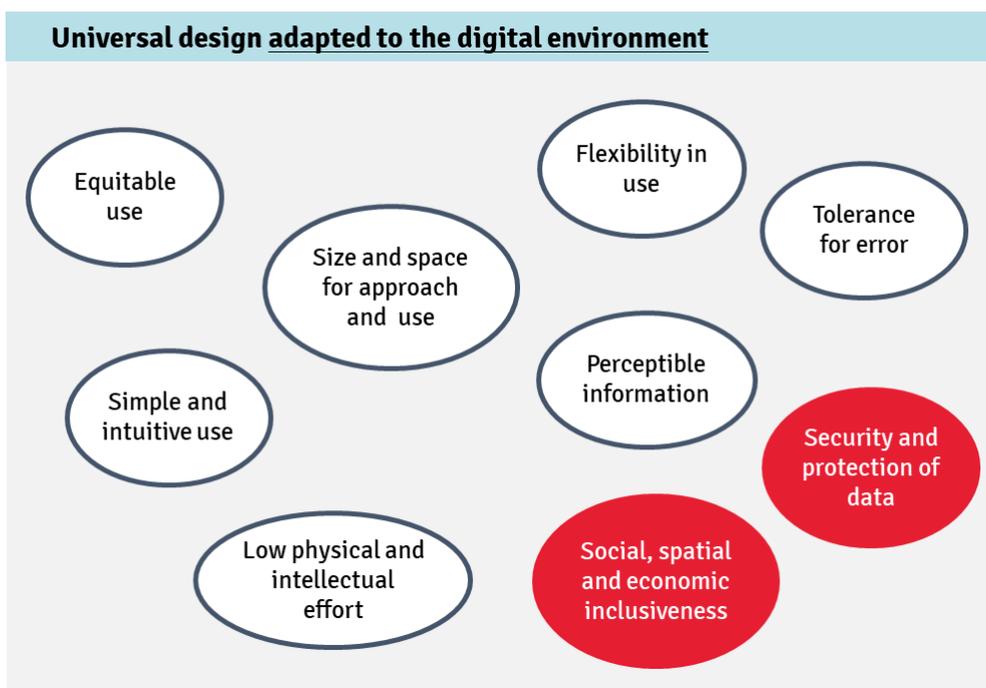


Figure 3. Universal design adapted to the digital environment

2.2. Compliance of this manual with Universal Design principles

In this section, an account on how the proposed Design Manual fits into the Universal Design principles will be presented. It is important to account for this aspect because any piece of new knowledge generated recovers and expands previous knowledge. We get inspiration and insights from previous background, and we use this existing knowledge to reach further understanding on the topics under study. In this case, general instructions for design of environments (such as the 7+2 principles) should be adapted to the specific implementation of digital mobility and delivery services, and its digital and physical associated interfaces. In our work, we keep in mind three main aspects on how to reach that the final product can be used by as many users as possible: (1) to design products, systems that are readily usable by most users without any modification, (2) to adapt products, systems to different users (by providing adaptable user interfaces), and (3) to make interfaces that are compatible with assistive products and assistive technologies.

The first principle of **equitable use** is brought into the field of digital platforms in the combination of universal features plus special adaptations when required. The equivalent use is achieved by the available customization options (enlarging fonts, captions or transcript for audio contents, for example) or the adaptation to requested devices (for instance, compatibility with an external reader). Universality and customization, when needed, are not contradictory elements, but go hand in hand in this implementation. The purpose is to cater for all the users, but also making the design appealing to different individual characteristics. This last principle is especially relevant in digital platforms, to avoid an aesthetic and general image that addresses the younger segment or builds some specific aspirational imaginary that is not appealing for all types of population.

With regards to the second principle of **flexibility in use**, it is especially considered at the time of digital mobility and delivery services that offer a variety of options. For example, payment options may be a barrier to the access to products and services. The point of the adaptability to the user's pace, present within the second principle, is very clearly translated into the smart traffic lights proposal, where one of the studied benefits was the recognition and adaptation to the user's speed of crossing. This aspect considers that each person has their own speed to cross a street as a result of different levels of physical ability, age and health condition. There is not a clear distinction between capability and impairment but it is rather a continuum line where all the individuals are placed with different levels of ability. If a portion of the population is excluded from a system or structure, the problem is not the population but the design.

With regards to the third principle of **simple and intuitive use**, it is very much associated with the simplification of complicated information in order to facilitate orientation and comprehension. It is also related to the shortening of the workflow, attempting to recover information automatically every time that this is possible. And, of course, the visual aids, the description of products associated to images is a way of eliciting meaning in the most intuitive way. The intention to accommodate a wide range of literacy and language skills



can be facilitated by using pictures, images and icons as a core element of the linguistic environment of the digital interface design of the mobility or the delivery service; as well as by using simple language avoiding foreign words that may add unnecessary complexity; and the availability of language options, considering the idiomatic variety that always exists in a given territory. All these aspects will be addressed in this manual.

Related to the fourth principle of **perceptible information**, this guide provides a consistent orientation about the organization of information on the screen, i.e. the layout of the information that is offered to the user. The screen placement that includes the screen layout, for example, ways to make the most important pieces stand out, the use of typefaces and fonts are covered in this guide. The compatibility with techniques or devices required by specific forms of impairment (e.g., by using multisensory solutions) is also covered.

The fifth principle of **tolerance for error** will be treated with the account of different notifications and alerts that minimizes risks and consider the ubiquity of human errors of all kinds. The tolerance for error is present in the reinforced interaction with the platform in the most sensitive stages of a purchase or hiring of a service, such as the moment of entering credit card info or making the payment.

The sixth principle of **low physical and intellectual effort** concentrates on an important portion of the recommendations of the present guide. Some elements such as the auto-completion or suggestions made by the app have the goal of avoiding repetitive action and saving cognitive and attentional resources. Specifications on the condition of the physical environment where smart traffic lights or digital lockers are placed, following this guide, address the ease or orientation, the facilitation of navigation in the space and the greatest possible absence of obstacles. The minimization of intellectual efforts also implies minimizing the anxiety that is generated in the act of orienting oneself in space and also signage, posts etc. to support memory loss and calling for attention. All these actions will be covered along this guideline.

The seventh principle of **Size and Space for approach and use** is covered in the sections devoted to the spatial organization of information and elements in the digital platform, the recommendations relative to the vehicles and the use of space inside them and other elements of the general layout of the service.

In addition, the project pays particular attention to the additional principles we propose i.e. the equal opportunities to access to digital mobility services by all social groups, regardless of their age, gender, level of income, social background, literacy, digital literacy, ethnicity, or location. And finally, security and protection of data will also be addressed as all target groups need to be protected in their digital information from unauthorized access, corruption, or capture along its lifecycle. The UDM-V1 will provide guidelines for preventing misuse of collecting information and unsolicited communications to guarantee individual privacy and responsibility from the side of organizations.

2.3. Compliance of this manual with the European Accessibility Act

Accessibility, inclusiveness, and usability are required conditions to reach accepted levels of equality and avoidance of discrimination and are fundamental for the recognition of basic equal rights for people of all physical, cognitive and sensorial conditions. The European Accessibility Act (EAA) will set new EU-wide minimum accessibility requirements for a range of products and services. Its goal is to consolidate the right of persons with disabilities to access goods and services offered in the EU internal market. The Act is a Directive, which means it sets binding accessibility goals but leaves it to the Member States of the European Union to decide the channels they implement to reach them.

The Act came into force on 27 June 2019 and Member States have three years to transpose it into national law. This implies the inclusion of new national legislation and/or updating existing legislation in accordance with the specifications of the Act. EU countries must communicate the text of said national legislation to the European Commission (see Annex A2 for a detailed analysis of the relevant regulations of the directive).

At the European level it is possible to recognize a growing sensitivity and interest towards accessibility and inclusivity in the digital environment, with a wide array of legal instruments to address the mentioned accessibility in which the European Accessibility Act is one of the most important. It is part of a nudging effect to boost the adoption of measures and adaptations in member states, and that also covers privacy and data protection. Nevertheless, although there is a clear emergence of legal instruments that enforce or encourage accessibility in the digital domain, most of the rules do not actually specify the elements or components expected in the accessibility. There is no technical or process-oriented definition that may be of use in concrete applications. The European standards are still to be created. This UDM-V1 will contribute to lead to them.

3. Capabilities-limitations spectrum

Most of the literature dealing with the limitations of vulnerable groups towards ICT tends to underestimate or overlook the capacities that are already in place and that are the starting point for any future development. The UDM-V1 provides capabilities such as the starting point for designing for accessibility and inclusion.

Actually, the main pillars of the fieldwork realized in T1.3 and developed in D1.3 are related with the capabilities, limitations, and requirements paths for the end users (Nowell et al. 2017). Following the scheme of the previous Universal Design Manual (Story 1998), this section focuses on what people can do – their capabilities and their current state in respect to the options available to them. Actually, the capability set outlined by Sen's approach (1992) is not merely related with achievements; but rather to the freedom of choice and, to a person's quality of life. It is often asserted that the quality of life of vulnerable groups is improved when they adopt information and communication technology (ICT) such as the internet, mobile phones and computers. In the case of digital mobility and delivery services, they offer new opportunities to travel to work and study, to find jobs farther away from the location of home, to access health care, take care of people, to purchase products and comply with other needs of the everyday life. Most of the literature dealing with the limitations of vulnerable groups towards ICT tend to underestimate or overlook the capacities that are already in place and that are the starting point for any future development. When the WP1 identified capabilities, limitations and requirements are included in the word cloud of terms from the UDM-V1 we obtain the (Figure 4)

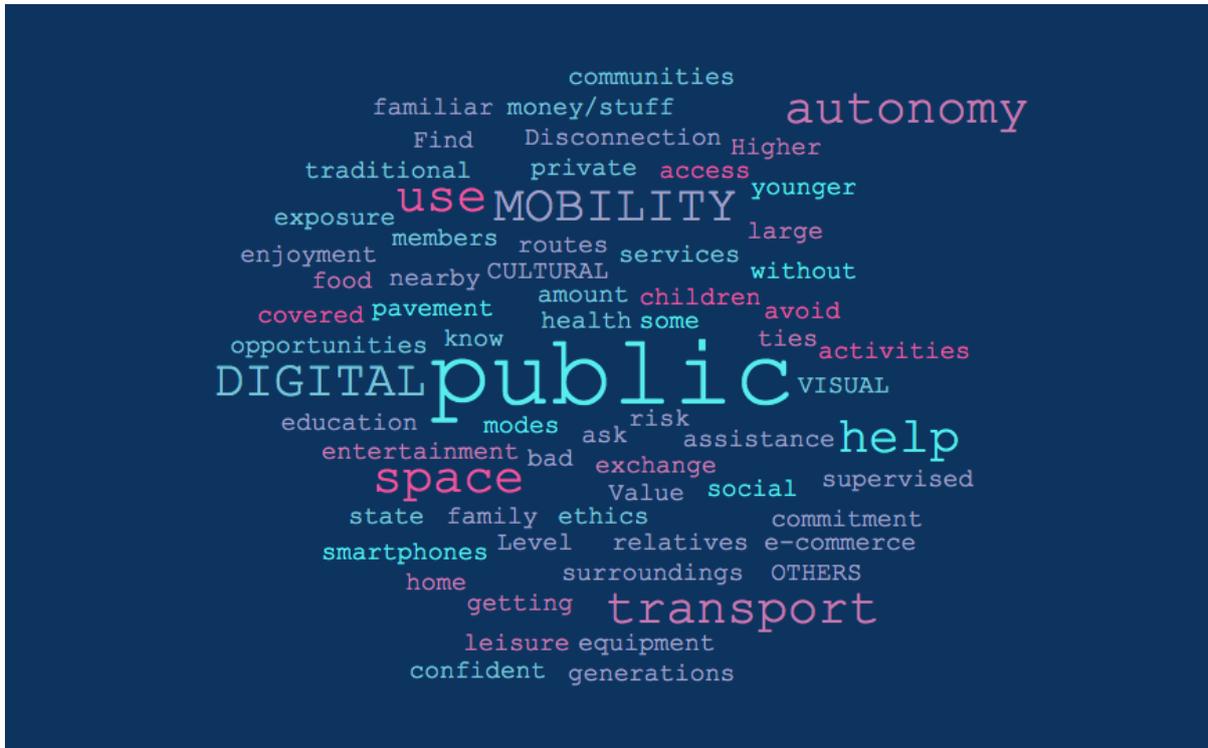


Figure 4. Word cloud of terms from capabilities-limitations and requirements paths based on the thematic analysis of user and non-user interviews (D1.3)

We can observe in this cloud the keywords that indicate the meaning related to the capabilities: autonomy, opportunities, opportunities for mobility are highlighted in the verbatim of target-groups of interviewed users and non-users. Help and assistance appear as additional keywords, oriented at easing the regular activities of participants. Public is a central word, directly associated with both the public space and the public transport, addressing how the digital assistance might provide a new meaning and a new experience to these resources for the everyday activity.

In this section, we will analyse the existing capabilities and limitations regarding the use of digital platforms that in the INDIMO research we associate to the below radial diagram (Figure 5). This technique has been tested during the Community of Practice sessions related to each INDIMO pilot and associated with the persona created through the INDIMO project in D1.2.

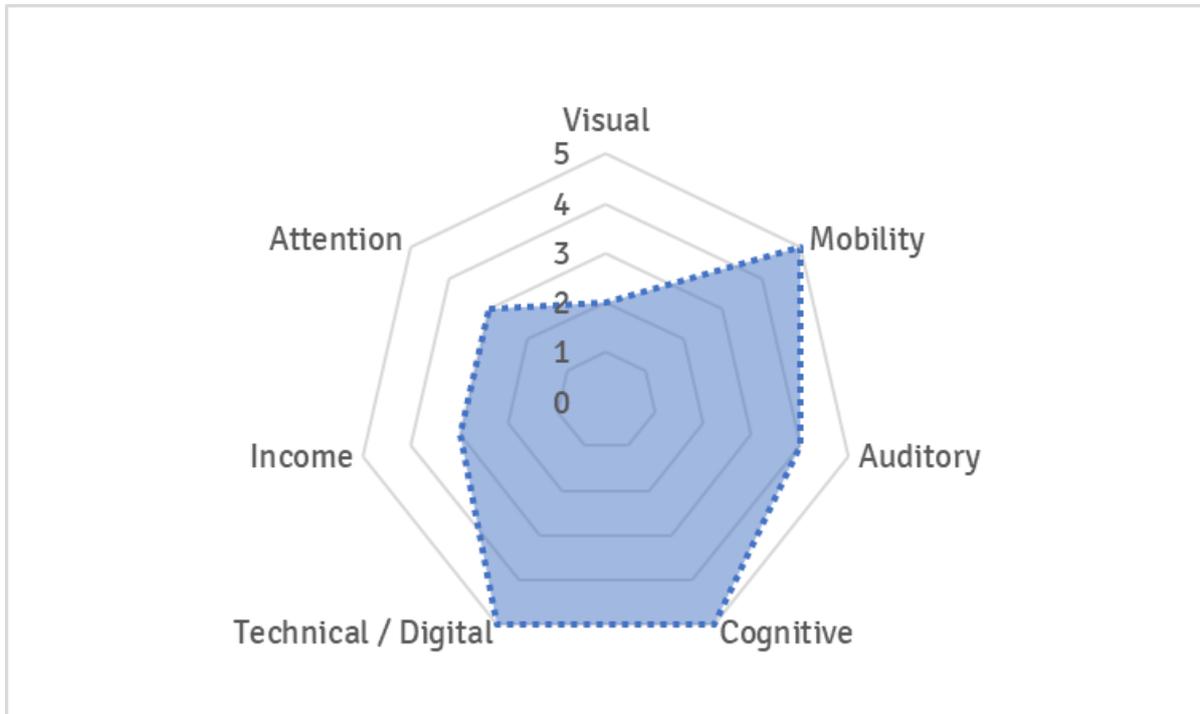


Figure 5. The axes with degrees of capability-limitation. Scale from 0 (no capability) to 5 (complete capability)

Usually, applications cover the different needs on an average basis (often below the accessibility standards), which sometimes causes that the application is only usable in ideal conditions, therefore it is not universal and/or accessible. Some applications may cover needs from vulnerable-to-exclusion people, but it strongly depends on the personal opinions of people involved during the development process. To manage this issue, we propose a different approach of assessment and development of accessible digital mobility and delivery solutions.

The first thing that we state is that it is not correct to talk about impaired people as an individualized group. All the people have certain degree of functional limitation that is overcome with personal and collective strategies. This means that the axes capability-limitation is in fact a spectrum where all people can be located. This deconstructs the old paradigm of functional “normality”. For instance, there is not a group of visually impaired people separated from a majority of people with normal vision. Rather, there are different degrees of ability and limitation with regards to vision: some people are completely unable to see, others can only recognize certain shapes or certain contrasts, others are unable to see some colours, other have problems to distinguish tones, others do not see objects from afar, and others see blurry objects when they are too close. This implies that, if there is a spectrum the design should attempt to cover, it should be the largest possible portion of this axis. Some of the aspects that limit mobility may be permanent (such as a permanent disease or a physical malformation), others are temporary limitations (such as being injured and having a cast, or having just undergone surgery) and other aspects are situational (for example, being pregnant, being in the street with children or older people).

Design has to contemplate all these different scenarios and cater for them as much as possible.

In addition, we should consider that social factors should also be implemented in the assessment process. Affordability in the digital world may also be limiting mobility and it should also be considered in the design of services. The affordability of equipment and data plans, or the cost of additional data, may be conditioning the user's behaviour with certain apps. Attention level of users may be hard to estimate during development, but can be implemented, tested, and validated during (beta) testing.

3.1. The axes with degrees of capabilities and limitations

This section will explain what the different axes of the radial diagram cover, what the extremes on them are and how they relate to this research.

3.1.1. Visual capability level

There is a spectrum of different severity of problems in the vision that require customised solutions for the users. This axis ranges from people with minimum level of limitation, such as difficulties to read from afar or at close distance (who just need customizing the fonts) to complete blindness, where digital solutions require higher complexity.

The level of autonomy in people's everyday life is also sensitive to the degree of their impairment. In the extreme of the axis, corresponding to complete blindness, certain avoidance of screens by users has been observed, when this is an option. Also, when digital solutions do not address the needs of blind people, doing things on their own, without digital assistance, is feasible and the preferred option. The segment within this group that is not totally blind has full capacity of using mobility apps as long as they comply with a number of adaptations: enough contrast to help readability, colourful letters, customizable fonts and some characteristics that will be explored in detail later on. However, not all people with reduced vision are able to use a smartphone and its apps developed for the rest of the INDIMO target groups.

Based on INDIMO research, those who are completely blind have the ability of quick learning in the search for independence. For instance, they learn routes to go to relevant places, such as a job, and tend to repeat routes they are familiar with. They are not afraid or ashamed to ask for help on their way, and they consider that a good portion of the assistance that is provided by passers-by could be given by an app. The condition for this is that the software works properly and fits organically into their routines. If the use is complicated, they rather see it as "another gadget".

3.1.2. Mobility capability level

This axis goes from people with a slower motion due to temporary limitations such as injuries to people who need special equipment and conditions to move on their own (such as a wheelchair). Depending on the level of limitation, users may need the assistance of family and friends to complete some activities. Some users may require special assistance

when they come across infrastructure or pavement in a bad state. Usually, these users value how route planner apps could contribute to their mobility if they informed them about these disturbances in the public space.

The analysis of the Semi-structured Interviews carried out in WP1T1.3 have highlighted that similarly to the people with reduced vision, people with reduced mobility were not afraid of asking strangers for help, and thought that it would be great if apps could relieve them from this external aid. The use of the app while they are using a wheelchair may cause certain complications. When assessing smart traffic lights, the more hand-free the designed device was, the better for their autonomy. They use private means of mobility as well as public transport. For the last alternative, help from strangers might be also needed.

3.1.3. Income capability level

It is well known that the population show very heterogenous levels of income, which are correlated with their educational level and that may be correlated with their connectivity, access to equipment and level of digital skills. Even focusing on low-income groups, it is a heterogenous segment of the population. Despite their economic condition, there is a widespread use of apps and familiarity with the digital environment. In more extreme cases of poverty there are limitations arising from the equipment (e.g. smartphone), which does not have enough storage space to install new apps, and with connectivity, since they tend to have phone plans with a limited mobile internet.

3.1.4. Technical/Digital capability level

While some people had first contact with digital devices when they were small children, and they spent their childhood playing on tablets and smart phones, other people were born and raised in a world with no personal computers. As it appears in the INDIMO research, many of the latter may be aware of the need of incorporating these tools and do it gradually. Although many users do not have a fully flexible mindset towards digital technologies, a great portion of the population use apps to communicate with their relatives (mainly instant messaging) and some social networks for entertainment (e.g., Facebook). Their incorporation of technology tends to be driven and guided by a relative or someone of their trust, for instance, a family member that encourages them to have Whatsapp to communicate more easily. The word-of-mouth appropriation is specially highlighted in people with low-digital skills. But, as the research showed, mechanically learning the basic features of one app does not mean the ability to automatically transfer that knowledge to another app or environment. The digital skills of the population show a clear dispersion, and although instant messaging can be the most used feature, route planners are less present.

3.1.5. Cognitive capability level

The cognitive axis moves from slight difficulties for understanding due to normal age deterioration of faculties or lack of proper education to more severe states of confusion, loss of memory or limitations to recognize people or places. Cognitive barriers imply a wide

array of conditions, which render a heterogeneous landscape. During the INDIMO fieldwork, we recognized that even within one impairment, there are different levels which involve different functionalities and practical guidance. The apps and other digital interfaces have the aim of enabling users to face the lowest number of possible choices. Choices in general may be associated with stress and the possibility of losing orientation. A straightforward line of workflow and the simplification of procedures may help release anxiety. Auto-filling, suggestions, recovering previous orders and indications are contributions for the simplification of cognitive processes in the user. It is suggested also to avoid the excess of texts and the simplification of concepts through images and icons. Even in severe cognitive impairment cases, familiarity with intuitive apps and apps based on icons and steps (such as Instagram) was found.

There are also aspects of the physical interface that are associated with the axes of cognitive impairment: the speed of speech of service agents, the identification in their look to clear uncertainties etc.

3.1.6. Attention capability level (distraction level)

This axis moves from circumstantial losses of focus as a result of the presence of other stimuli to a more permanent inability to clear the attention when facing irrelevant distractions. In our research, different distraction levels are observed associated to age, dementia condition and also to people under medical treatment. In the P4 Madrid pilot, it appeared that cooking may be an activity that implies a higher level of risk for people that have memory or attention problems. Thus, a food delivery service provides a new and appropriate solution for this specific scenario. Distraction level can also increase when travelling with a children or people in need of assistance. Due to the shared attention on a navigation application and the assisted person hands-free or voice-controlled options may be helpful.

3.1.7. Auditory capability level

This axis ranges from partial deficit of auditive ability, for instance, due to the deterioration of ageing, to a deaf or hard of hearing person. The auditory impairment from early ages may imply a deficit in the access to oral language. During this research, auditory impairment was not specifically explored. For specific cases of impairment, new axes can be defined.

3.2. Implementation of the capability-limitations spectrum. The INDIMO persona examples

In this section, we propose an exercise that can be implemented by any developer, operator or service provider. The purpose is to assess the capabilities/limitations of their potential users and think of how to make their services universal (or, at least, with a higher degree of universality).

1. The first step is identifying a spectrum of capability-limitations where people can be characterized.
2. In the second step, the operator or developer visualises the scope of the spectrum that is covered by the usability characteristics of the service. A hint to start with this visualization work is to think how the proposed axes fit into different profiles of potential users.

We are going to present the exercise using the profiles of fictional persona created in the task 1.2 of INDIMO project (see INDIMO Deliverable D1.2). We avoid feelings of stigmatization or private identification by working with fictional profiles.

As it was defined in D1.2, a persona is an imaginative, but accurate, representation of the user profile and all of its characteristics (Harlay, 2015). This representation enables designers to think of the user as a specific person with a name, face, and life frame, instead of treating users as a faceless profile with no identity. These creations capture the most relevant user profiles and characteristics based on the research and the insights from the semi-structured interviews with users and non-users in task 1.3. We have created six personas corresponding to our five pilot experiences (the Madrid pilot has two personas). We will present the main characteristics of each persona and assign values to them in the capability-limitation spectrum. The values are the result of interpretation and are not averages, medians nor any statistical measurement of an observable population. The main purpose of the description that follows is to illustrate how this method can be used to understand target users and the fit of a service to them.

This exercise of self-assessment was carried out during the CoP meetings in the pilots and gives the opportunity to operators and developers, together with the assistance of experienced researchers, to understand the potential users of DMS/DDS for accommodating their needs.

3.2.1. Pilot 1. Emilia-Romagna - Luisa

Persona: Luisa

Bio¹: Luisa is a 76-year-old widowed woman living in Monghidoro, where she grew up. She is retired, lives in the centre of Monghidoro and has a daughter and a grandchild. Her husband passed away a few years ago. She went to school until she was 14 years old, but she had to leave school to go to work and support her family.

She mainly wants to stay in touch with her relatives and her grandchild. That's why she received a smartphone from her daughter, however she does not use a lot of functions as she finds it quite difficult. She is inclined to (try to) use something if it is recommended by her family, like her smartphone. However, she lacks digital skills and requires help from others to (learn how to) use it. Other than that, she is active in her local community. Sometimes she received packages from family and friends.

¹ The personas were developed in Task 1.2 and are described in more detail in Deliverable D1.2.



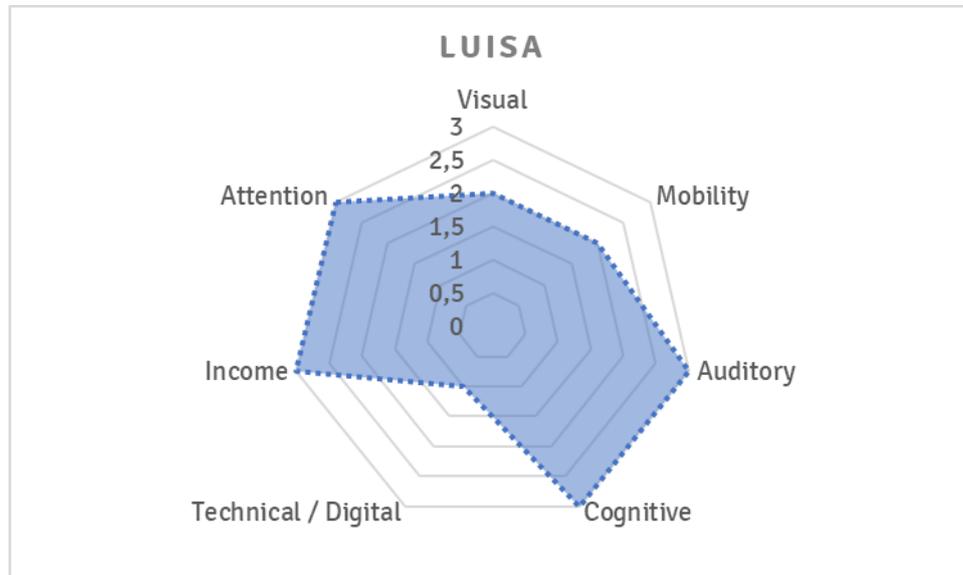
Spectrum capability-limitation representation and explanation (Figure 6):


Figure 6. Spectrum capability-limitation area for Luisa

Visual capability: 2 out of 5. Luisa has worn glasses, with a high degree of magnification, for more than 25 years. She has both presbyopia and astigmatism, which implies that she has problems with reading and with focusing on images. She uses her Whatsapp app with very big fonts, which were set by her daughter. But when picking another app or web, she usually misses how to enlarge fonts and ends up holding the device close to her face.

Mobility capability: 2 out of 5. With the age, she has lost some mobility and flexibility. She prefers not to use a walking stick, as a personal aesthetic preference. But she tries to avoid walking longer distances or going out too often. When she has to cover non-walkable distances, she prefers to call a local taxi by phone or get the assistance of relatives.

Cognitive capability: 3 out of 5. She shows clarity and consistency during conversations, is oriented in time and space, and has a normal verbal reasoning. She does not show signs of cognitive deterioration as a result of the age. But sometimes she has problems to memorize names or close activities (e.g., where she just left an object).

Auditory capability: 3 out of 5. She has never had auditory problems. But she started to notice, 5 years back that she has some difficulties in hearing people from afar, mainly, when people are in a next room. She requires that people talk to her slowly and clearly.

Digital/Technical skills: 1 out of 5. As mentioned before, she requires help in order to install, set up and start using a digital app. Sometimes, she even needs help during regular use of common messaging apps. She tries to avoid Whatsapp, even when it is the fastest way of contacting other relatives, like her daughter. She does it if she has no choice. She never took computer lessons, and she thinks that, given her age, she would not make a good use of instruction. However, she tries to learn from the indications of her daughter.

Income level: 3 out of 5. She receives a pension from the Italian state that covers some of her everyday expenditures. Because she owns her house and does not have to pay rent, she can have some average quality of life with her pension income. From time to time, her daughter and grandson bring her some expensive medicines or invite her to have dinner out. She could afford cheap trips for holidays, but she is not willing to make the effort.

Attention level: 3 out of 5. She can hold her attention, follow a whole conversation without losing focus, or understand a complete movie or TV series. Nevertheless, she gets tired of complex activities, such as board games, puzzles or sudokus, and quit them very soon. She is unable to stay focused when referring to complex intellectual activities.

3.2.2. Pilot 2. Antwerp - Johanna

Persona: Johanna.

Bio: Johanna is a visually impaired woman of 40 years old. She is single, lives in Antwerp and takes pride in her job as public service officer. She is frustrated with the current traffic situation and is well aware of the current inconveniences in traffic. She has an active travel pattern as she has to get from home to work and back in complex urban context. She uses a combination of public transport and travel on foot. She practiced her routes with mobility supervisors/trainers and is unlikely to travel to unknown places or use unknown routes without assistance. She is not shy to ask for help when she needs it.

Spectrum capability-limitation representation and explanation (Figure 7):

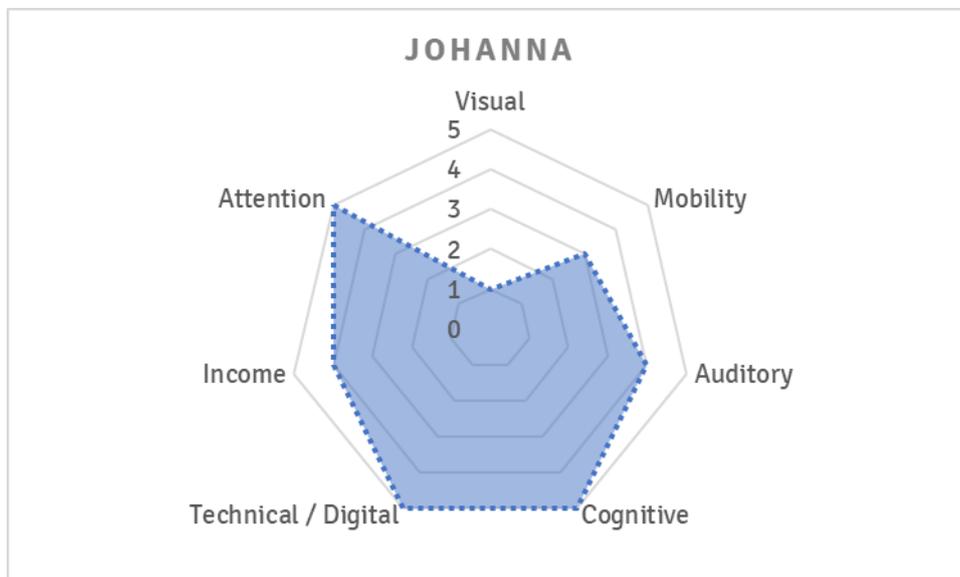


Figure 7. Spectrum capability-limitation area for Johanna

Visual capability: 1 out of 5. Her visual impairment is severe, she is completely blind, and has been since she was born. She uses assistive technology and is not shy to ask for help in the public space, as mentioned in her description.

Mobility capability: 3 out of 5. Because of her visual limitation, as previously mentioned, she is cautious at the time of venturing out of home. She has rehearsed her routes with



mobility trainers and prefers to avoid travelling to unknown places or follow unfamiliar routes without requiring the assistance of a trusted person. This conditions her mobility pattern although it does not stop her from moving to the places she needs. But each journey takes a moment of meditation and planning.

Cognitive capability: 5 out of 5. She has an intellectually demanding job, in which she shows verbal and numerical reasoning and mental agility. She is able to resolve complex tasks and continuously exercises cognitive skills. She also enjoys playing chess, for which she has to picture and reconstruct in her mind the position of the pieces.

Auditory capability: 4 out of 5. She has lost 20% of hearing capacity in her left ear, due to an accident she had when she was a child. Otherwise, she has a good hearing from the other ear.

Digital/Technical skills: 5 out of 5. She is savvy with computers and technology in general. She enjoys buying the most up-to-date devices and configure them with the most up-to-date assistive technology. She was raised in a family where many people worked with technology and had fun with it.

Income level: 4 out of 5. She has a stable job in the public administration where she has been working for over 10 years. Even with a stable situation, and because of her impairment, she feels sometimes anxious about the possibility of losing her job and having trouble to find a new one. This feeling makes her often refrain from making large expenses and motivates her to save money.

Attention level: 5 out of 5. She is attentive and very frequently exercises her memory when learning new routes or the placement of objects in the new environments she meets. Memory and attention are key factors that enable their best possible navigation of the space and overcome of physical obstacles.

3.2.3. Pilot 3. Galilee - Mariam

Persona: Mariam

Bio: Mariam is a 25 year old woman who was born and raised in a village in the area of Galilee. She is a part-time university student and combines this with a sales job at the grocery store outside her village. Before starting studying and working, she spent most of her time in her village. She has digital know-how and uses multiple apps.

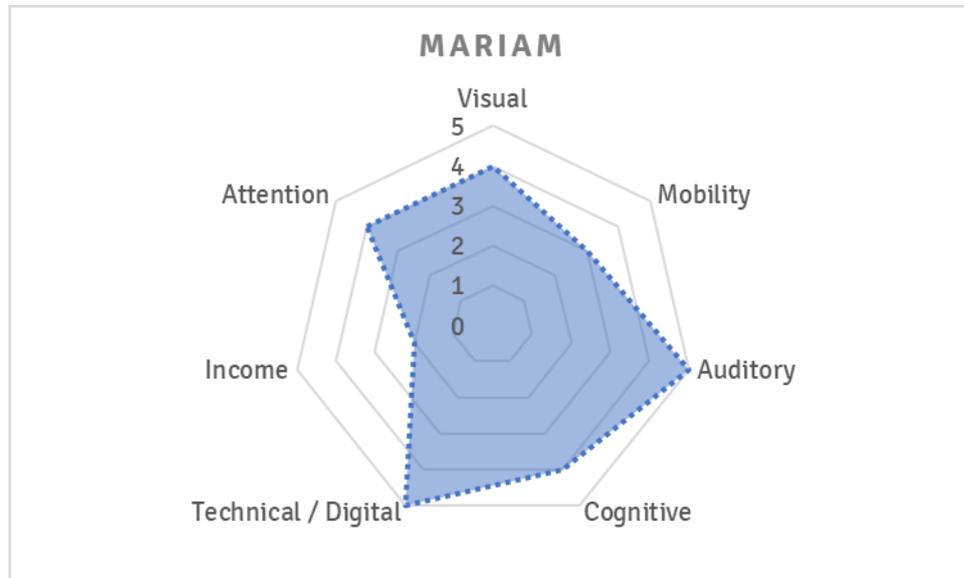
Spectrum capability-limitation representation and explanation (Figure 8):


Figure 8. Spectrum capability-limitation area for Mariam

Visual capability: 4 out of 5. She has worn glasses since she started to study long hours at night. Her sight may get tired and lead to headaches. But she has a slight 1.5 grade of myopia and she can as well manage outside without her glasses, with no great consequences.

Mobility capability: 3 out of 5. Because of the place where she lives with her family, she does not have many mobility alternatives to go to her university. She has to walk 800 meters to the main road where she can take a bus that does not run frequently: she often waits for 20 to 25 minutes for the bus to come. This implies that she does not have a lot of flexibility to manage her time, to coordinate with her employment and household chores. Sometimes, she is forced to call a taxi or ride-hailing because the coordination of her schedule would be otherwise impossible. She finds limitations to move alone late at night because she is afraid of being sexually attacked or harassed. So, in a nutshell, although she has no physical impairment, other factors of the social environment limit her freedom to move.

Cognitive capability: 4 out of 5. She performs complex reasoning when studying and exercises her cognitive skills. She has dyslexia which implies that she had difficulties to learn how to write when she was younger. It might also involve some problems of lateral orientation and slightly the need of additional time to complete some intellectual tasks.

Auditory capability: 5 out of 5. She does not have any auditory problems. She hears perfectly sounds of all ranges and pitches.

Digital/Technical skills: 5 out of 5. She is savvy with computers and technology in general. She needs them very much to move around; she thinks she could not do it without ride-hailing and route planning apps, given the bad coverage of public transit services in the village where she lives.

Income level: 2 out of 5. For her, working at the same time of studying is not a choice, it is a must or, otherwise, she would not be able to afford her studies. Her family members are workers and would not have the resources to cover the university expenses. Working at the grocery store is very demanding (there are customers all the time) and she cannot study while at the store. For this reason, she has little time to study for her lessons and does her homework late at night.

Attention level: 4 out of 5. She does not have special difficulties concerning attention or memory. But because she has to allocate mental resources simultaneously to her job, her classes and her homework, plus the cleaning activities that she is expected to complete at home, she may sometimes make attention mistakes. This also involves the use of a mobile phone.

3.2.4. Pilot 4. Madrid - María Carmen

Persona: María Carmen

Bio (as created in T1.2): María Carmen is a widowed woman of 60 years old. She lives in her apartment in the centre of Madrid. Her two children live in the outskirts of the city. She receives financial support from both the state and her children for everyday expenses like groceries. She is socially isolated from her family and from other people. She is very socially aware and sensitive to this kind of topics. Because of this she is not very commercially inclined as she wants to know what the social impact of things are and she does not want to be an accessory. María Carmen has basic digital skills, meaning she can use WhatsApp to stay in touch with relatives and friends.

Spectrum capability-limitation representation and explanation (Figure 9):

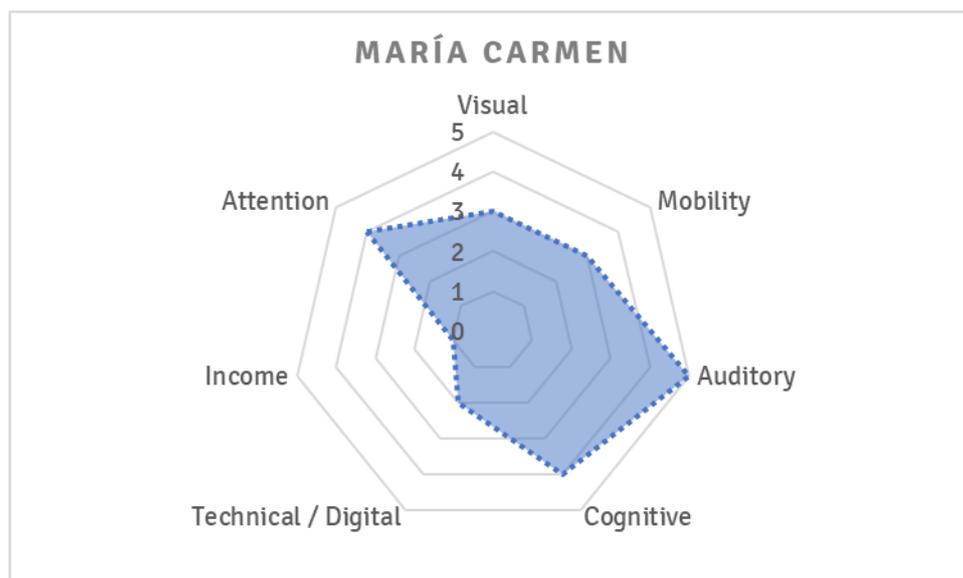


Figure 9. Spectrum capability-limitation area for María Carmen

Visual capability: 3 out of 5. She has problems focusing on text when reading but for some time she has refused to go to the optician because she does not feel comfortable with

glasses. Besides, she feels that glasses for reading are for older people and she does not like to feel that way. Sometimes, she struggles with reading text.

Mobility capability: 3 out of 5. She lives in the centre of Madrid in proximity to, at least, 3 metro stations. But she finds that the many stairs and levels of the metro are very uncomfortable and prefers to avoid it and take the bus. The bus in the centre is sometimes delayed due to congestion and does not have as good frequencies and service as the metro. But every time she has to face the stairs or lifts of the metro, she ends up tired or finds it too complex. When she had COVID-19 infection and had to be stay isolated at home for 14 days, she needed the assistance of her family who could not always be there for her. Coordination was an issue.

Cognitive capability: 4 out of 5. She stays mentally active by reading novels and often listening to the radio. She does not perform complex tasks, because she does not like it and because she would not need them either.

Auditory capability: 5 out of 5. She does not have any auditory problems. She hears perfectly sounds of all ranges and pitches.

Digital/Technical skills: 2 out of 5. As we have mentioned in the presentation, María Carmen intensively uses WhatsApp to get in touch with her family. She knows and employs plenty of the functionalities of the app, such as sending images, voice messages or emojis. Nevertheless, she would not feel comfortable with downloading a different app, and she would not have all the resources to explore a new platform and integrate it in her life. In case, she would need to download another app (if she is forced, for instance, to complete some digital paperwork of the state), she would ask her children to do it for her and to write the instructions to use it in a sheet of paper.

Income level: 2 out of 5. Her husband previously supplied the only income of the household and since he died, she has received financial aid from the state and continuous help from her children for buying everyday groceries and paying bills. She can survive with this help but does not feel so financially stable. She tries to save some money. For instance, she does not eat out often, or even walks every time she can instead of buying a transport ticket.

Attention level: 4 out of 5. She does not have special difficulties concerning attention or memory. Her personality is a bit disperse and many times, when multi-tasking, she might get distracted and produce an unexpected outcome.

3.2.5. Pilot 4. Madrid - Sara

Persona: Sara

Bio: Sara is a young woman of 26 years old. She has Down syndrome and partly lives independently in a community, partly with her guardian. She is technological and digitally savvy, which means that she has a high level of digital literacy. She knows she is different but she trusts herself. She is in need of a safe environment as she does not have the capability to react to certain situations. Sara is in need of an easy way to understand and follow interfaces which only requires one decision at the time, as she might get frustrated,

angry or panicked. It is important that if she gets lost, someone can easily guide them. She needs to restrict her calorie intake due to a heart disease and the lack of feeling satiated when eating.

Spectrum capability-limitation representation and explanation (Figure 10):

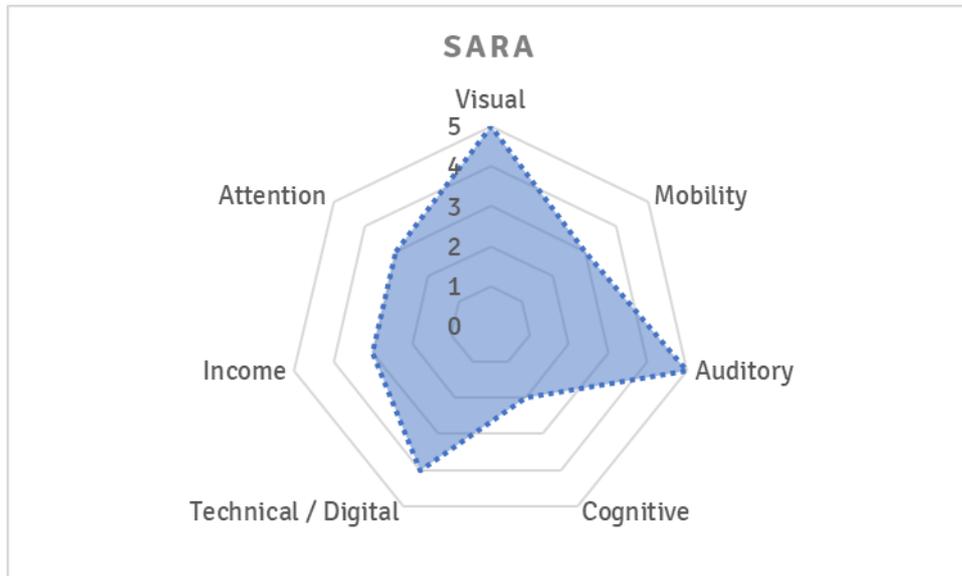


Figure 10. Spectrum capability-limitation area for Sara

Visual capability: 5 out of 5. She sees perfectly well. She does not need glasses and never complained about difficulties with her sight.

Mobility capability: 3 out of 5. She rides public transport but she is more skilful moving overground, because she might get disoriented in the metro and experience anxiety and stress. Metro maps tend to be difficult to read for her and the feeling of lack of spatial reference intensifies in the underground walkways. Walking overground is her preferred option to get around, and then taking the bus.

Cognitive capability: 2 out of 5. She shows characteristics common to Down syndrome. As mentioned before, lack of orientation and anxiety might be a problem also for navigating web and digital environments and require solutions that require making one decision at a time. For major decisions, the intervention of the guardian is required.

Auditory capability: 5 out of 5. She does not have any auditory problems. She hears perfectly sounds of all ranges and pitches.

Digital/Technical skills: 4 out of 5. Like many other youngsters of her age, she likes being online, mainly connected to social networks. She has profiles in many platforms such as Facebook, Instagram and Tik Tok and enjoys sharing pictures and memes and using other functions. She prefers Instagram over other platforms because the process to share content is step-to-step, easy and relatively intuitive. Platforms are suitable as long as they have an easy interface.

Income level: 3 out of 5. She is supported by her family, which does not have financial problems. Nevertheless, she has the intention to find a job suitable for her impairment.

Attention level: 3 out of 5. Sometimes she may forget certain things or lose the focus while completing a task, but it is not that frequent nor that severe. She has functional capability to complete many cognitive tasks that are adjusted to her condition.

3.2.6. Pilot 5. Berlin - Marie

Persona: Marie

Bio: Marie is a 30 years old woman. She is married, has two children, one toddler and one baby. She usually works part-time, however she is now on maternity leave. She lives in the peri-urban location of Berlin with her husband, who needs the car to get to work. Her husband is very busy and her parents live an hour away, so she has little support from others to take care of her child and the husband.

There are only limited public transport options in her neighbourhood, so it is more convenient to use the ridesharing option as she wants to bring her children along. She is already a user of the ride sharing service as it helps her get everyday tasks done more swiftly and with less frustrations as the public transport is inadequate. She is now able to plan her trips to the grocery store, doctor, school etcetera without too much hassle.

She is an open-minded woman who does not mind sharing with people she does not know and she is not afraid to try out new technologies. However, she is not an explorative person and will not actively look for certain things as she is quite busy, she relies on information from others.

Spectrum capability-limitation representation and explanation (Figure 11):

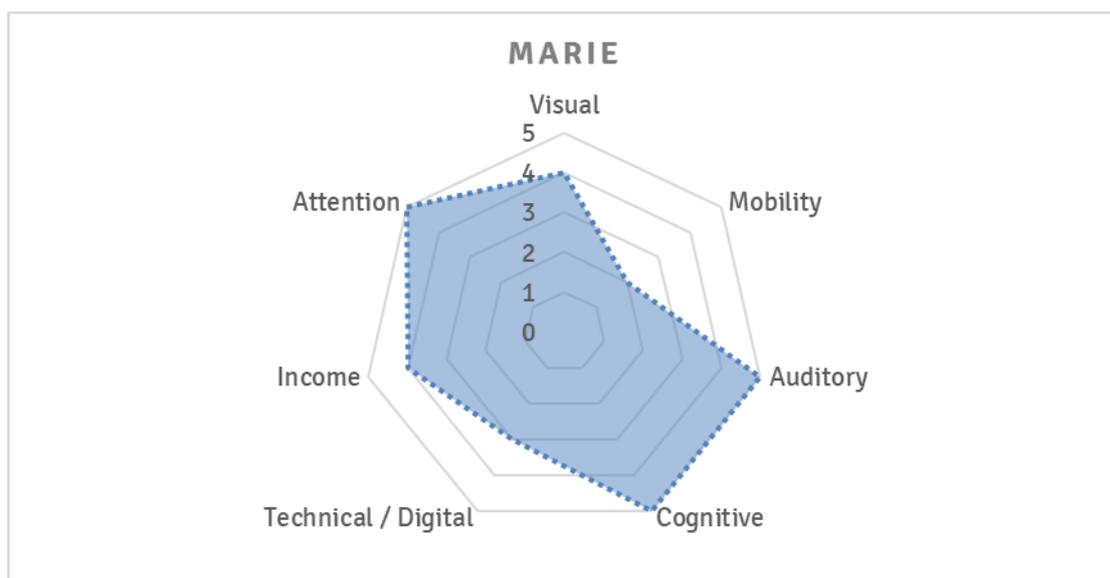


Figure 11. Spectrum capability-limitation area for Marie

Visual capability: 4 out of 5. She has never worn glasses. Some weeks ago, she noticed she saw signs from afar in a blurry way. She made an appointment with the optician to have a check.

Mobility capability: 2 out of 5. Regarding mobility her main issue is the inadequacy of the service of public transport in her area for her travel purposes, and the difficulty of using the public transport with two children. Her children are very energetic, they move, they shout, and she feels that other passengers may be disturbed. That is why she started to use ride sharing where there are fewer passengers. But she has some doubts about it every time the driver is not as willing to provide help with the two children as she would expect.

Cognitive capability: 5 out of 5. Her work implies complex reasoning and mental operations. She exercises her cognitive skills very often.

Auditory capability: 5 out of 5. She does not have any auditory problems. She hears perfectly sounds of all ranges and pitches.

Digital/Technical skills: 3 out of 5. As we have already presented, even when she is skilful with digital tools, she has no problem to download, install and execute any type of mobile app, she is not very explorative. This implies that she devotes a long time taking care of the children, working, carrying the children to places, that she does not have the strength, willingness and time to spend searching for new solutions for her life. She is busy and she relies on information provided by others.

Income level: 4 out of 5. Both she and her husband are employed, so they do not have big financial issues. However, raising two children entails a moderate level of fixed expenses and, because she has to devote time to taking care of them, she can only work part-time. Saving money is important for her to find a balance.

Attention level: 5 out of 5. She is a very concentrated, detail-focused person. She memorizes even small facts and is very attentive to her surroundings.

3.3. Learnings and insights from the fieldwork

The finalized WP1 and the on-going WP3 of the INDIMO project implied conducting five pilot experiences, with different digital mobility solutions or digital delivery solutions, in five different places, Emilia-Romagna, Antwerp, Galilee, Madrid and Berlin. Additional field work was conducted in Budapest use case, where the general usability and knowledge gap of digital mobility solutions were assessed through the mobility patterns of selected user groups. It also complemented the evaluation of further characteristics, limitations, and requirements of those user groups, aiding the thematic and user-centric analysis of the five pilot locations. In each pilot and use case, different characteristics of vulnerable-to-exclusion target groups were identified. The insights from the pilots allowed us to identify needs of the users and potential users. Needs vary across groups, but there are threads as “**space**”, “**time**” and “**trust**” that are points of contact and common areas.

The first thread is the “**space**”. In the case of environments characterized by scattered rural villages, such as in the pilots of Emilia-Romagna and Galilee, digital mobility solutions (e.g.



apps) may compensate the lack of infrastructure, the transport poverty and the difficulties for personal mobility. In the case of Emilia-Romagna, there are logistics problems to reach rural areas and the level of service is perceived as lower compared to the urban areas. The digital locker for deliveries could overcome distances and enhance accessibility, especially for older people for whom picking up parcels demanded a great amount of effort but also for workers that cannot go to the post office or receive a package at home due to inconvenient times. In the case of Galilee, there is a need of mobility alternatives given the lack of public transport and good connectivity in the Arab rural villages. This need is even greater for Arab women, since cultural barriers and a hostile atmosphere prevent many of them to drive and ride the public transport. But there are additional needs related to the spatial configuration of this place. Most of the mobility apps have severe difficulties to match the digital mapping with the real geography. There are rural streets with no names nor numbers; this implies a difficulty for the user to order a ride. In the Budapest use case, since the target audience includes wheelchair users and other people who have difficulties to move on uneven surfaces or on stairs, they mainly chose vehicles which provided easy alighting and boarding. Therefore, their limitations mostly concern the spatial characteristics of the service itself instead of the application connected to it.

In the Antwerp pilot, people with reduced mobility or reduced vision find a number of obstacles in the physical environment that prevent their everyday activity. The needs have to do with the adaptation of traffic lights but also the adaptation of the surroundings to overcome these limitations: the short time provided by the traffic lights, the uncertainty about when it is going to change, the uneven pedestrian spaces, the height of the button to ask for a traffic light change and so on are the main needs to be addressed.

The second thread articulating needs is “**time**”. Time is a valuable resource and the importance of making good use of it appears in the different pilots. It shows a very sensitive approach in the Berlin pilot, covering a ride-sharing app for caregivers (focusing on women). Time needs to be flexible: the driver and the remaining passengers should be tolerant to the fact that a mother may be delayed (because the child is more unpredictable, he/she does not want to go out, the mother spends time picking items needed by the child etc.), and also the caregiver needs the driver to be punctual (because of the difficulty of waiting in the public space with a child or the time constraints typical of the role).

In the case of Madrid, the existence of a food delivery app may save time, and the convenience of it is often remarked. The point here is that an app for delivery allows to give a different quality to time: time to relax instead of time to cook; a gained time instead of a time devoted to a domestic chore. Nevertheless, in Madrid certain vulnerable-to-exclusion groups perceived the app as an assistance they do not need; as a help that undermines their own autonomy. In Budapest, the aspect where time comes in is the availability of real-time information from the app. A person with reduced vision requires real-time information at which stop the public transport vehicle is, as stop announcement within the bus is not always reliable. Sometimes, buses do not stop at every bus stop, only when it was requested or there are waiting passengers. For these groups, real-time information in the app is a key aspect of finding spatial guidance.

Finally, the last thread that may organize the needs across the pilots is “**trust**” and having human contact behind the digital interface. Human contact is a requirement to overcome all the fears contained in the digital domain; it is the ultimate safety net for vulnerable-to-exclusion population that ventures into the unknown digital world. In Emilia-Romagna, an assistant at the locker spot would be helpful to overcome digital-skills-related problems; in Antwerp, the target population very much depends on the help of passers-by to overcome physical obstacles, this assistance narrowed for fears raised by the COVID-19 pandemic; in Galilee, having direct contact with the driver is a requirement to trust them, to overcome fears related with physical insecurity; in Madrid, the possibility of ordering food through WhatsApp or arranging details of delivery through a call to the rider were very frequent claims to the service; in Berlin there was a request of empathy directed to the driver: women need drivers to care about the needs of a mother and to help her onboard and offboard. Human contact is a key value to ensure all needs are met in inclusive digital services. In Budapest, the aspect of trust appears in relation to provision of information. It is confirmed in this fieldwork that it is not enough that vehicles and services provide inclusive conditions, if these conditions are not adequately communicated. So, inclusiveness is not only producing adaptations but, also, providing the right information about these actions.

We produced new insights offered by this research that go beyond what has been done by previous literature. First, there is limited previous research on the requirements of women towards ride-sharing apps beyond the threat of violence and misconduct from drivers or other passengers. An important insight of our research is to evidence that regular mobility services address a “male individual” user and do not contemplate the specific needs of caregivers in charge of dependents. Another learning of our study is that the literature about mobility apps tends to consider a “universal user”, ignoring or underestimating the many cultural barriers that prevent women from taking part in shared mobility. Our study shows that in Arab communities in the Middle East there is family disapproval of women sharing a vehicle with people other than members of their family. These cultural barriers for the use of mobility services are rarely central in previous studies, since transport is often approached from a technical and engineering perspective.

With regards to mobility and physical disability, a lot has been written about disability as a barrier to accessing certain services. Digital mobility services offer new alternatives to overcome some of these barriers. Nevertheless, some people with reduced mobility may feel that these apps are an unrequired assistance which in fact undermine their ability to have things done by themselves and would prefer avoiding any type of assistance. In the case of smart traffic lights, most of the previous articles concentrate in simulations or training to build capabilities for disabled people to cross the street, but most of the responsibility is put on the shoulders of the most vulnerable users of the street: pedestrians and pedestrian with disabilities. The pilot exposed a technology that changed priorities, from the flow of traffic to the human scale needs. But it was found as an interesting insight that no accessibility solution is only a technological solution. If smart traffic lights were not deployed along maintenance works and improvements 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 consider that digital approaches to problems have to also tackle the physical interface.

Regarding foreign people, previous literature acknowledges the difficulties that migrants may face in unfamiliar contexts, their language barriers and difficulties accessing updated equipment or packages of mobile data. However, the potential of this group to engage in e-commerce, to send money to family or exchange other documents or items, and buying typical products from their home country are not significantly stressed. A familiarity with e-commerce apps already exists and can be expanded.

Finally, there has been a lot written about the digital inclusion of older people and people with low-digital skills. There is a recognition that there is an ongoing process of population ageing and, along with it, a challenge for older people to incorporate digital tools to sustain independent living and take advantage of opportunities for societal engagement (Boulton-Lewis et al, 2007; Loos 2012). Nevertheless, we found that we cannot treat the aged segment as a homogenous segment because there are idiosyncratic elements of the environment that might be stronger factors than the generation belonging. For instance, the approach of older people towards technology may radically vary between rural environments and urban environments. At the same time, “older people” is a concept that covers a very large period of time, from 65 up to 100. This 35-year gap makes a lot of difference. Another interesting point is the willingness to learn, to engage in workshops or classes of capabilities building, as we will explore in the following section of capabilities of the different profiles.

3.4. How to design for inclusion? Some tips for developers and operators

In this final section some tips for developers and operators are provided in order to design digital interfaces of a physical mobility and delivery service for inclusion.

Visual capability

Digital interfaces of a physical mobility and delivery service can extend the capabilities of this group by offering more adjustable and customizable interfaces that improve navigation and assist also in the interaction with the physical environment. The ability of the development and design of the app to include external readers will also be essential for this group.

Mobility capability

Digital interfaces of a physical mobility and delivery service can extend the capabilities of people with different levels of mobility impairment by offering new opportunities and alternatives of mobility (or by replacing unnecessary mobility), anticipating obstacles and difficulties *en route*, incorporating mappings with the information required by this group and providing the required information about the physical conditions of services.

Income capability

Digital interfaces of a physical mobility and delivery service can extend the capabilities of the people of all income levels by offering new opportunities of mobility with conditions adapted to their needs. Attention should be given by developers to widening the choices of payment methods (many people have no bank accounts or debit/credit cards or only receive income in cash). and, similar to the previous profile, design apps that are low-equipment and low-resources demanding. Offering freemium services (or even exception from data consumption) may also provide additional aid for the affected people.

Technical/Digital capability

Digital interfaces of a physical mobility and delivery service can extend the capabilities of all the users with a simplified and intuitive interface where commands are sorted step by step. The presence of continuous human assistance may be an anchor for confidence (even if users do not always use it, knowing that the option exists provides confidence for incorporating the app).

Cognitive capability level

Digital interfaces of a physical mobility and delivery service should enable users to face the lowest number possible of choices. Choices in general may be associated with stress and the possibility of losing orientation. A straightforward line of workflow and the simplification of procedures may help release anxiety. Auto-filling, suggestions, recovering previous orders and indications are contributions for the simplification of cognitive processes in the user. It is suggested also to avoid the excess of texts and the simplification of concepts through images and icons. Even in sever cognitive impairment cases, familiarity with intuitive apps and apps based on icons and steps (such as Instagram) was found. There are also aspects of the physical interface that are very associated to the axes of cognitive impairment: the speed of speech of service agents, the identification in their look to clear uncertainties etc.

Attention capability level (distraction level)

Digital interfaces of a physical mobility and delivery service, e.g. a delivery food service, should provide a new and appropriate solution for this specific scenario. Distraction level can also increase when travelling with a children or people-in-need-of-assistance. Due to the shared attention on a navigation application and the assisted person hands-free or voice-controlled options may be helpful.

Auditory capability

During this research, auditory impairment was not specifically explored. For specific cases of impairment new axes can be defined.

4. Prioritisation of user requirements for accessibility and inclusion

4.1. Methodology

The guidelines included in the UDM-V1 respond to a set of user requirements identified through a structured process. The requirements are demands from the participants towards the tested apps and services in the INDIMO pilots in order to enhance their digital and physical usability, their accessibility, their data privacy and security, the workflow and inclusivity.

The requirements were identified through the semi-structured interviews with users and non-users of digital mobility and delivery applications in Tasks 1.2 and 1.3. Then the UDM-V1 guidelines were developed base on the following steps:

The requirements were validated and prioritised through a series of Communities of Practice sessions in each pilot (for details on the Communities of Practice see Deliverable D3.2), which included the following steps:

1. **Target groups** for each pilot were **identified** and participants from these groups were recruited, inviting them to participate on the CoP on regular basis.

2. A **list of requirements was developed** from the initial list of 80 requirements derived from the semi-structured interviews (see tables 28-33 in D1.2 and table 40 in D1.3). With the purpose of having a manageable number of requirements that facilitate their testing and validation through quantitative polls and other qualitative methods, this original list was adjusted by merging some of the requirements that were close together and by selecting main requirements within the first mentioned listing.

Pilot-specific requirements, i.e. requirements that apply to a particular pilot only (for example, those referring in a very direct way to the smart traffic light in the Antwerp pilot) were also included. So, the final list of requirements to be tested had a portion of shared requirements and others that were tailor-made for each pilot, according to the user's concerns. The main requirements were selected following the frequency of appearance during the qualitative fieldwork, the focus given by the interviewees in the course of their responses, and their relevance in accordance to the research objectives.

3. Specific CoP meetings across the pilots were conducted to run the exercise of **requirement prioritization** (see Deliverable D3.2 for more details about the participants of each pilot CoP). The participants rated various aspects of the requirements on a 3-step scale. 3 meant a high level of priority, 2 an intermediate level and 1 a low level of priority. Figure 12 shows the used scales.



Figure 12. Scales used for the requirements rating and prioritization

Opening the meeting, the profile characteristics each of the pilots were explained to the CoP participants and there was a brief explanation of each requirement. Via an online, simultaneous, short and personal survey of participants, the members of the CoP had the opportunity of assessing the requirements. Then, through debate consensus was reached among all the participants establishing a final common level of priority.

- a. There was a CoP meeting session with users and potential users of the digital mobility services to assess each of the different selected requirements according to the value they find in them.
- b. Later, a second round of CoP meeting sessions with developers, operators and policymakers was organized with the purpose of assessing each requirement according to the effort that their implementation would take.

4. Based on the scores established at the CoP meetings a **priority matrix** has been established for each requirement. The priority matrix (or prioritization matrix) is an analysis and decision-making tool used in project management where this selection is critical to the overall quality improvement process. This tool provides analysts with a resource to narrow down proposals, resolve disagreements and increase the chances of a successful project by promoting consensus and bringing stakeholders closer together.

The list of requirements was evaluated according to two assessment criteria: importance declared by the users and non-users participating to the Community of practice meeting and ease of implementation provided by the developers and operators at the same time or during a bilateral following meeting with them.. Finally, the requirements were scored or ranked by using a value scale, where A, B, C, D and E refer to the following coding: when a single requirement got A, this means that it is extremely valuable for users and feasible for developers or operators, when the requirement got and E, this means that it is not so important for users and the required effort to developers and operators is high:

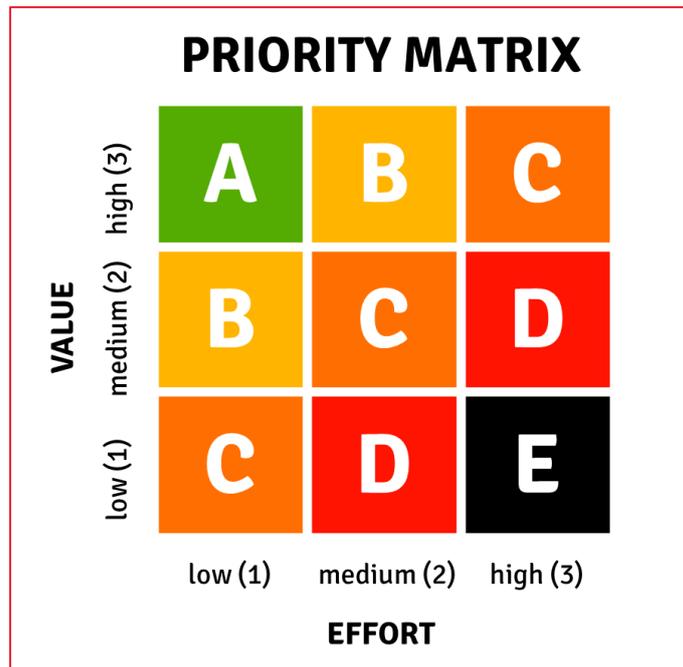


Figure 13. The priority matrix used for the Requirements prioritization

The priority matrix can be indicative for future allocation of resources and attempts to respond to the question of how to distribute times and efforts among different demands to the service, as it is shown in the following graph:

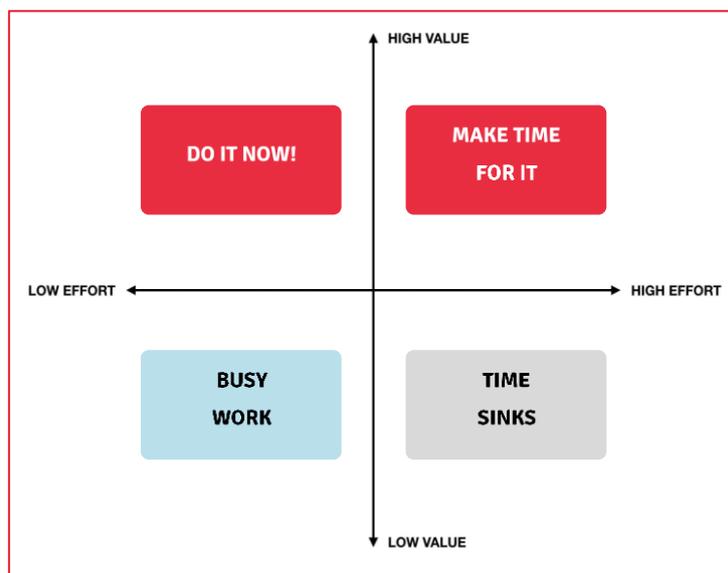


Figure 14. Concept diagram for the development future allocation of resources

The intersection of both evaluations is the letter coding shown in the priority matrix.

5. As soon as it was possible to identify the combined position of the requirements regarding importance and ease of implementation, the work of **translating these requirements into guidelines** for the UDM and UIL began; all the main requirements

identified should be covered with one or more items of accessibility and inclusivity in this guideline. The level of priority assigned by each pilot CoP is a good approach to the level of priority that different requirements should be given during the implementation testing phase of each INDIMO pilot.

4.2. The outcome of CoP assessment and bilateral meetings with developers

This section presents the results of the prioritisation exercise for each pilot. The requirements listed per each pilot are displayed in different background colours in the corresponding tables, according to the legend described as follows Table 2.

Colour legend for Requirements prioritized at each CoP	
	Main requirements (from D1.3)
	Additional main requirements for specific pilot (from D1.3)
	Requirements by persona (from D1.2)

Table 2. Colour legend for requirements prioritized at each CoP

4.2.1. Pilot 1: Digital Lockers – Emilia-Romagna

The Communities of Practice in Emilia-Romagna for the requirements assessment has shown a concern with regards to the ability of the potential e-mobility or e-delivery service of meeting the users' requirements. There were some concerns about the digital locker replacing the physical services contributing to greater inaccessibility, despite their intention. Once these initial doubts were overcome, the need for engaging associations with already built ties with the target audience was highlighted (i.e., older people and migrants) to facilitate the spread of digital services in a guided way, with proximity agents. The following are the prioritised requirements of P1. Emilia-Romagna:

ID	Requirements rated in P1 Emilia-Romagna	Value	Effort	Priority
R1	ACCESSIBILITY			
R1.51	service to increase the independence of the users	2,5	1	A-
R3	INCLUSIVENESS			
R3.01	Humans behind; there should always be the possibility of getting human assistance.	3	1	A
R3.04	Availability of language choices (considering foreign people)	3	2	B
R3.08	School to support service introduction (ONLY FOR LOCKER DDS)	2,5		n.a.
R3.51	Some sort of remote support function provided by the service, preferably in the form of a helpdesk of which the contact information is provided by the digital interface. This should be available 24/7	3	3	C
R3.54	Work together with organisations or associations with ties to the target audience	2,5	3	C-
R4	WORKFLOW			

ID	Requirements rated in P1 Emilia-Romagna	Value	Effort	Priority
R4.51	An easy one-time registration	3	2	B
R4.53	Easy to use interface that does not include too many steps to activate or use the service	3	1	A
R5	PRIVACY AND DATA SECURITY			
R5.51	Offer a transparent privacy policy in line with the regulations	2	1	B
R5.52	Certain security measures to be taken to keep the users and their data safe	2	1	B
R8	COMMUNICATIONS			
R8.51	Recognisable and easily identifiable service tool / "strumento-servizio riconoscibile e facilmente identificabile"	3	1	A
R8.52	Awareness campaign that targets their user audience and stresses the benefits of the service	3	2	B
R8.53	To organise some sort of teaching method for the target audience (e.g. Educational session)	3		n.a.

Table 3. Requirements rated in P1 | Emilia-Romagna

4.2.2. Pilot 2: Inclusive traffic lights - Antwerp

In the case of pilot 2, in Antwerp, a great portion of the debate moved around whether a universal design solution was really possible for the case of achieving inclusiveness in smart traffic lights, or whether there should be a specific solution for people with reduced vision, people with reduced mobility, elderly and so forth. This is the final output for the requirement identification and prioritization is as follows:

ID	Requirements rated in P2 Antwerp	Value	Effort	Priority
R1	ACCESSIBILITY			
R1.01	Anticipation and control over the graphic interface: Uniformed icons and spatial organization	3	1	A
R1.02	Anticipation and control over the graphic interface: Avoid automatic updating of the version (labels or button may be missing afterwards)	3	1	A
R1.16	Extend length of light according to user's needs and indicate how much time of green is left (ONLY FOR TRAFFIC LIGHTS)	1	3	E
R1.17	Communicate status of lights (red/green) to users (ONLY FOR TRAFFIC LIGHTS)	1,5	3	D-
R1.20	Preferably, no action demanded from user (ONLY FOR TRAFFIC LIGHTS)	2	3	D
R1.22	Traffic lights should have auditive signal so people with reduced vision places themselves in the surroundings (ONLY FOR TRAFFIC LIGHTS)	3	1	A
R1.51	Service to increase the independence of the users			n.a.
R1.52	Install audio options and/or auditive support for people with a visual impairment	3	1	A
R3	INCLUSIVENESS			
R3.01	Humans behind; there should always be the possibility of getting human assistance.	3	2	B
R3.03	There should be no foreign/technical words on the platform	3	1	A



ID	Requirements rated in P2 Antwerp	Value	Effort	Priority
R3.51	Some sort of remote support function provided by the service, preferably in the form of a helpdesk of which the contact information is provided by the digital interface. This should be available 24/7	3	2	B
R3.54	Work together with organisations or associations with ties to the target audience	3		n.a.
R4	WORKFLOW			
R4.03	Include the possibility of viewing user's ratings.	3	1	A
R4.51	An easy one-time registration	3	1	A
R4.52	Service to be reliable at all times	3	3	C
R4.53	Easy to use interface that does not include too many steps to activate or use the service	3	1	A
R5	PRIVACY AND DATA SECURITY			
R5.01	Terms and conditions summarized in checkboxes	2	1	B
R5.51	Offer a transparent privacy policy in line with the regulations	2	1	B
R5.52	Certain security measures to be taken to keep the users and their data safe	2	2	C
R5.54	Service should require as less personal data as possible to function properly	2	1	B
R6	SAFETY & SECURITY			
R6.01	Include emergency button in case of physical/ sexual attack	1	2	D
R8	COMMUNICATIONS			
R8.01	The graphic interface should look that is made for everyone, not only young people	3	1	A
R8.51	Recognisable and easily identifiable service tool	3	2	B
R8.52	Awareness campaign that targets their user audience and stresses the benefits of the service	2	1	B
R8.53	To organise some sort of teaching method for the target audience (e.g. Educational session)	3	1	A
R8.54	Campaign and training sessions as mentioned above, Emilia-Romagna, Antwerp, as well as Galilee and Berlin see the benefit of developing an introductory video tutorial that explains the service step-by-step		2	n.a.
R9	COVID-19 RELATED			
R9.01	Establish a COVID-19 protocol and communicate it.	1	1	C

Table 4. Requirements rated in P2 | Antwerp

4.2.3. Pilot 3: Informal ride-sharing in ethnic towns - Galilee

With regards to Galilee, it was mentioned that most users of ridesharing belong to a segment which is already familiar with services deployed by apps. A good portion of the female users are students or professionals that have previously incorporated ridesharing services as a replacement of other modes. Enhancing digital skills for usability is not as relevant as addressing the specific target group of Arab women with communication and also implementing measures for these people to feel safe while riding the service. The final outcome of their requirement identification and prioritization is as follows:



ID	Requirements rated in P3 Galilee	Value	Effort	Priority
R1	ACCESSIBILITY			
R1.03	Include map visualization with the real time position of driver/rider	3	3	C
R1.04	Matching the digital mapping with the real geography using the colloquial variety of local language	2	3	D
R1.05	Attracting routes/locations to support educational and caring mobility needs	1		n.a.
R1.53	Possibility to enhance the font	2	1	B
R3	INCLUSIVENESS			
R3.01	Humans behind; there should always be the possibility of getting human assistance.	3	3	C
R3.04	Availability of language choices (considering foreign people)	3	3	C
R3.51	Some sort of remote support function provided by the service, preferably in the form of a helpdesk of which the contact information is provided by the digital interface. This should be available 24/7	2	3	D
R3.52	Service needs to be affordable or at least offer transparent pricing	3	3	C
R3.53	Users should be able to contact the service agent	3	3	C
R3.54	Work together with organisations or associations with ties to the target audience	3	2	B
R4	WORKFLOW			
R4.01	Very important information (i.e. Working hours, contact phone) should appear very big at the beginning	2	3	D
R4.03	Include the possibility of viewing user's ratings.	3	3	C
R4.51	An easy one-time registration	3	1	A
R4.52	Service to be reliable at all times	3	3	C
R4.53	Easy to use interface that does not include too many steps to activate or use the service	3	2	B
R5	PRIVACY AND DATA SECURITY			
R5.01	Terms and conditions summarized in checkboxes	3	2	B
R5.52	Certain security measures to be taken to keep the users and their data safe	3	3	C
R5.54	Service should require as less personal data as possible to function properly	3	2	B
R6	SAFETY & SECURITY			
R6.01	Include emergency button in case of physical/ sexual attack	3	3	C
R6.51	Service provided by or endorsed by a trusted and reliable organisation	2	3	D
R7	PHYSICAL INTERFACE			
R7.51	Service agent should be reliable, friendly and empathic	2	3	D
R7.53	Service agent needs to have a profile showing the reviews of other users and giving a feedback option	3	3	C
R8	COMMUNICATIONS			
R8.52	Awareness campaign that targets their user audience and stresses the benefits of the service	2	2	C

ID	Requirements rated in P3 Galilee	Value	Effort	Priority
R8.54	Campaign and training sessions as mentioned above, Emilia-Romagna, Antwerp, as well as Galilee and Berlin see the benefit of developing an introductory video tutorial that explains the service step-by-step	3	3	C
R9	COVID-19 RELATED			
R9.01	Establish a COVID-19 protocol and communicate it.	3	3	C

Table 5. Requirements rated in P3 | Galilee

4.2.4. Pilot 4: Cycle logistics platform for delivery healthy food - Madrid

In Madrid, the CoP highlighted the need to provide assistance when users have difficulties, and how the operator could include these aspects. This assistance does not need to be available 24 hours a day, but other alternatives may be integrated (i.e. during the food delivery time). Finally, it was remarked that it is unavoidable that the information is structured in a way that is easy to read, considering the input of people with mental disabilities and the insights of the related stakeholders. The main outputs of the requirements identification and prioritization for Madrid are the following:

ID	Requirements rated in P4 Madrid	Value	Effort	Priority
R1	ACCESSIBILITY			
R1.01	Anticipation and control over the graphic interface: Uniformed icons and spatial organization	2	3	D
R1.02	Anticipation and control over the graphic interface: Avoid automatic updating of the version (labels or button may be missing afterwards)	2	2	C
R1.03	Include map visualization with the real time position of driver/rider	2	2	C
R1.51	Service to increase the independence of the users	2	3	D
R1.52	Install audio options and/or auditive support for people with a visual impairment	3	3	C
R1.53	Possibility to enhance the font	3	1	A
R2	MORE OPTIONS			
R2.01	Options for courier and fresh-food delivery and not only cooked food. (ONLY FOR FOOD DDS)	3	3	C
R3	INCLUSIVENESS			
R3.01	Humans behind; there should always be the possibility of getting human assistance.	3	3	C
R3.02	Possibility of calling the driver/rider to arrange place of pick up (either to facilitate mobility or avoid exposure, or to clear doubts).	2	3	D
R3.03	There should be no foreign/technical words on the platform	2	1	B
R3.51	Some sort of remote support function provided by the service, preferably in the form of a helpdesk of which the contact information is provided by the digital interface. This should be available 24/7	2	2	C
R3.52	Service needs to be affordable or at least offer transparent pricing	3	3	C

ID	Requirements rated in P4 Madrid	Value	Effort	Priority
R3.53	Users should be able to contact the service agent	3	3	C
R3.54	Work together with organisations or associations with ties to the target audience	2	2	C
R4	WORKFLOW			
R4.01	Very important information (i.e. working hours, contact phone) should appear very big at the beginning	3	1	A
R4.02	Many visual aids (for instance, every payment method should have an icon).	3	2	B
R4.03	Include the possibility of viewing user's ratings.	2	3	D
R4.04	A completion bar, so people not familiar with apps do not feel anxious nor uncertain about the end.	2	3	D
R4.05	There should be a calculator or estimator of the order/trip price.	3	1	A
R4.06	Error detection (by the system) and help offer	3	3	C
R4.53	Easy to use interface that does not include too many steps to activate or use the service	3	3	C
R5	PRIVACY AND DATA SECURITY			
R5.01	Terms and conditions summarized in checkboxes	2	1	B
R5.51	Offer a transparent privacy policy in line with the regulations	2	1	B
R5.53	Provide the option of an anonymous or discrete profile, which can be compared by the aforementioned requirement	1	1	C
R6	SAFETY & SECURITY			
R6.51	Service provided by or endorsed by a trusted and reliable organisation	2	1	B
R7	PHYSICAL INTERFACE			
R7.01	Riders/drivers should introduce themselves and know the user's name. Possibility of uniform (to be easily identified).	3	1	A
R7.51	Service agent should be reliable, friendly and empathic	3	1	A
R7.53	Service agent needs to have a profile showing the reviews of other users and giving a feedback option	1	3	E
R8	COMMUNICATIONS			
R8.52	Awareness campaign that targets their user audience and stresses the benefits of the service	3	3	C
R8.53	To organise some sort of teaching method for the target audience (e.g. Educational session)	2	3	D
R9	COVID-19 RELATED			
R9.01	Establish a COVID-19 protocol and communicate it.	3	1	A

Table 6. Requirements rated in P4 | Madrid

4.2.5. Pilot 5: On-demand ride-sharing integrated into multimodal route planning - Berlin

In Berlin, most requirements held a high relevance for the users, especially those regarding the information provided and adaptation to take children in the vehicles, as it is visible in the following output of the requirements' prioritization for Berlin:



Table 7. Requirements rated in P5 | Berlin

ID	Requirements rated in P5 Berlin	Value	Effort	Priority
R1	ACCESSIBILITY			
R1.01	Anticipation and control over the graphic interface: Uniformed icons and spatial organization	2	3	D
R1.02	Anticipation and control over the graphic interface: Avoid automatic updating of the version (labels or button may be missing afterwards)	1	1	C
R1.03	Include map visualization with the real time position of driver/rider	3	1	A
R1.04	Matching the digital mapping with the real geography using the colloquial variety of local language	2	3	D
R1.05	Trip chain possibility	3	2	B
R1.52	Install audio options and/or auditive support for people with a visual impairment	2	1	B
R3	INCLUSIVENESS			
R3.01	Humans behind; there should always be the possibility of getting human assistance.	3	1	A
R3.02	Possibility of calling the driver/rider to arrange place of pick up (either to facilitate mobility or avoid exposure, or to clear doubts).	3	2	B
R3.51	Some sort of remote support function provided by the service, preferably in the form of a helpdesk of which the contact information is provided by the digital interface. This should be available 24/7	3	1	A
R3.52	Service needs to be affordable or at least offer transparent pricing	3	1	A
R3.53	Users should be able to contact the service agent	3	1	A
R3.54	Work together with organisations or associations with ties to the target audience	2	3	D
R4	WORKFLOW			
R4.01	Very important information (i.e. working hours, contact phone) should appear very big at the beginning	2	2	C
R4.02	Many visual aids (for instance, every payment method should have an icon).	3	1	A
R4.03	Include the possibility of viewing user's ratings.	3	1	A
R4.04	A completion bar, so people not familiar with apps do not feel anxious nor uncertain about the end.	3	2	B
R4.05	There should be a calculator or estimator of the order/trip price.	3	1	A
R4.06	Error detection (by the system) and help offer	2	3	D
R4.07	To clarify what equipment the vehicle has and what to expect when booking a ride with children or with disable people	1	1	C

ID	Requirements rated in P5 Berlin	Value	Effort	Priority
R4.08	To be able to add child age information, know if the car will have the right child seat	3	1	A
R4.09	Adding to favourites their home or work address	3	2	B
R4.51	An easy one-time registration	2	2	C
R4.52	Service to be reliable at all times	3	3	C
R4.53	Easy to use interface that does not include too many steps to activate or use the service	3	3	C
R5	PRIVACY AND DATA SECURITY			
R5.01	Terms and conditions summarized in checkboxes	1	2	D
R5.51	Offer a transparent privacy policy in line with the regulations	1	2	D
R5.52	Certain security measures to be taken to keep the users and their data safe	3	1	A
R5.54	Service should require as less personal data as possible to function properly	/	1	n.a.
R6	SAFETY & SECURITY			
R6.01	Include emergency button in case of physical/ sexual attack	3	2	B
R6.51	Service provided by or endorsed by a trusted and reliable organisation	3	1	A
R7	PHYSICAL INTERFACE			
R7.51	Service agent should be reliable, friendly and empathic	3	1	A
R7.52	Service agent too should be child-friendly	3	1	A
R7.53	Service agent needs to have a profile showing the reviews of other users and giving a feedback option	2	3	D
R8	COMMUNICATIONS			
R8.51	Recognisable and easily identifiable service tool	3	2	B
R8.52	Awareness campaign that targets their user audience and stresses the benefits of the service	2		n.a.
R8.54	Campaign and training sessions as mentioned above, Emilia-Romagna, Antwerp, as well as Galilee and Berlin see the benefit of developing an introductory video tutorial that explains the service step-by-step	3	3	C
R9	COVID-19 RELATED			
R9.01	Establish a COVID-19 protocol and communicate it.	3	1	A

4.3. Summary of users' requirements

The process of the identification of the requirements in WP1 through the thematic analysis of semi-structured interviews and the result of the process of prioritization of these requirements in the five INDIMO Communities of Practice (D3.2) resulted in Table 8. Based on this set of requirements and on the correspondent level of priority assigned by the communities of practice participants, the UDM-V1 draft guidelines have been developed.

Table 8. INDIMO | Requirements prioritized in all pilots

Legend of colours

	Main requirements (from D1.3)
	Additional main requirements for specific pilot (from D1.3)
	Requirements by persona (from D1.2)

ID	INDIMO Requirements prioritized in all pilots	P1	P2	P2	P4	P5
R1	ACCESSIBILITY					
R1.01	Anticipation and control over the graphic interface: Uniformed icons and spatial organization		A		D	D
R1.02	Anticipation and control over the graphic interface: Avoid automatic updating of the version (labels or button may be missing afterwards)		A		C	C
R1.03	Include map visualization with the real time position of driver/rider			C	C	A
R1.04	Matching the digital mapping with the real geography using the colloquial variety of local language			D		D
R1.05	Trip chain possibility			n.a.		B
R1.16	Extend length of light according to user's needs and indicate how much time of green is left (ONLY FOR TRAFFIC LIGHTS)		E			
R1.17	Communicate status of lights (red/green) to users (ONLY FOR TRAFFIC LIGHTS)		D-			
R1.20	Preferably, no action demanded from user (ONLY FOR TRAFFIC LIGHTS)		D			
R1.22	Traffic lights should have auditive signal so people with reduced vision places themselves in the surroundings (ONLY FOR TRAFFIC LIGHTS)		A			
R1.51	Service to increase the independence of the users	A-			D	
R1.52	Install audio options and/or auditive support for people with a visual impairment		A		C	B
R1.53	Possibility to enhance the font			B	A	
R2	MORE OPTIONS					
R2.01	Options for courier and fresh-food delivery and not only cooked food. (ONLY FOR FOOD DDS)				C	

ID	INDIMO Requirements prioritized in all pilots	P1	P2	P2	P4	P5
R3	INCLUSIVENESS					
R3.01	Humans behind; there should always be the possibility of getting human assistance.	A	B	C	C	A
R3.02	Possibility of calling the driver/rider to arrange place of pick up (either to facilitate mobility or avoid exposure, or to clear doubts).				D	B
R3.03	There should be no foreign/technical words on the platform		A		B	
R3.04	Availability of language choices (considering foreign people)	B		C		
R3.08	Training to support service introduction (ONLY FOR LOCKER DDS)	n.a.				
R3.51	Some sort of remote support function provided by the service, preferably in the form of a helpdesk of which the contact information is provided by the digital interface. This should be available 24/7	C	B	D	C	A
R3.52	Service needs to be affordable or at least offer transparent pricing			C	C	A
R3.53	Users should be able to contact the service agent			C	C	A
R3.54	Work together with organisations or associations with ties to the target audience	C-	n.a.	B	C	D
R4	WORKFLOW					
R4.01	Very important information (i.e. working hours, contact phone) should appear very big at the beginning			D	A	C
R4.02	Many visual aids (for instance, every payment method should have an icon).				B	A
R4.03	Include the possibility of viewing user's ratings.		A	C	D	A
R4.04	A completion bar, so people not familiar with apps do not feel anxious nor uncertain about the end.				D	B
R4.05	There should be a calculator or estimator of the order/trip price.				A	A
R4.06	Error detection (by the system) and help offer				C	D
R4.07	To clarify what equipment the vehicle has and what to expect when booking a ride with children or with disable people					C
R4.08	To be able to add child age information, know if the car will have the right child seat					A
R4.09	Adding to favourites their home or work address					B
R4.51	An easy one-time registration	B	A	A		C
R4.52	Service to be reliable at all times		C	C		C
R4.53	Easy to use interface that does not include too many steps to activate or use the service	A	A	B	C	C
R5	PRIVACY AND DATA SECURITY					
R5.01	Terms and conditions summarized in checkboxes		B	B	B	D

ID	INDIMO Requirements prioritized in all pilots	P1	P2	P2	P4	P5
R5.51	Offer a transparent privacy policy in line with the regulations	B	B		B	D
R5.52	Certain security measures to be taken to keep the users and their data safe	B	C	C		A
R5.53	Provide the option of an anonymous or discrete profile, which can be compared by the aforementioned requirement				C	
R5.54	Service should require as less personal data as possible to function properly		B	B		n.a.
R6	SAFETY & SECURITY					
R6.01	Include emergency button in case of physical/ sexual attack		D	C		B
R6.51	Service provided by or endorsed by a trusted and reliable organisation			D	B	A
R7	PHYSICAL INTERFACE					
R7.01	Riders/drivers should introduce themselves and know the user's name. Possibility of uniform (to be easily identified).				A	
R7.51	Service agent should be reliable, friendly and empathic			D	A	A
R7.52	Service agent too should be child-friendly					A
R7.53	Service agent needs to have a profile showing the reviews of other users and giving a feedback option			C	E	D
R8	COMMUNICATIONS					
R8.01	The graphic interface should look that is made for everyone, not only young people		A			
R8.51	Recognisable and easily identifiable service tool	A	B			B
R8.52	Awareness campaign that targets their user audience and stresses the benefits of the service	B	B	C	C	n.a.
R8.53	To organise some sort of teaching method for the target audience (e.g. Educational session)	n.a.	A		D	
R8.54	Campaign and training sessions as mentioned above, Emilia-Romagna, Antwerp, as well as Galilee and Berlin see the benefit of developing an introductory video tutorial that explains the service step-by-step		n.a.	C		C
R9	COVID-19 RELATED					
R9.01	Establish a COVID-19 protocol and communicate it.		C	C	A	A

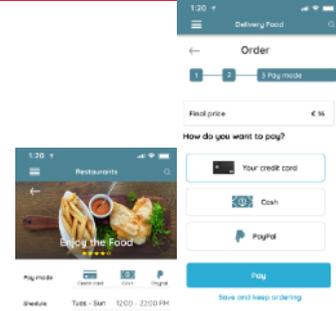
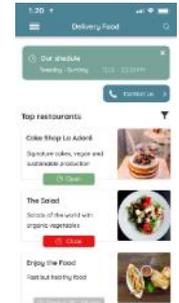
4.4. Guidelines for developers and operators

This sub-section includes the selected validated requirements and a proposed path for UI|UX designers, developers and operators to deal with them, linking requirements, details of development and design examples (Table 9). A more detailed design system section is provided in Annex A3, where the design examples are further detailed. The UDM-V2 will present these refined guidelines in a more navigable website through the hyperlinks and in different local languages mainly associated to the current INDIMO pilots (e.g. Italian, Flemish, Spanish and German).

Table 9. Details of requirement development

Legend: in **red** the main requirements (MR) accompanied, in parentheses, by their priority according to the pilot project (P1, P2, P3, P4, P5); in **black** the other requirements presented only by the interviewees (OR) or elaborated within the second co-creation European Transport Forum workshop (WS - Task 5.2).

Type of Requirement	Requirement	Detail of development	Design examples and references
1. Digital interface			
a. Fonts	<p>Possibility to enhance the font (MR) (P3:B, P4:A)</p>	<p>When clicking on Setting (horizontal bars visible on the screen), there is an alternative to adjust the font size with easy-to-understand options, for example, Small, Medium, Large, Very Large. (for all kinds of services)</p>	 <p>See Figure 26</p>
b. Colors	<p>High contrast mode</p>	<p>When you click on Setting (horizontal bars in a visible place on the screen), there is an alternative to adjust the contrast of the colors of the app and the result it produces. Example: display an image with more contrast and another with less contrast side by side. (for all kinds of services)</p>	 <p>See Figure 26</p>
c. Icons (see UIL)			

Type of Requirement			
Requirement	Detail of development	Design examples and references	
<p>Uniformed icons and spatial organization (MR) (P2:A, P4:D, P5:D)</p> <p>Many visual aids (for instance, every payment method should have an icon). (MR) (P4:B, P5:A)</p>	<p>This is worked more in detail in the UIL (see D2.2). Each payment option has its own clearly identifiable icon (icon for credit card, icon for PayPal-type electronic payment, icon for cash payment, icon for vouchers, etc.) (for all types of services)</p>		<p>See Figure 33 and Figure 37</p>
<p>d. Spatial organization and flow</p> <p>Uniformed icons and spatial organization (MR) (P2:A, P4:D, P5:D)</p> <p>Very important information (i.e. working hours, contact phone) should appear very big at the beginning (MR) (P3:D, P4:A, P5:C)</p>	<p>The essential information (hours of operation, direct contact channels) is standardized in a prominent place on the screen, preferably at the top, and with graphic characteristics that highlight it. (for all kinds of services)</p>		<p>See Figure 23</p>

Type of Requirement

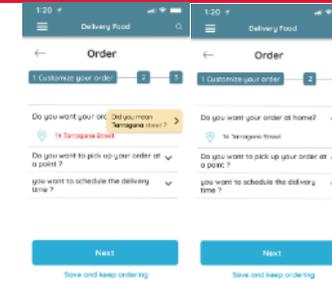
Requirement

Detail of development

Design examples and references

Error detection (by the system) and help offer (MR) (P4:C, P5:D)

Showing how error detection works. For example, if a person writes "Medrid" instead of "Madrid", a sign appears that asks: "Did you mean Madrid?" The same in front of or an address that the system does not recognize, or other pertinent information that can be automatically detected. (for all kinds of services)

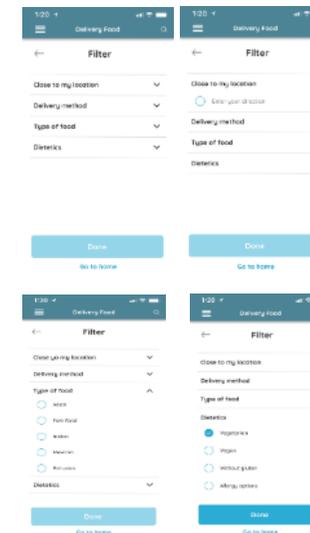


See Figure 35

-Step-by-step flow solved with questions (OR)

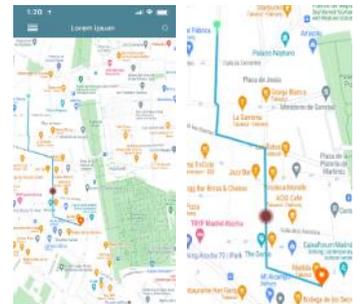
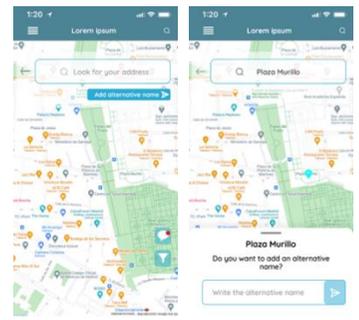
-Easy to use interface that does not include too many steps to activate or use the service (MR) (P1:A, P2:A, P3:B, P4:C, P5:C)

The succession of screens to exemplify the step by step solved with questions. Delivery example: first screen: What is your address? (filter the stores that have that scope), second screen: what kind of food do you want? - filter the corresponding stores), third screen: shows the filtered restaurants with their corresponding photos. (for all kinds of services; in this case, delivery example)



See Figure 31 and Figure 32



Type of Requirement	Requirement	Detail of development	Design examples and references
<p>e. Maps and indication of location</p> <p>-Include map visualization with the real time position of driver/rider (MR) (P3:C, P4:C, P5:A)</p>	<p>The different visual elements used to indicate on the map: the pin that indicates the real-time location of the rider / driver, a different pin to indicate the place of origin and destination, the important milestones of the neighborhood marked; the route offered by the app indicated with a dotted line or some similar resource. (important for ride-sharing / ride-hailing and delivery)</p>		<p>See Figure 40</p>
<p>-Matching the digital mapping with the real geography using the colloquial variety of local language (MR) (P3:D, P5:D)</p>	<p>The coincidence between the pragmatic nomenclature that a street receives and how it is indicated on the map. (important for ride-sharing / ride-hailing and delivery)</p> <p>The design solution is to generate functionalities for users to write the alternative name of the street. Two examples are given.</p> <ol style="list-style-type: none"> 1. The user can directly type the alternative name 2. When searching for the place, a notice appears where the user can type the alternative name of the site. <p>With that information, using the alternative name or both could be programmed.</p>		<p>See Figure 41</p>

Type of Requirement

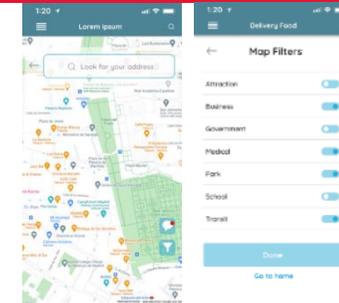
Requirement

-Attracting routes/locations to support educational and caring mobility needs (MR) (P5:B)

Detail of development

Possibility to highlight the care sites. The ride-sharing / ride-hailing / lockers maps show nearby places that are of interest to a caregiver (schools, hospitals, medical clinics, pharmacies, supermarkets). It is contemplated that the location of these places can also condition the trip (example, chained trip) (important for ride-sharing / ride-hailing and delivery). On the map there is a floating button with a filter. From there the user can go directly to configure the vision filters on the map

Design examples and references



See Figure 42

f. Visual aids

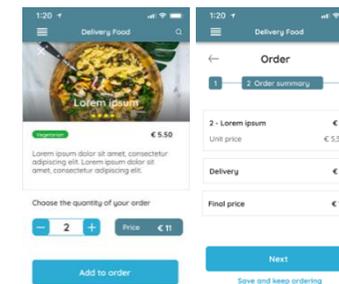
i. Calculator

-There should be a calculator or estimator of the order/trip price. (MR) (P4:A, P5:A)

Showing the characteristics of a calculator: large and visible figures, univocal (without confusion between 8 and 0, or 0 and 0, for example), and the total is broken down with the value of each item. (for all apps).

Two design examples are proposed:

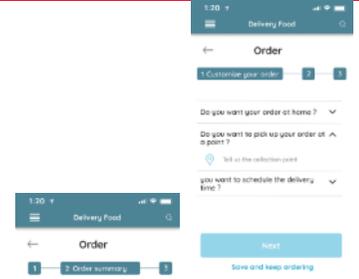
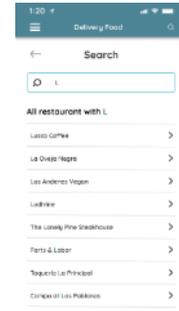
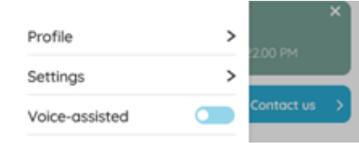
1. When ordering a meal, the user, by increasing the number of dishes, modifies the final price.
2. The second corresponds to the order process, where the price is broken down between food, delivery.



See Figure 33 and Figure 36

ii. Completion bar



Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>A completion bar, so people not familiar with apps do not feel anxious nor uncertain about the end (MR) (P4:D, P5:B)</p>	<p>What a completeness bar looks like, with the % or number of steps remaining to complete the order. (for all apps)</p>	 <p>See Figure 34</p>
<p>g. Autocompletion/ suggestions by the app Include auto-filling/ suggestions by the app (for visually and cognitively impaired) (OR) Autocompletion with the past order/service, with the possibility of modifying it. (OR)</p>	<p>Showing how autocompletion works, although it is a well-known operation in the web world. (for all apps)</p>	 <p>See Figure 30</p>
<p>h. Compatibility with devices i. Voice-assisted menu Add a voice-assisted menu (for people with reduced vision) (OR) ii. Low-tech equipment Produce a light version of the app which is acceptable for a variety of equipments. (WS)</p>	<p>When clicking on Setting there is the option to activate external aids such as the voice-assisted menu (more technical detail is required on how this utility is activated). In the Registration phase there should be a question of do you want to activate mobility, vision, hearing (for all apps). Two design examples are proposed.</p>	 <p>See Figure 24</p>



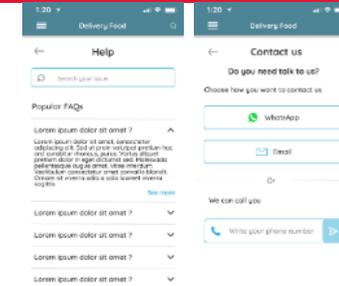
Type of Requirement

Requirement

Detail of development

Design examples and references

Also, a WhatsApp icon for people to communicate may be added. That is always at the discretion of each programmer.



k. Information

i. Real-time information provided by the app

Include map visualization with the real time position of driver/rider (MR) (P3:C, P4:C, P5:A)

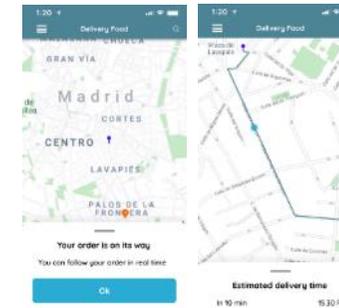
Real-time information of the location of the parcel (for lockers) (WS)

Include route planners with real time info (so blind people can trust them to get off the bus/train) (OR)

Include a real-time estimation of occupation and travel time (WS)

ii. Information requested about people in charge

How the map shows in real time the location of a package / product in the case of delivery / locker. Along with that the estimated delivery / arrival time. (Important for lockers and delivery)



See Figure 38



Type of Requirement

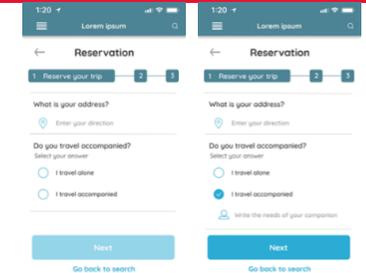
Requirement

Detail of development

Design examples and references

To be able to add child age information, know if the car will have the right child seat (MR) (P5:A)

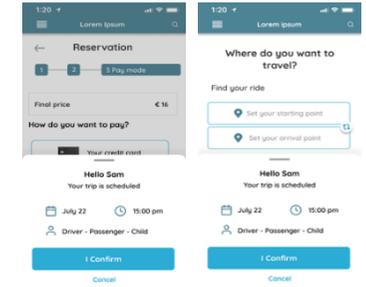
When a ride-sharing / ride-hailing vehicle is requested, a box opens that asks if you are traveling with a person in charge, if it is a child, how old is it, to offer you a seat of adequate security. (important for ride-sharing / ride-hailing). The user has to answer some questions to book his trip. By selecting the companion option, the option to write the needs of his travel companion is activated.



See Figure 43

The app should give the option of selecting “service with children”, indicating the number of children and the age (OR)

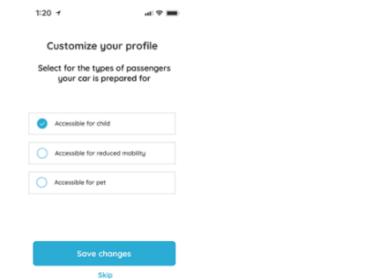
Showing the message that reaches the other passengers advising that a child is traveling in the same vehicle. (important for ride-sharing / ride-hailing).



See Figure 43

Direct a car whose driver is tolerant to children and willing to provide the required assistance (OR)

Two examples are shown in which the user is notified of his trip. The first is at the time of booking the trip; the second, once it is already booked (generally this notification is when the trip is ready after booking)



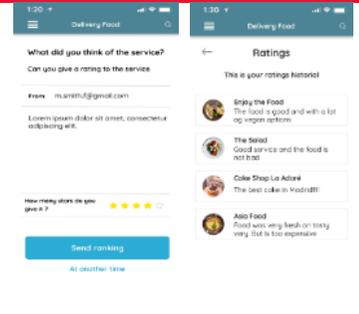
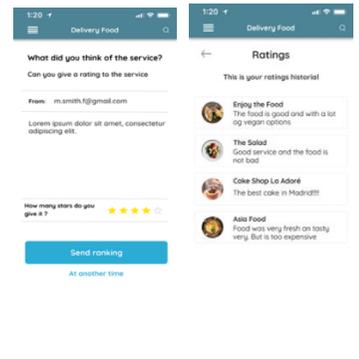
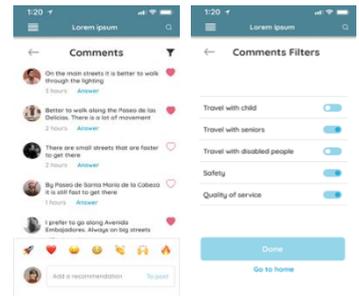
See Figure 44

Showing the message received by the caregiver informing that a vehicle was directed to him with a driver who is tolerant towards children and who is trained to offer adequate assistance for this type of trip. (important for ride-sharing / ride-hailing).

In the registration process, user is asked what kind of people he/she has the car prepared for.

L. Ratings and users’ feedback



Type of Requirement	Requirement	Detail of development	Design examples and references
	<p>Include the possibility of viewing user's ratings. (MR) (the rating that the user gives the service) (P2:A, P3:C, P4:D, P5:A)</p> <p>At the end, the user should be asked for suggestions or complaints (OR)</p> <p>The day after the order, the app should mail the user and require them to rank and comment about the restaurant/service (OR)</p>	<p>Showing how to agree to give a score to the service. For example, a poster after the end of the service, an email with a link, an option in the Setting. (for all apps)</p> <p>In the following examples the user can give feedback from their menu, that is housed in the rating history.</p>	 <p>See Figure 27</p>
	<p>Comment is requested in order to be able to rate a driver (WS)</p> <p>Service agent needs to have a profile showing the reviews of other users and giving a feedback option (MR) (P3:C, P4:E, P5:D)</p>	<p>Showing how the scoring system is expected to be: simple, from 1 to 5 stars, plus a comment indicating some characteristics of the user who offers the evaluation, for example, if it is a woman or a man, yes the service was daytime or night-time (the latter, if applicable). (for all apps)</p>	 <p>See Figure 27 and Figure 39</p>
<p>m. Privacy and data security</p>	<p>Comment filter system. Possibility of filtering the comments of other users according to these characteristics (for example, a woman's interest in knowing the comments made by other women about an X-driver working at night). (for all apps)</p> <p>In the examples, a filter is added in the comments part, in them user can choose the types of comments that he/she wants to show</p>	 <p>See Figure 45</p>	

Type of Requirement	Requirement	Detail of development	Design examples and references
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i. Terms and conditions

Terms and conditions summarized in checkboxes (MR) (P2:B, P3:B, P4:B, P5:D)

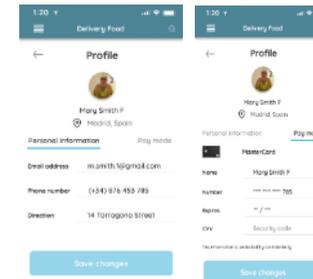
Example of how the Terms and conditions are synthesized in 3 or 4 boxes. (for all apps)

Offer a transparent privacy policy in line with the regulations (MR) (P1:B, P2:B, P4:B, P5:D)

ii. Data storage characteristics

Checklist of what data is stored and for how long. (OR)

Example of how the list is showing what information is stored and for how long. For example, Name and email, 6 months; address and phone, 3 months; order detail, 1 month; credit card details, 3 months. This is just an example. (for all apps)



See Figure 25

iii. Feedback on transactions



Type of Requirement

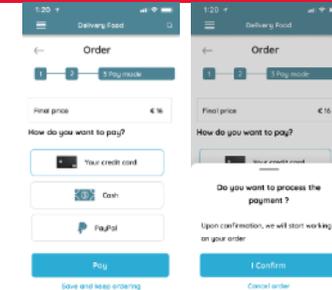
Requirement

Detail of development

Design examples and references

Feedback, such as notifications and warnings, to reassure online payments (OR)

Example of how the poster is to ensure (double check) the completion of a payment. For example, do you want to move forward with the payment process? (for all apps)



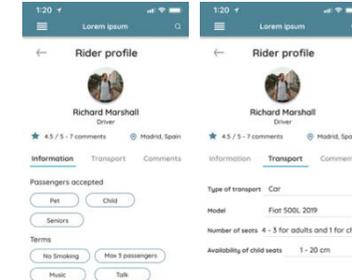
See Figure 37

n. Security

i. Emergency/Help button

Include emergency button in case of physical/ sexual attack (MR) (P2:D, P3:C, P5:B)

How the profile of a driver / rider should look, with his photo, his full name, pertinent information (such as whether he smokes or not in the case of a driver) the average score that other users have given him and the ability to open and view the comments that other users have written. (important for ride-sharing / ride-hailing and delivery)

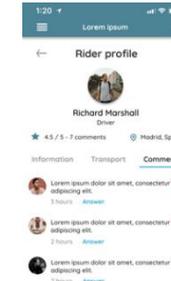


See Figure 46

Create help button (OR)

Service provided by or endorsed by a trusted and reliable organization (MR)(P3:D, P4:B, P5:A)

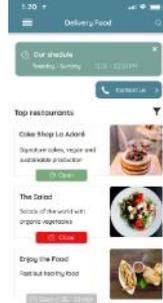
The information required for a driver / rider has been joined in the three examples shown. Although it is focused on a rider, it can be easily adapted to all profiles.



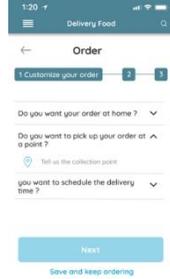
See Figure 46

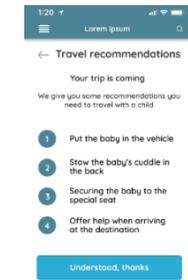


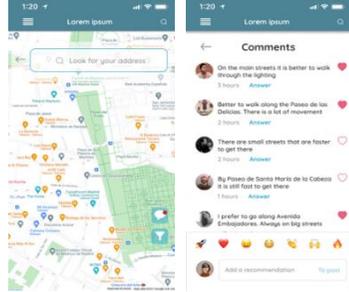
Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>Add a photo of the rider/driver that will serve the user for better identification (WS)</p> <p>o. Communication</p> <p><i>i. Channels for communication</i></p> <p>Importance of local peer volunteers as trusted communicators (OR)</p> <p>Promote the services “offline”: events and flyers (OR)</p> <p>Awareness campaign that targets their user audience and stresses the benefits of the service (MR) (P1:B, P2:B, P3:C, P4:C)</p> <p><i>ii. Values communicated</i></p>	<p>How the profile of a driver / rider should look, with his photo, his full name, pertinent information (such as whether he smokes or not in the case of a driver) the average score that other users have given him and the ability to open and view the comments that other users have written. (important for ride-sharing / ride-hailing and delivery)</p>	

Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>The graphic interface should look that is made for everyone, not only young people (MR) (P2:A)</p>	<p>At this point, give an example of how it should be done vs. how it shouldn't be done. For example, HOW NOT: a fictional illustration of the home page of an app that is openly designed for young people (with hashtags, words in English, technical or generational words, very niche images) vs HOW YES: the image of a home page of a fictional app that produces a “neutral from a generational point of view” result. (for all apps)</p>	 <p>See Figure 23</p>
<p>Create a positive attitude through communication (OR)</p> <p>Highlight the environmental and social values behind the service. (OR)</p> <p>Communicate the social project behind the service and the benefits of workers (OR)</p> <p>Do not communicate ride-sharing/ ridepooling as a replacement of bikes or public transport, but as a complement. (OR)</p>		
<p>p. Language</p> <p>There should be no foreign/technical words on the platform (MR) (P2:A, P4:B)</p>		

Type of Requirement	Requirement	Detail of development	Design examples and references
	<p>Availability of language choices (considering foreign people) (MR)(P1:B, P3:C)</p> <p>q. Payment options</p> <p>There should be no minimum amount of purchase (MR)</p> <p>Service needs to be affordable or at least offer transparent pricing (OR)</p> <p>Allow payment alternatives, especially cash but also digital wallets payments (such as PayPal). (OR)</p> <p>The user should indicate in the app how they will pay and with which bill (WS)</p> <p>Offer the possibility of buying coupons for the service to allow cash payments but avoiding the rider/driver to have cash on him. (WS)</p> <p>The riders/drivers have a card reader machine (WS)</p>		
	<p>2. Physical Interface</p> <p><i>Ridesharing/ ride-hailing services</i></p> <p>a. On Boarding/ Off Boarding</p> <p><i>i. Safe spots</i></p>		

Type of Requirement			
Requirement	Detail of development	Design examples and references	
Identify safe spots for boarding (e.g. a quiet side street instead of a multi-lane avenue) (OR)	Showing the alternative that the user of ride-sharing / ride-hailing has: indicate the pick-up point at the indicated address or choose a point close to the address. The map recognizes and shows places near the home that offer greater public safety (for example, avenues where there is good lighting, or a lot of movement, or many shops) or greater road safety (for example, calm and internal streets with a single lane Low traffic). The user can choose. The same for the descent of the user.		See Figure 34
Generate meeting points or use existing bus stops to pick up users. (WS)			
Include the option of picking up the user at the corner or some blocks away (WS)			
<p>b. Booking a service</p> <p>Possibility of booking service in advance (important for people with children) (OR)</p> <p>Alternative channels to order: WhatsApp number or phone number. (OR)</p> <p>Possibility of choosing the gender of the driver/rider through the app (WS)</p>	Showing where the telephone number should be located and the indication to request a service by WhatsApp.		

Type of Requirement	Requirement	Detail of development	Design examples and references
<p>c. Contact with user</p> <p>Drivers should call the user some minutes before arriving to ask whether the user has an intercom or whether they should announce it by a phone call.</p> <p>Drivers should speak slowly and in a clear way. (OR)</p> <p>Drivers should offer support when necessary (for example, when passenger has a child) (OR)</p> <p>Drivers receive training about inclusivity (WS)</p>	<p>Showing the different actions in which a trained DRIVER must provide assistance: putting the baby in the vehicle, putting the baby's cot in the back, securing the baby to the special seat, offering the woman carrying a child or stroller helps to enter the origin / destination.</p>		<p>See Figure 47</p>
<p>Smart traffic lights</p> <p>d. Communicating status of the light and other features</p> <p>Communicate status of lights (red/green) to users (AMR) (P2:D-)</p>	<p>Showing the different ways of communicating the status of the traffic light: a) sound that differs from ambient sound; b) sound and vibration from the mobile; c) dynamic poster that tells how much time is left for the pedestrian crossing.</p>		<p>See Figure 45</p>

Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>Road works should be clearly communicated (WS)</p>	<p>Showing how the map of the associated app indicates incidents / works that may represent an obstacle in the navigation of the space: a) closed streets, b) infrastructure works; c) small maintenance work; d) machinery working that makes ambient noise and prevents clear hearing of the traffic light signaling; e) other incidents. In the image where the map is, there is a comment button.</p> <p>Here the user can write his comments about the route, but also, he can see the comments of other users.</p>	
<p>f. Surroundings/ quality of the road</p> <p>Offer the user extra info on the quality of the road (OR)</p> <p>Changes in the surface of the pavement to indicate proximity of the smart traffic light (WS)</p>	<p>On the second screen, we see how you can leave a comment and read the ones that are already written.</p> <p>With this information, you can complement the instructions that will be given to people who need assistance.</p> <p>Showing in a general way what accessibility elements should have a pedestrian crossing where an intelligent traffic light works: a) curb level with the road with adequate inclination; b) surfaces with tactile relief that indicate the</p>	<p>Programming: auditory with prompts</p> <p>Use user comments to feed the app with directions options</p>

Type of Requirement			
Requirement	Detail of development	Design examples and references	
<p>Accompany the installation of smart traffic lights with works of urban rehabilitation and modernization, focusing especially on crossings (OR)</p> <p>Integrate smart traffic lights in route planners such as Google Maps (OR)</p>	<p>presence of the smart traffic light; c) if it is defined that the traffic light requires pressing a button, it must be at an accessible height for a person of any height or in a wheelchair; d) clean corner of obstacles or additional signage; e) if the crossing is very long, with several lanes, offer some kind of rest in the middle.</p>		
<p>g. Notifying technical problems of the lights</p> <p>Button to notify problems with the lights (WS)</p>	<p>Showing how it is possible to enter the app to report a problem. For example, enter Settings, notification, and the app asks the intersection of streets where the traffic light with problems is and what is the problem it has.</p>		<p>See Figure 27</p>
<p>Delivery/ courier services</p>			
<p>a. Characteristics of the delivery packages</p> <p>Uniformed shapes of the packages, for instance, main dish in squared package, side-dish in a round package (for people with reduced vision) (OR)</p>	<p>Code suggestion for the shape of the containers. It should be very simple to facilitate the identification of the dishes to the touch: main dish in square container; accompaniment in round container; dessert in smaller container.</p>		
<p>b. Options of food</p> <p>Enlarge food options (vegetarian, healthy etc) (OR)</p>	<p>Showing that early in the purchase you should ask if you want to order a regular order or for a</p>		<p>See Figure 34</p>



Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>Options for courier and fresh-food delivery and not only cooked food (MR) (P4:C)</p> <p>Separate regular orders from special occasions (OR)</p> <p>Budget menus (OR)</p>	<p>special occasion. This is to integrate new consumers and demands (for example, shopping at a nursing home).</p>	
<p>c. Contact with user</p> <p>Riders should call the user some minutes before arriving to ask whether the user has an intercom or whether they should announce it by a phone call. (OR)</p> <p>Riders/drivers should speak slowly and in a clear way. (OR)</p> <p>Riders should offer support when necessary (for example, when user has a child) (OR)</p>	<p>Showing the different actions in which a RIDER must provide assistance: contact the user in advance to arrange how the delivery will be made, leave the order on the portal if requested, go up to the door of the apartment if requested, help the user with the load of the product if it is heavy or difficult.</p>	

5. Checklist for service assessment

This co-created UDM-V1 primarily focuses on the digital interface part of digital mobility and delivery services, but the service itself should also ensure accessibility and inclusivity. The structure of the IT system usually derives from the physical system. Therefore, to provide an inclusive digital service the base-system should be assessed with an inclusivity and accessibility approach.

The service assessment contains aspects and requirements for different subsystems and from different viewpoints regarding the targeted user groups. The goal of the assessment is to give operators and developers an insight into universal design, and as they perform the assessment process themselves, they obtain important information about inclusivity and get familiarized with the general needs and requirements of vulnerable-to-exclusion people.

As a result of the assessment, operators and developers can determine the performance of their service on the different axes of capabilities and limitations. On the one hand, this result may encourage them to improve the accessibility and inclusivity of the service if the scores prove to be low and it also aids to identify the main areas of possible improvement. On the other hand, it aids the development or updating process of the related application in terms of focusing resources: if the service itself could be reached with a specific level of capabilities but the application's insufficiency prevents it, actions should be taken to improve the related sub-systems. Ideally, both the service provided and the related digital interface should have similar ratings on every axe of the capabilities-limitations spectrum.

The main process of any service may consist of several subsystems, but the whole service can only operate in an accessible and inclusive way if all of these subsystems are suitable and designed universally. This guide summarizes the main requirements for the potential components of a general service. Not every service will contain each subsystem but in order to effectively improve the service, those factors should also be assessed by the same manner.

Service access point

- Service location itself is accessible:
 - Visual impairment: tactile paths, signs, Braille displays, audible announcements (if possible)
 - Mobility impairment: barrier-free and spacious facilities, enough seats
 - Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
 - Accessible with children (enough space, child seat)
 - Accessible with large baggage, pets (incl. guide-dogs) etc.
- Route to service access point is accessible:
 - Mobility impairment: barrier-free and spacious facilities

- Careful placement of access point (e.g., point of aggregation of communities)
- Connection to transport services (e.g., public transport)
- Accessible with children, pets, baggage (enough space)
- User is led to the service access point:
 - Service point (if it is physical) itself is signed clearly, it is easy to identify
 - Clear and understandable information along the route:
 - Clear information about temporary changes, e.g., diversions, constructions, closures;
 - Accessible information on orientation:
 - Visual impairment: tactile paths, signs, Braille displays, audible announcements (if possible)
 - Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
 - Universal icons and signs
 - Texts are available in several languages
- Service time:
 - Service hours as long as possible
 - Allow users enough time for the service process, so they do not have to hurry
- Safety, security:
 - Safe and quiet place
 - Secure environment
- Coverage:
 - Geographical coverage as large as possible
 - Customizable access point (if possible, e.g., boarding point for ride sharing)
 - Personal access point (if possible, e.g., a locker)

Vehicle

- Vehicle itself is accessible (at least as an option):
 - Mobility impairment: barrier-free and spacious, enough seats, same level of vehicle floor and platform
 - Accessible with children (enough space, child seat)
 - Accessible with large baggage, pets (incl. guide-dogs) etc.
- On-board information is accessible:
 - Vehicle is indicated clearly, it is easily recognizable from outside
 - Vehicle characteristics are available
 - Visual impairment: tactile paths, signs, Braille displays, audible announcements (if possible)
 - Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
 - Universal icons and signs
 - Texts are available in several languages

Physical interface / Product

- Physical interface/product is accessible:
 - Visual impairment: tactile signs, Braille displays, audible announcements (if possible), different shaped objects/buttons for different parts/functions, touch-screen equipped with text-to-speech options (with physical button to switching it on), physical buttons for number input is preferable
 - Mobility impairment: interface/product can be used from wheelchair (adjusted height) and with one hand
 - Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
 - Description is available in several languages
- Contact to the interface:
 - As few actions needed from users as possible (e.g. activating interface)
 - Simple and understandable instructions
 - Clear feedback about the process
- Wide range of product options:
 - Options of users with health diseases, limitations, e.g. allergies

Service personnel (direct contact)

- Good manners, appearance:
 - Introduce themselves (if contact is direct)
 - Know user's name (if contact is personal)
 - Tidy outfit and appearance
 - Uniform or clearly distinguishable outfit (if possible)
- Contact with user:
 - Profile and personal data are displayed
 - Notifying user before arrival (if contact is direct)
 - Possibility of contact before use, to arrange details (if needed)
 - Speaking slowly and in a clear way
 - Offering support if needed
 - Trained about inclusivity
 - Assigning the same personnel for the same user if possible
 - Capable of communicate in English (or other additional languages)

Booking

- Option of booking in advance (if possible)
- Alternative channels to order:
 - WhatsApp/Viber/Messenger etc.
 - Phone number
- Customizable booking:
 - Accessibility options (if they are not universal throughout the whole service)
 - Special needs, e.g. children, pets, baggage
 - Choosing the gender of personnel (if contact is direct and can be relevant)

- Available information about the presence of other occupants/users (e.g. children, pets; if it can be relevant)

Payment

- As wide variety of payment forms as possible:
 - Cash (if not increases security risk significantly)
 - Credit/Debit card
 - Digital wallets (e.g. Paypal)
 - In advance / after use
 - Personal account
- No minimum amount of purchase
- Affordable and transparent pricing:
 - Clear and understandable fares/prices
 - Indication of actual price
 - Budget options
- Secure place for payment
- Optional (and not mandatory) connection/integration of account with other services

Customer service

- Possibility of getting human assistance:
 - Assigning the same personnel for the same user if possible
 - Include person with impairment in staff
 - Reliable, friendly, and empathic staff
- Alternative channels:
 - Personal assistance, support (if possible) at contact points
 - Remote help via phone
 - Remote help online (in video, audio, or text)
 - Assistance chat for people who cannot speak / cannot speak the language
- Availability in 24/7 if possible, or at least during service working hours
- Accessible in several languages

Dissemination

- Letting know possible users about the existence of service via as many channels as possible:
 - Electronic media, online
 - Social media, influencers
 - Integration in electronic services, e.g., Google Maps
 - Local, printed media
 - Flyers, brochures
 - Local organizations, associations
 - Advertisements in local stores, services, schools
- Facilitating user involvement:

- Clear communication of advantages
- Clear description of registration process
- Manual/guide available in own language

Covid-19 protocol

- Establishment and communication of cleaning protocol
- Actions to prevent infection:
 - Disinfection, ventilation of service area
 - Personal hygiene equipment
 - Control of crowd, keeping distance

6. Recommendations

After presenting the major content of the UDM-V1, we propose a summary of the main items that developers, operators and policymakers should bear in mind at the time of creating digital mobility and delivery services and platforms, and at the point of upgrading or updating existing apps/services. These are some of the main concepts and principles that can be extracted from the guidelines and should accompany their implementation.

First, **target groups** and a variety of citizens and relevant organizations should be involved and committed throughout the process. Users are a valuable source of insights and should accompany the design generation from the beginning to the end, through different instances of consultation.

With regards to the **accessibility** items, the first recommendation is related to the inclusion of multichannel communication and feedback from users, which implies that different sensorial levels of interaction are considered. Channels of input-output should cover as many senses as possible. This point is addressed in the present document with different requirements, from the sound to confirm user's actions, the availability of captions for tutorial videos, the written chat with service agents etc.

The second recommendation refers to the **simplification of the cognitive processes** contained in the use of the app. This covers all the requirements included in section 3 and detailed in section 5, associated with auto-filling, completion, suggestions by the app, warning messages and error correction. Altogether, they aim at reducing the mental load and the complexity of mental work contained in the process or ordering or purchasing. It implies also relieving memory and enabling that several resources are invested in other mental tasks.

The third recommendation concerns **the provision of certainty**, aiming at avoiding unexpected elements and generating uniformity and sense of anticipation. This is related to some requirements such as the uniformity of icons and spatial organization, the uniformity of shapes and packages, the presence of maps with the real-time position of goods and service agents, among other points.

The fourth recommendation concerns not only implementing **universality and adaptations for all users and related capabilities** when needed, but also **communicating** them. This means, that providing up-to-date or real-time accurate information about accessibility measures of the services is part of the accessibility condition itself.

The fifth and last **recommendation about accessibility** has to do with pondering over the importance of human contact even in digital services. Humans value other humans: humanity represents warmth and accompaniment and human contact is especially important for users who feel vulnerable when facing a challenging scenario.

With regards to **inclusivity**, the first recommendation is to consider users who are looking after other people, who are responsible for others. Caregivers have special needs that should be explored at the time of designing, including their requirements with regards to

equipment, onboarding and offboarding spots (in the case of mobility), contact with the driver/courier and other users etc.

The second recommendation deals with taking care of the **language**. Language options should be present, especially in multi-lingual societies or areas with many migrants. But, beyond that, it is important to build a neutral idiomatic interface, which is free of generational or technical terms, or words specifically associated with a niche of users.

Another key **recommendation for ensuring the inclusivity** is to provide affordable services or, at least, offer a wide range of products and services where different users can find the one that is suitable for their **level of income**. The requirement of no minimum amount of purchase or the availability of economic menus in delivery food for example addresses this point.

With regards to the aspect of **usability**, the first recommendation is the **simplification of processes and resources**: for instance, a step-by-step flow which is solved with questions directed to the user in a clear form. The second recommendation is the **graphic richness of the app**, the use of visual aids to simplify process of interpretation and decoding. In line with the last item, some **specific visual supports**, such as completion bar, may alleviate the feeling of anxiety and uncertainty about the end of the workflow.

A good point to be made here is **the recognition of the difficulty during the design stage** of complying with many demands. The importance of balancing different types of needs and several user requirements that emerge from different concerns. For instance, the requirement of auto-completion to simplify tasks with the requirement of privacy regarding data management. This balance will depend very much on the creativity and experience of those who oversee the design and the available resources of the organization.

7. Lessons learned

During the co-creation process of this first version of the Universal Design Manual, both meetings with target-groups and end-user experts on the topic and the review of the associated Universal and inclusive Design literature nourished insights' identification and learnings that casted light to the Universal Design process. The aspiration to broaden the accessibility and inclusivity conditions in the digital platforms cannot only be performed with a change in the employed technological resources and a transformation in associated infrastructure. A whole empowering of the population should be accomplished; the approach towards impairment should change gradually. The first idea that should be worked out is that all people have a certain degree of capability and temporary or permanent impairment in some dimension of the everyday activity. If a group of people cannot perform a key-life activity, it is because the architecture or infrastructure or associated service is not universally designed. Capabilities and limitations are not only about the physical, visual, or cognitive conditions in themselves; it is about the relationship between those conditions and the built environment. And this element should shape the mindsets of the potential users of UDM-V1 (i.e. developers, operators, UI|UX designers, policy-Makers, NGO). This built environment is a result of the social interaction and of the structured social organization and, as many other aspects of the social organization, can be transformed.

A second interesting lesson learned is that design should be done without labelling groups, without associating special functionalities with target-groups of end-users, because that may contribute to stigmatize them. In fact, it undermines the concept of universality which implies that contributions on accessibility generate benefits for all types of users, disregarding the current presence of an impairment. Just to offer an example, including images in the description of food of a delivery service is not only useful for people with cognitive impairment but for any kind of user in order to facilitate interpretation, stimulate comprehension, reduce the load of cognitive processing and generate a more long-lasting mental picture of the item perceived. A universal service considers a wide range of different users, understanding the impossibility to categorize all types of users, and searching in every functionality for the inclusion of as many users' requirements as possible.

The reflection on accessibility was born from a general social aspiration and was fitted into different fields and areas of activity. The physical accessibility, specially associated to the urban architecture and the transport, was one of the first domains where large transformations were carried along as part of wider policies. As we could see, there are regulations and standards for the design of web platforms, but the setting of standards for specific mobile apps is still less explored. There is a good opportunity to start working on this issue at an early stage of the DMS/DDS development. Many of the current ICT standard devices are a solid background for the development of specific standards for digital mobility and delivery technology. The current generation of researchers can rely on a long path already covered by previous researchers, developers, operators, UI|UX designers, policy-makers and NGOs that represents users.

8. Conclusion and next steps

This is one of the first Universal Design Manuals to inspire the developers, operators and policy makers, as well as the representatives of target-groups to design, implement, regulate and advocate digital mobility and delivery products and environments that have well-integrated universally usable features. The content of the current UDM-V1 is largely inspired by the Principles of Universal Design previously elaborated in 1997 within the Center for Universal Design, 1997) for all design disciplines. They are useful for evaluating existing products and environments, guiding the design process, and educating designers and consumers about the characteristics of more usable designs. However, they are mainly conceived for dealing with physical services and for people with different kinds of impairments. They can be adaptable to the digital environment and all kinds of socio-economic and cybersecurity barriers, but they are not sufficient. Therefore, two specific principles have been added to the more consolidated seven universal design principles: one related with social, spatial and economic inclusiveness and a second one related with security and protection of data. Both, principles help to enlarge to all social minorities that cross gender, age, and ethnic origin and intersect other variables such as income, education, and health. The requirements, and guidelines included in Section 4 illustrate the intent of each guideline that accompanies the 7+2 principles. While the five pilots of INDIMO serve this purpose well, it is the hope of the INDIMO consortium that the apps and the digital interfaces of the physical services tested in the five INDIMO pilots are only a starting point for increasing the acceptance of the concept of Universal Design within the developers and transport operators.

The first iteration of the UDM presented in this deliverable will go through a testing and evaluation in the five INDIMO pilots in order to carry out an evaluation of usability. Then, there is a feedback loop to WP2 tool development to develop the second and final version of the UDM, which will be the publicly available guidelines (deliverable D2.2) at the end of the project (M34). In WP4, Task 4.3 (Process evaluation), we have a specific evaluation stream which evaluates the usability of the INDIMO toolkit based on a number of indicators such as coverage of essential topics, coherence and ease of use (see section 6.2 on Usability assessment Deliverable D 4.1).

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- Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 establishing common rules on compensation and assistance to passengers in

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Regulation (EU) No 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European standardisation, amending Council Directives 89/686/EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC, 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC of the European Parliament and of the Council and repealing Council Decision 87/95/EEC and Decision No 1673/2006/EC of the European Parliament and of the Council Text with EEA relevance

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<https://informationisbeautiful.net/visualizations/colours-in-cultures/>

<https://accessible-colors.com/>

<https://www.w3.org/TR/css-color-3/#introduction>

Annex A1: INDIMO inclusive terminology: descriptions of user characteristics

To avoid misalignments, we suggest to distinguish three different levels:

1. **User profiles:** the specific users of each digital mobility service/application explored by each pilot project (i.e. Older people who receive/send parcels; Migrants or foreign people who receive/send parcels; Vulnerable pedestrians; Informal ride sharing users; Healthy food delivery users; On demand ride sharing users).
2. [Vulnerable-to-exclusion] **User Characteristics:** describes the characteristics of users directly addressed by each pilot (e.g. older people, foreigners, rural residents in Emilia-Romagna; older people and PRM in Antwerp; ethnic minorities and women in Galilee; women in Berlin; PRM, women, older people in Madrid)
3. [Hidden] **User characteristics:** includes characteristics not directly addressed by pilots but mentioned in one or more pilots as "*hidden*" characteristics (e.g. caregivers in the Antwerp pilot). Such characteristics will not appear as separated ones, but are mentioned in the user characteristic description when applicable/appropriate.

PLEASE NOTE: this inclusive terminology only refers to user characteristics and not to user profiles. Descriptions have been developed taking into consideration how users' characteristics have been addressed in each pilot. The project website will include only the main user characteristics, which will be also included in all official project communication materials (e.g. brochure).

Older people Globally, the population is ageing and the World Health Organisation (WHO) predicts that, by 2050, the population aged 60 years or more will double, whilst those aged 80 years or more will number 400 million persons.

The ageing process is not uniform across the population, there is no a "typical" older person. A large part of this diversity arises from people's physical and social environments and the impact of these environments on their lifestyle, opportunities and health behaviours. Mobility opportunities are part of these facilitating or hindering environments.

From the travel behaviour perspective, older people have a quite varied routine compared to people who spend most of their day in schools or workplaces. When fully independent, mobility needs of the eldest are mainly linked to socialisation, pursuing their own interests and activities, caring for grandchildren and family support. Often, physical constraints affect travel behaviour and needs, especially when living alone and relatives are far away. The need to monitor personal health condition is another important factor affecting travel choices, therefore easy access to healthcare services and public facilities must not be neglected.

Circumstances and life conditions can evolve rapidly and the risk of social isolation and loneliness is deeply increased by poor mobility choices. In addition, frailest older adults may live in permanent or non-permanent reduced mobility conditions.

In the context of mobility services, new technology represents a powerful tool to help reduce loneliness and increase autonomy, since it gives older adults more self-reliance and connectedness. Differently in health-care services, technology is often perceived by users as a tool of isolation (e.g. distance-monitoring). Despite the increasing number of older adults accessing the web, a strong digital divide between older adults and younger people still exists. Moreover, an internal divide exists also among those who actively seek connection and those who are not interested or afraid of it. Older people are less keen to use new smartphones since they rather maintain routine gestures with the old ones. They are often not reached by a fast-speed connection, especially if they live in rural areas, or aren't aware of its benefits.

Understanding travel choices and use of digital mobility apps across age groups is of paramount importance to ensure solutions are designed to fit their needs. To this end, INDIMO will focus on services related with pedestrian mobility and with product delivery for this target group.

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<https://ilcuk.org.uk/the-future-of-transport-in-an-ageing-society/>

Su, F. and M.G.H. Bell, Transport for older people: Characteristics and solutions. *Research in Transportation Economics*, 2009. 25(1): p. 46-55.

Ethnic minorities

In the context of INDIMO the term ethnic minorities includes all people who permanently live in a multi-ethnic community. Cultural identity is an important factor influencing individual needs, travel choices, and travel distance. Depending on the size and typology of the built context, on the local multi-cultural mix and on the level of social cohesion, the severity of social exclusion may strongly vary. National and local policies are rarely able to provide equal access to social and economic opportunities and resources to minorities, and for transport services the same applies.

People whose religious or cultural beliefs limit their interaction with the social, physical or digital environment, especially when they are abroad or find themselves in an unfriendly or unfamiliar context also count as ethnic minorities. For people belonging to this category, barriers to the use of digital (and non-digital) mobility services can be related with the perceived fear of victimization

while travelling, which influences travel needs and behaviour. Such fear can be related to real traumatic experiences or by actual insecurity due to contextual factors. When deciding about their mode choices ----and which routes to select-ethnic minorities must consider all odds. In particular, women and older people belonging to this group are those most affected by the lack of services addressing their need for personal safety.

Digital mobility services oftentimes do not target this group's needs, therefore potential users do not receive paramount information, causing higher isolation and fragmentation of the community.

References:

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<https://www.ethnicity-facts-figures.service.gov.uk/culture-and-community/transport/travel-by-distance-trips-type-of-transport-and-purpose/latest>

Foreign people

In the context of INDIMO the term foreign people includes people who settle in a host country that differs from their home country especially from the linguistic and cultural point of view. As for ethnic minorities, foreign people's cultural identity is an important factor influencing individual needs, travel choices, and travel distance.

For this group the main barrier to the use of digital (and non-digital) mobility services is represented by local language proficiency, excluding them from the related benefits and from participating in the local decision-making processes. Another barrier is the lack of access to online banking services due to the large amount of documentation required in most European countries. Such documentation hard to obtain both from host countries and from the countries of origin, preventing access to the digital payment options.

For the same reason foreigners with lower economic conditions can hardly afford to rent or buy houses in central or connected areas and encounter difficulties with the bureaucracy and contracts. Therefore, they often live in poorly served suburbs, both in terms of public transport and digital connectivity.

It has been observed that foreign people, especially migrants who have recently settled in a host country, are more likely to commute, walk and cycle compared to locals of the same age and broadly use digital technologies which allow them to keep social connections with their families and peers. Finally, it is worth

mentioning the fact that care-givers often belong to this group, resulting in very specific mobility patterns and needs.

Understanding travel behaviour and use of digital mobility apps across different cultural groups is paramount to ensure solutions are designed to fit their needs.

References:

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(UN DESA, Recommendations on Statistics of International Migration, Revision 1 (1998) https://unstats.un.org/unsd/publication/seriesm/seriesm_58rev1e.pdf

https://ec.europa.eu/eurostat/statistics-explained/index.php/Asylum_statistics

https://www.rand.org/pubs/technical_reports/TR1187.html

<https://www.ethnicity-facts-figures.service.gov.uk/culture-and-community/transport/travel-by-distance-trips-type-of-transport-and-purpose/latest>

People living in peri-urban or rural areas

In the context of INDIMO this group represents all the people who encounter barriers to digital mobility services due to geographic conditions with poor access to transport infrastructure and/or to reliable digital network connections. In fact the overall digital connectivity, from the peri-urban areas towards rural areas the level of service tend to decline. This group not only includes those who permanently dwell in such areas, but also those who temporarily choose to live and/or work far from central areas for some reason.

It has to be noted that concerning needs and requirements there are differences among people living in peri-urban areas or rural areas. In terms of transport services peri-urban areas are usually poorly served by short-haul sharing mobility services and delivery services while accessibility to long-haul or mass-transit transport is quite accessible. Rural areas are poorly served by all transport services and the only available digital mobility services are mostly car-pooling services and route planners.

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Universidade NOVA de Lisboa, 2019. Implications of Mobility as a Service (MaaS) in Urban and Rural Environments: Emerging Research and Opportunities (page 145)

<https://www.igi-global.com/book/implications-mobility-service-maas-urban/233691>

Lower educated people

Lower educated people may encounter barriers using digital mobility services in terms of understanding both features and terminology. Digital mobility applications may use technical jargons related either to the transport domain or to the digital innovation world, hampering full comprehension. Without appropriate guidance, complex procedures, long legal documentation and tricky gestures constitute barriers to people with a lower level of education.

As a corollary in Europe the average level of education is lower among people with lower economic conditions, minorities and women. Such fact may be linked with the insufficient support to equal access to education services. A lower level of education is one of the factors influencing the use of digital technologies, especially among older adults.

If coupled with low-digital skills, people belonging to this group hardly keep-up with the pace of new terminology related to technology and innovation, resulting in higher frustration when using digital services.

References:

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Lower income people

Lower income people not only have difficulties keeping pace with innovative products, such as last generation smartphones since they are too expensive for them. They may also have no access to cashless payment methods as they are not eligible for bank account and/or credit/debit cards.

Speaking about services offering individual or on-demand transport options, they are generally more expensive (€/km) than the public transport options. Applications are free of charge, yet the actual use oftentimes only allows for cashless payments. As an example, in areas where mass transit offer is poor or the person needs a car trunk, there are no affordable options.

It has to be mentioned that in most countries lower income people do not have equal access to education, fair living conditions and social participation. That makes it even more difficult for them to take advantage of digital mobility services.

References:

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_li01&lang=en

People lacking digital skills

People lacking digital skills are people who for any reason have low familiarity with the digital world. Such people are hardly aware of available services and, in some cases, they are only familiar with devices which are not powerful enough to run latest digital mobility applications. As a consequence, compared to digitally skilled people, they may have a more limited knowledge about the surrounding transport network, since physical wayfinding and signage are slowly disappearing everywhere (e.g. city maps, front offices, info points) while the amount of online information is increasing.

On average older people belong to this group, therefore they must rely on the support of more skilled members of their family, peers or community in order to use such services.

In the context of INDIMO, new digital mobility services should ensure information is easily accessible also to people belonging to this group.

References:

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<https://www.sciencedaily.com/releases/2018/03/180312091715.htm>

Non-connected people

Non-connected people include both – people who are temporarily or situationally excluded (e.g. device lost), people who use digital technologies but do not carry smartphones, people who for same reason have no internet connection even though they carry a smartphone and people who are unwilling or unable to use digital technologies.

On-site information access points (touchscreens, displays) in transport hubs or human support for shared mobility can in part mitigate the barriers these people

face when they wish to use such services. Yet it may not be enough since the service itself should take care of diverse needs and skills: except those unwilling to use digital services at all, all others will be involved in the INDIMO research in order to identify their needs.

References:

https://en.unesco.org/sites/default/files/internet_universality_indicators_print.pdf

Women

Due to a persisting lack of interest in gender issues, the mobility services are not designed with a gender-inclusive approach. Literature confirms that in Europe, women use public transport more than men. This is mostly due to the economic gap resulting from women's primary care role and the impact this has on employment and socio-economic conditions.

Women as passengers of public transport have diverse needs regarding safety, security and comfort. Certain transit environments are rather avoided and frequently travel patterns change, in order to protect their own safety. Studies confirm that the majority of women have been exposed to different degrees of sexual harassment, other forms of unwelcome behaviour or ultimately physical aggression while using public transport services. This causes economic and social harm, thus inequality.

Women's mobility choices are more complex, often related to carrying luggage or accompanying other people (children, PRMs, elders).

Other differences concern, for example, the value given to travelling time: when possible it is used to perform small tasks and if under pressure, journeys can be considered as preparation time or used to organize personal life. As final consideration, for employed women, as for all people going to work, appearance is crucial: wearing business suits or heels can prevent taking in consideration active mobility as an option.

To this day, improving mobility is often equated with improving automobility - not the mobility of all people. These are issues INDIMO wants to address. In the INDIMO project work-life balance questions will be considered from a gender perspective, including cross-barriers such as religious and cultural habits. Involving women from different socio-cultural backgrounds will help to develop digital mobility services and facilitate a more equal transport offer.

References:

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Caregivers

Care-giving activities and household-related journeys are under-evaluated by mobility planners and transport service providers. They involve not only women, but also men in helping other family or community members. As a reference term, according to Eurostat up to 25.8% of EU individuals working part-time suggest ‘child and adult care reasons’ as motivating their decisions.

The strategic design of digital mobility services is traditionally based on full-time work commutes only and multiple stop-overs are scarcely considered by most digital route-planning applications.

INDIMO will consider the daily mobility needs people who are in charge of caring tasks implying chained journeys (i.e. accompanying children and/or older adults, health care purposes, daily food shopping or “key life services” in general, that include trips to the supermarket, drugstore, family doctor, etc.). INDIMO will also support the development of digital and decision-making tools that facilitate this kind of mobility, which represents 40% of trip purposes worldwide.

References:

<https://www.eurofound.europa.eu/publications/report/2004/part-time-work-in-europe>

People with reduced

This group includes every person whose mobility in transport is reduced due to any kind of impairment. Each impairment – be it temporary or permanent, physical,



mobility (PRM) / People with reduced vision

sensory, visual or cognitive – influences how the person interacts with the physical or digital context.

Depending on the severity of their condition, people with reduced mobility (PRM) may use public transportation in autonomy or with some kind of aid (a person or a device). In both cases, a higher level of guidance is needed to provide impaired people with appropriate information and access (low-floor vehicles, in-level access to stations, high-contrast screens, etc.), according to all special needs.

INDIMO will focus on multi-channeled messages, since depending on the specific condition or impairment people belonging to this group are excluded from mainstreamed information (e.g. visually impaired people cannot read visual-only maps).

Effective real-time information services (about traffic, public transport disruptions and infrastructure conditions) is paramount for PRMs, as they seldom travel alone to unfamiliar destinations. Currently such destinations are only reached if someone can assist and inform them about the specific context, offer support when barriers appear (physical or digital) and help identifying alternative itineraries. As an example in case of rerouting, PRM people have a very narrow set of choices, compared to most transport users. Digital solutions, despite being extremely cheaper to adapt than physical infrastructures, rarely offer specific support in this sense.

Caregivers should also be involved in the design of such specific solutions, since they are often those who help PRMs to overcome barriers, also with digital applications.

References:

<https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html>

Socially isolated people

This group includes all those people who, for any reason, live an objective situation of absence of social relations and contact with others. Social isolation can lead to loneliness and vice versa. They are different but related concepts and they may occur at the same time.

Loneliness is an important influence on quality of life. It concerns the discrepancy between the social relations a person has and those he or she would like to have. This discrepancy may tell of the number of relationships or the intimacy of the relationships.

According to the literature, loneliness consists of two main dimensions, social and emotional. In the INDIMO project, the focus is on social loneliness, a concept that can vary across different life stages, social groups, cultures and historical periods.

It refers to the absence of an acceptable social network, that is, a wider circle of friends and acquaintances that can provide a sense of belonging, of companionship and of being a member of a community.

With a limited access to mobility services – because of socio-economical, cultural, or physical reasons – a social participation is hardly possible. In the context of the INDIMO project the specific needs of people belonging to this group will be addressed and digital mobility and delivery services solutions to mitigate isolation will be identified.

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Covid-19 confined people

Since beginning of year 2020 and for all the duration of the pandemic situation created by the COVID-19 outbreak, people belonging to this group are affected by mobility restrictions imposed by governments and health authorities to preserve public health and prevent infection.

The Covid 19 confined group of people includes people with none or reduced number of daily trips allowed out of home. Confinement due to COVID-19 restrictions distinguishes between isolation (separates sick people with a contagious disease from people who are not sick) and quarantine (separates and restricts the movement of people who were exposed to a contagious disease).

In the context of the INDIMO project the specific needs of people belonging to this group will be addressed and digital delivery solutions to mitigate the negative impacts of being confined will be identified. Concretely, when one contangoed person lives alone and cannot go out, s/he may need a care giver's support for her/his basic needs (i.e., food and medicaments, shopping and waste disposal). However, when the contangoed person is living with other family members, the support needed for respecting quarantine rules is potentially increased. Digital Delivery Solutions have become essential to maintain acceptable living standards during pandemic time.

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<https://www.eurofound.europa.eu/data/covid-19>

<https://ourarchive.otago.ac.nz/handle/10523/2367>

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<https://www.sciencedirect.com/science/article/pii/S0743016716306799#bib4>

Annex A2. Current European Legislation

The **European Accessibility Act (EAA)** previously mentioned aims at the “proper functioning of the internal market by approximating laws, regulations and administrative provisions of the Member States as regards accessibility requirements for certain products and services by, in particular, eliminating and preventing barriers to the free movement of certain accessible products and services arising from divergent accessibility requirements in the Member States”. It came into force on 27 June 2019. It offers a definition of people with disabilities in accordance with the definition of the UNCRPD including any person who has otherwise long-term physical, mental, intellectual or sensory impairment(s) which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with other persons. The document also mentions other type of people whose special needs should be considered: the persons who experience functional limitations, such as elderly persons, pregnant women or persons travelling with luggage, would also benefit from this Directive.

The EAA aims at establishing baselines for accessibility requirements, establishing clear-cut obligations for operators and manufacturers with regards to the design with accessibility criteria. The document includes a conformity assessment, which enables the operators and manufacturers to check compliance item by item. The conformity check is also extended to importers, according to the article 9 of the EAA, and to distributors, following the article 10. The regulation calls for fulfilling a declaration of conformity, establishing responsibility for compliance, and penalties for non-compliance. The document also contains indications about labelling the products for identification, requirements on instructions for use and safety information and prescriptions about keeping the technical documents.

From a regulatory perspective, the document is strongly determined to achieve the harmonization of standards that will enhance the operation of an internal market in the European Union. The Commission will, following the Article 10 of Regulation (EU) No 1025/2012, request one or more European standardization organizations to draft harmonized standards for the product accessibility requirements established in Annex I. The Commission will submit the first such draft request to the relevant committee by 28 June 2021.

The benefits of harmonizing accessibility requirements for the internal market have been demonstrated by the application of Directive 2014/33/EU of the European Parliament and of the Council regarding lifts and Regulation (EC) No 661/2009 of the European Parliament and of the Council in the area of transport.

Certain elements of the accessibility requirements, in particular regarding the provision of information as established in this Directive, are already covered by existing Union law in the field of passenger transport. This includes elements of Regulation (EC) No 261/2004 of the European Parliament and of the Council, Regulation (EC) No 1107/2006 of the European Parliament and of the Council, Regulation (EC) No 1371/2007 of the European

Parliament and of the Council, Regulation (EU) No 1177/2010 of the European Parliament and of the Council and Regulation (EU) No 181/2011 of the European Parliament and of the Council. This includes also relevant acts adopted on the basis of Directive 2008/57/EC of the European Parliament and of the Council. The mentioned regulation is also confirmed and strengthened by Directive (EU) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of the websites and mobile applications of public sector bodies.

These guides were provided to emphasize the use of accessible technical solutions. Different impairment types and levels are managed allowing developers to implement elements accordingly. However, the first guideline was published in 2009 and information technology changed entirely in the direction of touch-screen smartphones, so developers of digital mobility and delivery solutions face new challenges.

The EAA document presents the different requirements for the services classified according to several dimensions relevant for manufacturers, operators and users. Regarding the provision of information, it established the requirements of designing for more than one sensory channel; taking care of the size and characteristics of the fonts and shapes and with adjustable spacing. Flexible ways of improving vision clarity should be provided.

It recommends to provide understandable instructions and an accessible user interface. It strengthens the previous aspect pointing at the alternatives for speech, flexible magnification for people with reduced vision, brightness and contrast for a different level of visual limitations. It indicates that, when colours are meaningfully indicative of functions or notices, alternative colours should be used. It also suggests auditive signals to convey information and, when audio is included, ensuring the user's control over volume and speed.

A close background of the present UDM-V1 is the **Guidelines for Accessible Information**, developed in 2015 by the European Agency for Special Needs and Inclusive Education (2015). The Guidelines for accessible information are an open educational resource (OER) to assist on the elaboration of accessible information in general and for educational purposes in particular. These Guidelines are not aiming at covering all available information on accessibility or reach to every aspect of the domain, but to work as a summary to existing and useful resources which can be helpful for those who are not experts in ICT (information and communications technologies). They define accessibility following the 9th Article of the United Nations Convention on the Rights of Persons with Disabilities as:

“... appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas”. (United Nations, 2006, p. 8).

The document covers the different topics in two steps that are divided each in different sections. Step 1 is about making different types of information accessible. In the first section, the accessibility of the text is defined as the easiness of navigation around the text. It should be easy for everyone to navigate, including those using assistive technologies. It has to enable different users to transfer the text to different formats. Even when a text present charts, captions and headers, it should be easily translated to screen readers or other assistive technology. A list of action to make the text universally easy to navigate is provided.

The second section of this document refers to making the images more accessible, implying that the images have to be useful for all users, which implies that the visual input has to be exposed with an additional description of the information. It refers to image avoidance (every time there could be only text, which facilitates the adjustment to external readers), provide image alternatives, use contrast and image alternatives, and allow for scalable and adjustable size of online images.

The third section of the guidelines refer as how to make the audio accessible, which means that it is supplied in combination with other types of information, such as text, or replaced by a sign language video. This section covers aspects of volume control, visual equivalents, keyboard-accessible operators and other meaningful aspects. The fourth section is about making the video accessible, by means of close captions containing dialogues and accessory important information.

The second step deals with making the delivery of media accessible. First, it provides requirements for the electronic documents to be accessible, offering accessibility tools, and ensuring that documents are created in an accessible format, which implies tagging, code language of the document, use of up-to-date versions of the software and other items. The second section of the second step focus on the turning online resources accessible, through the compliance of the Web Content Accessibility Guidelines (WCAG 2.0). Section 3 is about the accessibility of the printed material, which is not directly connected to the present UDM-V1. Finally, there is a compliance checklist designed for practitioners to apply the specifications of the guidelines to different media and specific formats.

Another relevant set of guidelines, as regulatory background of the present UDM-V1, is **Buying social, a Guide to Taking Account of Social Considerations in Public Procurement**. These are the guidelines of the European Commission for public procurement (2011), that have been recently published. Under the **2014 Public Procurement Directives**, a previous document, member states may reserve the right to participate in procurement procedures for sheltered workshops and economic operators whose main aim is the social and professional integration of persons with disabilities or disadvantaged persons. It is also possible to provide for contracts to be performed in the context of structured and stable sheltered employment programmes. To benefit from the reservation, at least 30% of the employees of those workshops, economic operators or sheltered employment programmes must be persons with disabilities or disadvantaged.

When implementing the Directives, the United Nations Convention on the Rights of Persons with Disabilities (2006) should be taken into account, in particular in connection

with the choice of means of communications, technical specifications, award criteria and contract performance conditions (Preamble 3.) The directive also provides that “for all procurement which is intended for use by natural persons, whether general public or staff of the contracting authority, the technical specifications shall, except in duly justified cases, be drawn up so as to take into account accessibility criteria for persons with disabilities or design for all users”. (Article 42.). This section is based on the Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC.

What is meant by a person with disabilities or a disadvantaged person in the Directives? While the exact definition will depend on the member state(s) who decided to act under EU provisions on reserved contracts, and thus will be reflected in national law, they start defining the category of person with disability. Persons with disabilities in accordance with the UNCRPD include any person who has otherwise long-term physical, mental, intellectual or sensory impairment(s) which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with other persons.

The document **Buying social, a Guide to Taking Account of Social Considerations in Public Procurement** refers to the concept of Socially Responsible Public Procurement (SRPP) whose objective is to have a positive impact on society through the goods, services and works purchased by the public sector. It recognizes that public purchasers are not just interested in buying at the lowest possible price, or best value for money, but ensuring that procurement achieves social benefits. According to the document SRPP must be carried out in compliance with the 2014 Public procurement directives but also in compliance of the UN Convention on the Rights of Persons with Disabilities (UNCRPD). The document states that SRPP can be a driver towards social participation and employment opportunities for persons with disabilities, including through inclusive and accessible work environments.

This guideline document has a specific title devoted to “Accessibility and design for all”. It states there that goods, services and works contracted by the public sector should be accessible for all, including persons with disabilities. This is a key aspect of the SRPP and is compulsory in public hiring. This accessibility criteria for persons with disabilities is regarded in the Article 42 of the Directive 2014/24/EU and Article 60(1) of Directive 2014/25/EU. This section of the document is a call to actively engage in decision-making process and involve all the stakeholders and participants in the supply chain to ensure the optimal conditions for the usability of all characteristics of people. It is required monitoring and supplier engagement to achieve the goals of social and professional inclusion. The accessibility must be dealt with in technical specifications. Stimuli may be awarded for those proposing higher standards of accessibility than those requested in the technical specifications. Performance clauses may also be added to ensure that the services supplied are executed in a way that makes its results accessible.

In 2015, the European Telecommunications Standards Institute came out with a document/report “**Accessibility requirements for public procurement of ICT products and services in Europe**”. The primary goal of this document is to produce a European Standard

“that sets out in a single source, detailed, practical and quantifiable functional accessibility requirements that take note of global initiatives in that field and which are applicable to all Information and Communication Technology (ICT) products and services identified in Phase I of the Mandate and usable in public procurement” (p.16). These standards cover the specific adaptations for a number of impairments (visual, hearing, vocal capability, manipulation or strength, photosensitive, limited reach, limited cognition among others) for both hardware, software and web products.

Annex A3. Design system guidelines for developers and UI/UX designers with detailed figures.

These guidelines will nourish the UDM V2 website including the hyperlinks to each developed example that could be consulted in a systematic way. In the following design guide, the functionalities considered, and the corresponding requirements were translated in practical terms, referring to a design example of a food delivery application. Nevertheless, all functionalities considered here can be adapted to any content or need of a digital mobility or delivery service.

The first part of the design guide has been made thinking in a flow of actions. However, there is a second part that has to be separated from the flow because there are functionalities that cannot be integrated into a delivery app flow (such as some functionalities related to mobility services). As an example of this kind of functionality we can use the image / scheme that shows the different ways of communicating the status of the traffic light: a) sound that differs from surroundings sound; b) sound and vibration from the mobile; c) dynamic poster that tells how much time is left for the pedestrian crossing. Instead of making a design of these three possibilities, it is suggested to activate the voice assistance to navigate in the app. Also, the indications for mobility services follow the same directions. The route feedback from other users could even be taken into account to give a better accompaniment.

In any case, the same style of boxes, buttons, typography and color palette should be respected.

On the other hand, it is important to bear in mind that, for the design of an app or web, it is necessary to use coherence and consistency throughout it; always considering already known patterns. The idea is to adapt functionalities to our needs, without the user having to re-learn how to use an app.

Given this, in the following pages we propose the basis of this design, a brief design system.

Buttons

A specific color is used for everything that can be clicked. If the button is disabled, opacity at 50% will be used. On screens where the user must complete information, the button remains inactive until the user fills the necessary information. In the case of main buttons (which are buttons that direct the user's action), you also have to give them a second option (a button with less priority). In this way, the user can choose their route.

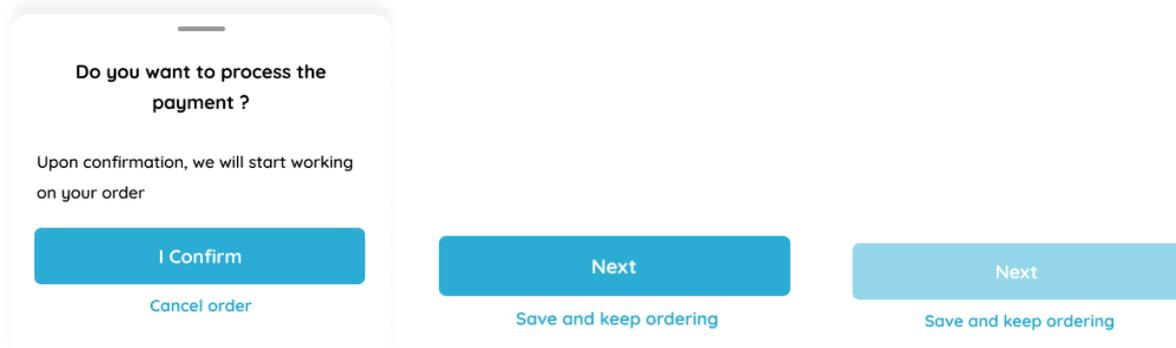


Figure 15. Design examples for buttons

Secondary button

In addition to the primary buttons, there are buttons that function as content selectors. In this case, it is played with the border of the button when it is active (with colored rim) or inactive.



Figure 16. Design examples for secondary buttons

Boxes

There are three different box styles that are used for each display. However, they follow the same logic in design. Based on these boxes, different variations are made depending on the functionality that is needed in each screen.



Figure 17. Design examples for boxes

Selectors

They are similar to boxes, but they have a selective or informative function within the app. This style is constantly used in the most common apps.

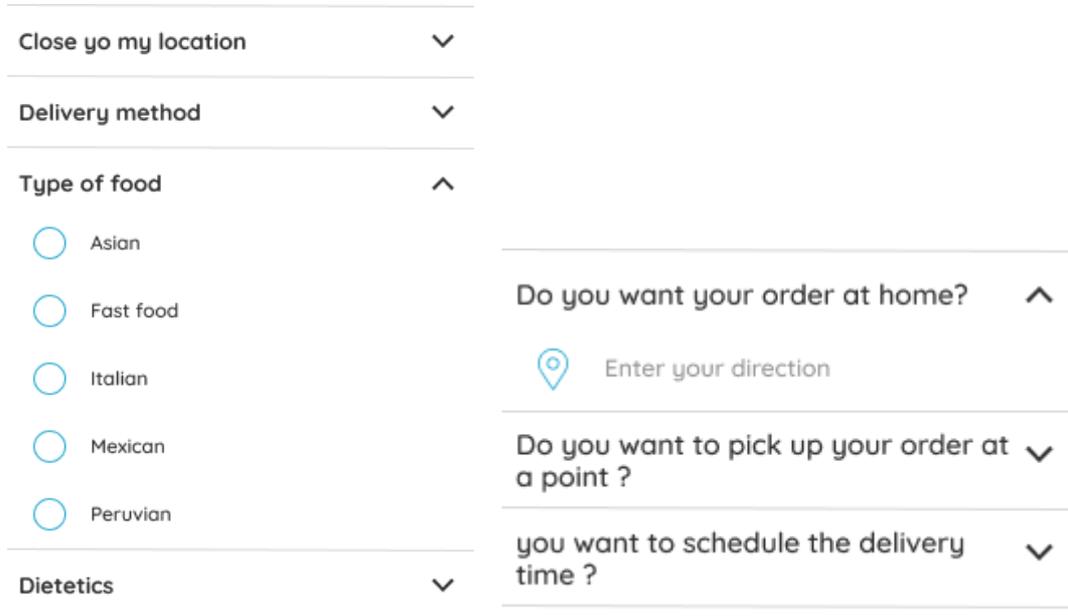


Figure 18. Design examples for selectors

Onboarding

Screens that show the onboarding of an app. In the example given, three main values of the app/service are highlighted to offer a value proposition to the user.

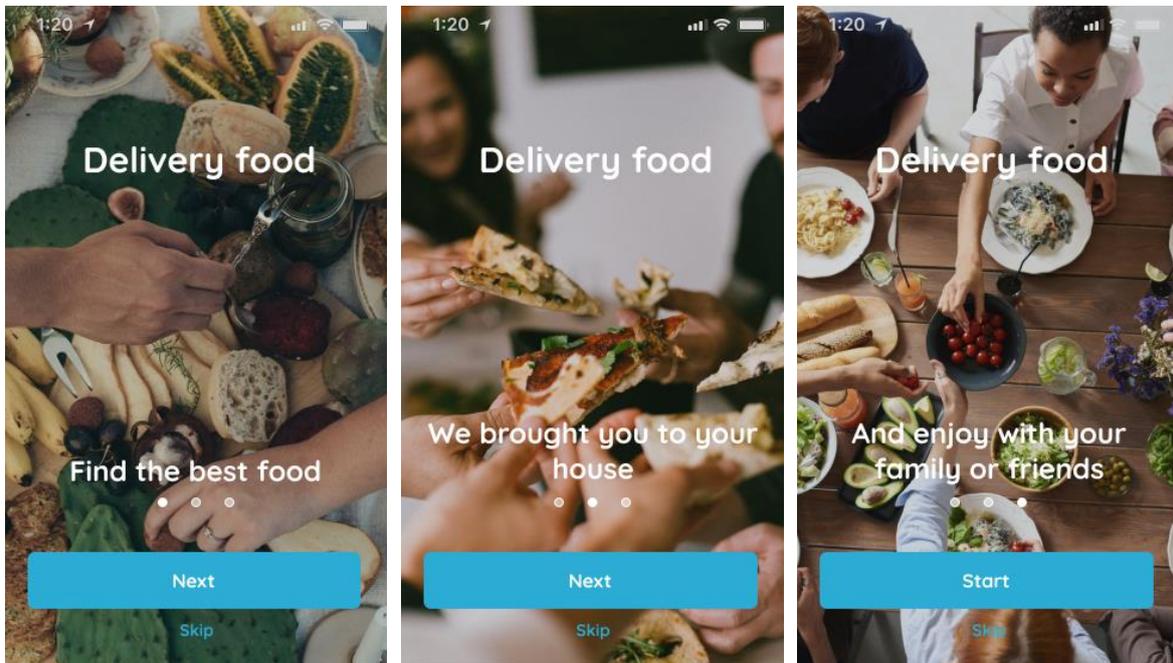


Figure 19. Design examples for onboarding screens

Registration

Sign Up

Registration screen. The user can choose the form of registration.

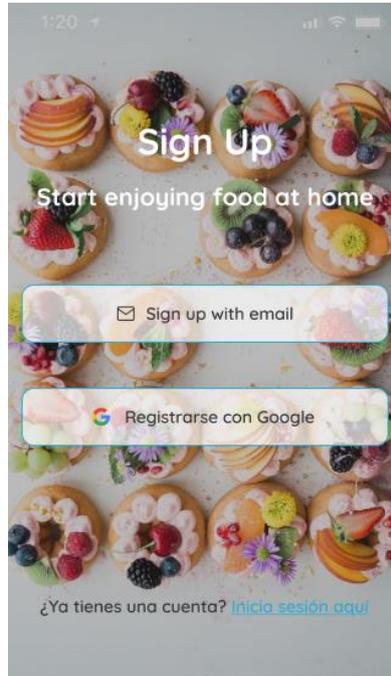


Figure 20. Design example for sign up screen

Choice of functionality

According to the needs of each app, questionnaire or functionalities selectors are added. In this case, the user is asked if they want to activate any of these options.

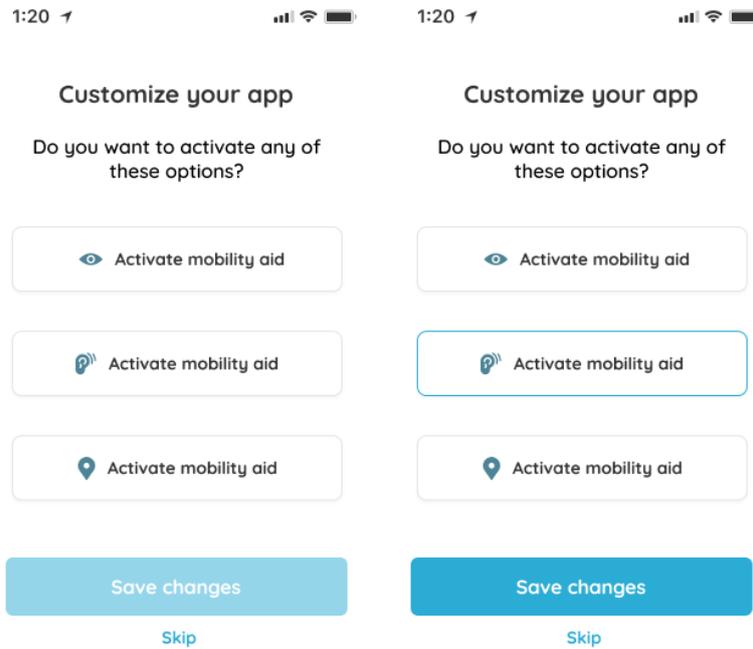


Figure 21. Design examples for choice of functionality

Tutorial

It is usually not used, but it can be included in an app where you want to teach the user a new logic.

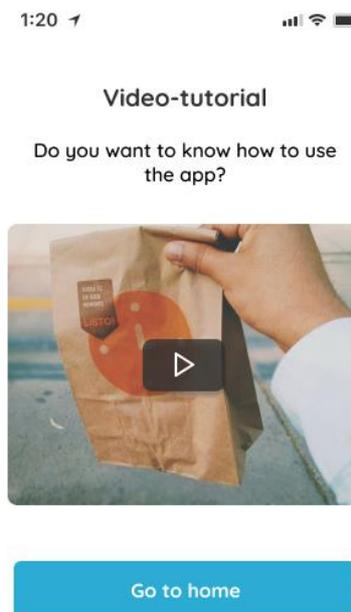


Figure 22. Design example for tutorial

Home

The home is the main screen when registering. It contains:

- **Menu:** a drop-down menu
- **Magnifier:** a full screen search
- **Hours of operation:** the user can close it if they want, but it is activated every time the user enters the app
- **Recommended Restaurants:** the criteria for filtering, it is seen in each app according to the user's priorities. They can be the most viewed options, the ones they want to enhance, etc.
- **Filters:** filter that the user can employ to select the type of recommendations
- **Contact:** so that the user has the possibility to establish a direct contact with the staff of the app

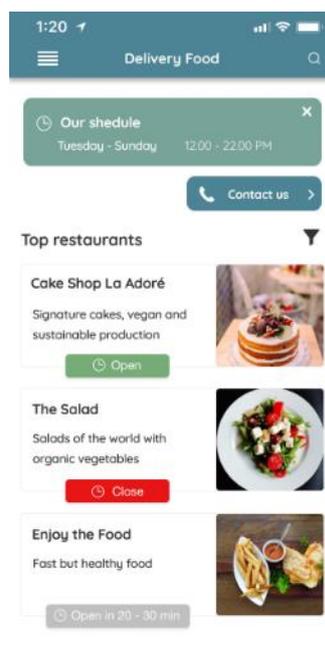


Figure 23. Design example for the home screen

Menu

Drop-down menu with the registered user and configuration options

In the case of the **Voice- assisted functionality:** works as a switch to activate or deactivate.

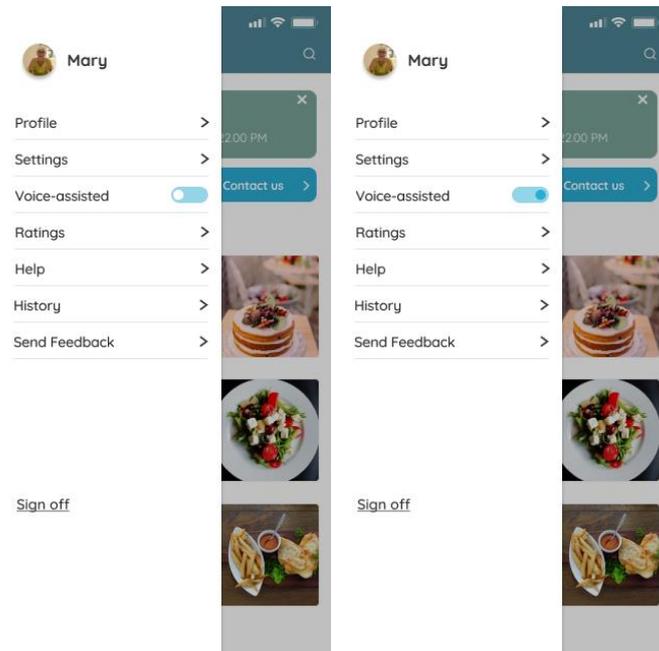


Figure 24. Design examples menu

Profile

Users will find here their information, which they can modify. When making any changes, the main button is activated so that the user can save the changes.

Users have two options to look at: their personal information and the preferred mode of payment.

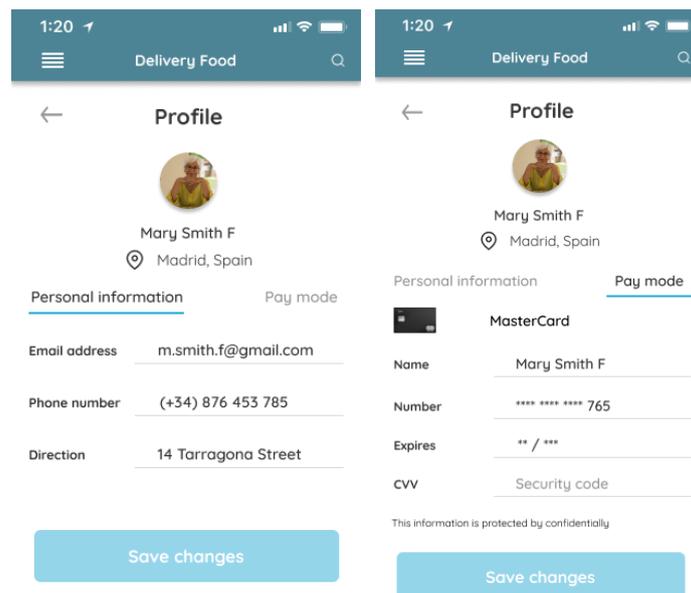


Figure 25. Design examples for profile

Configuration

In this case, the activation of two functionalities for the user are proposed: font size and contrast.

In both (as we have previously seen), functionalities work with selector boxes that are activated, shown by the bold rim when selected. On the other hand, we see an example of the main button deactivated and, when selecting an option, it changes to active.

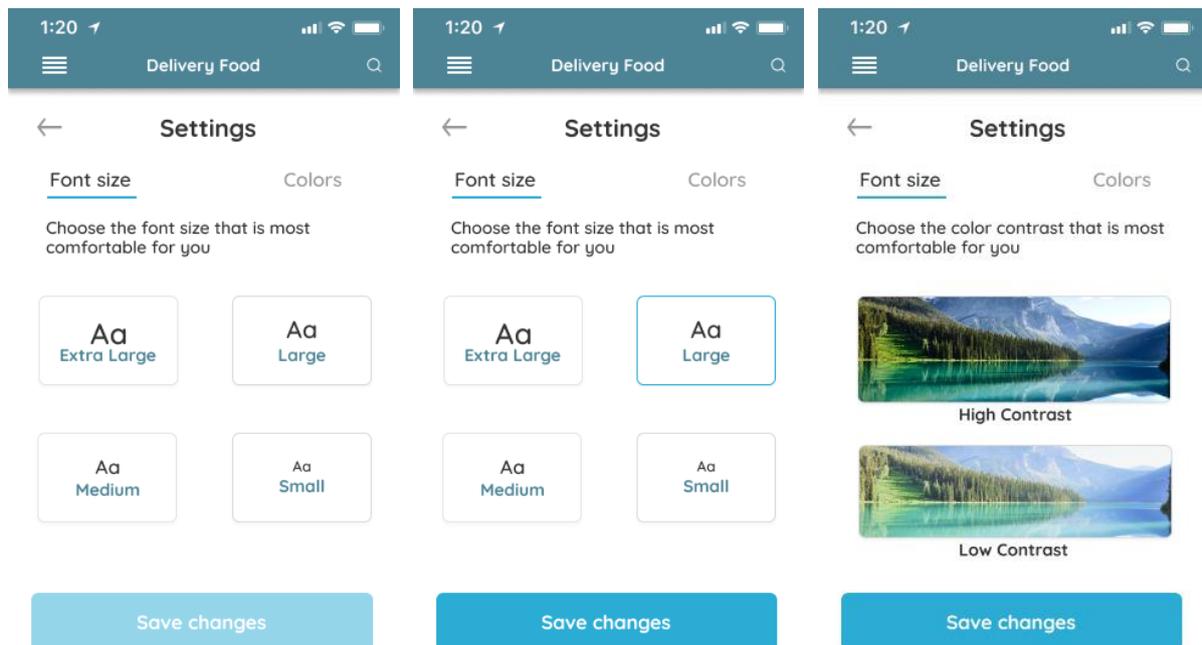


Figure 26. Design examples for configuration

Ratings + Feedback

Ratings

Record of the past comments made by the user within the app. It is useful for users to keep a record of their comments. If the user clicks on the box, they can go directly to a specific comment.

Feedback

General comments about the app that the user can send.

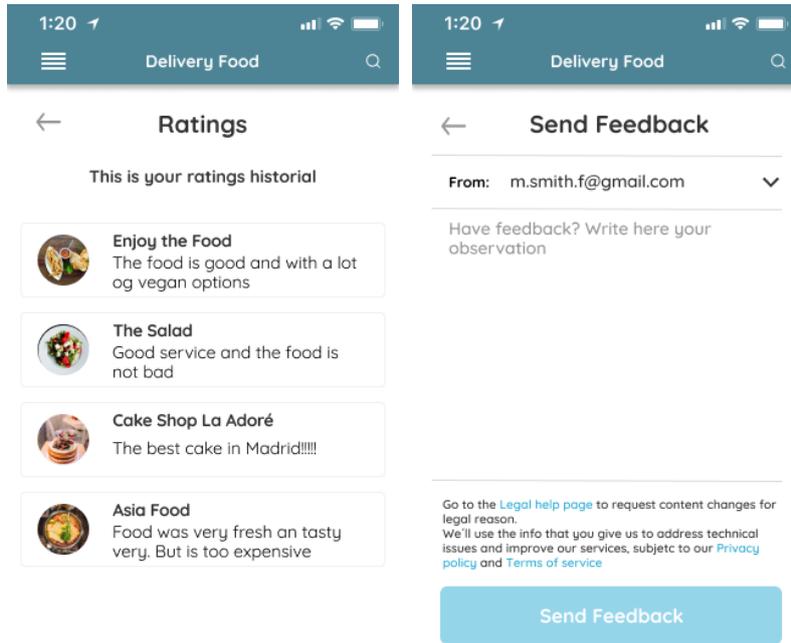


Figure 27. Design examples for ratings and feedbacks

Help

Frequently asked questions made by users, with drop-down format. The option to view all of them or search depending on the user’s need is also given.

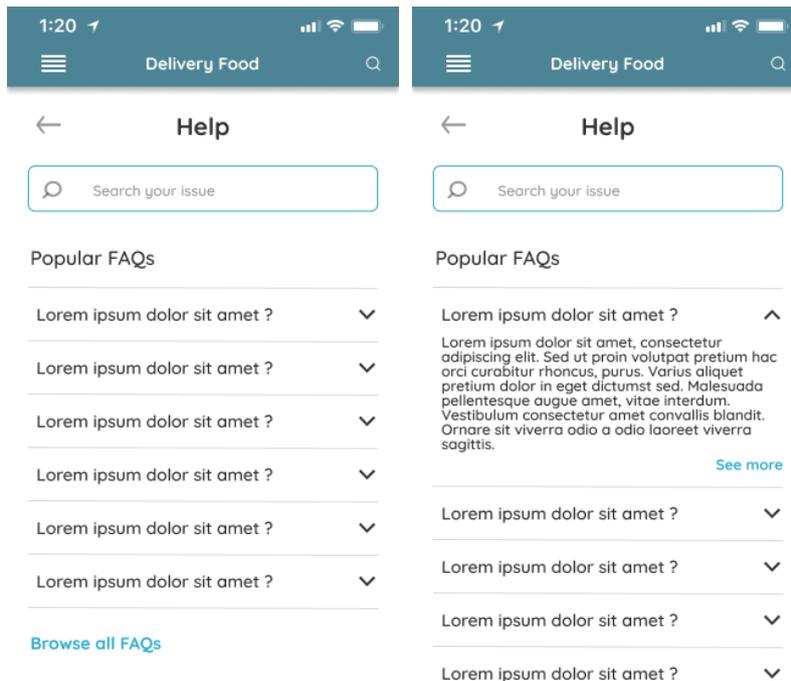


Figure 28. Design examples for help

Contact

On the home page, there is a "Contact us" button. By clicking on it, this screen is reached, with options for the user to contact or call the staff of the app.

Like other buttons in the app, when the user types the phone number, the send button is activated.

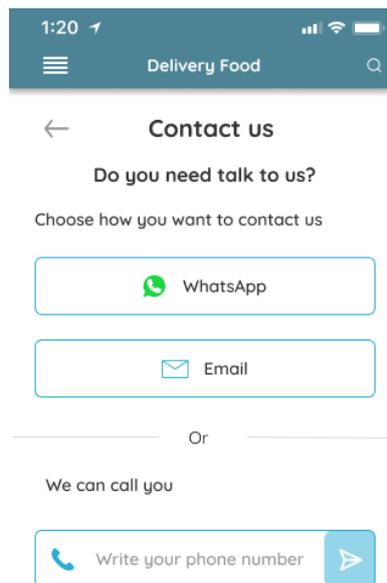


Figure 29. Design example for contact

Search

When you go to search, by clicking on the magnifying glass, the search engine appears in full screen with the last searches of the user.

When searching (as seen in the example), the contents are filtered depending on the letter or word that the user searches.

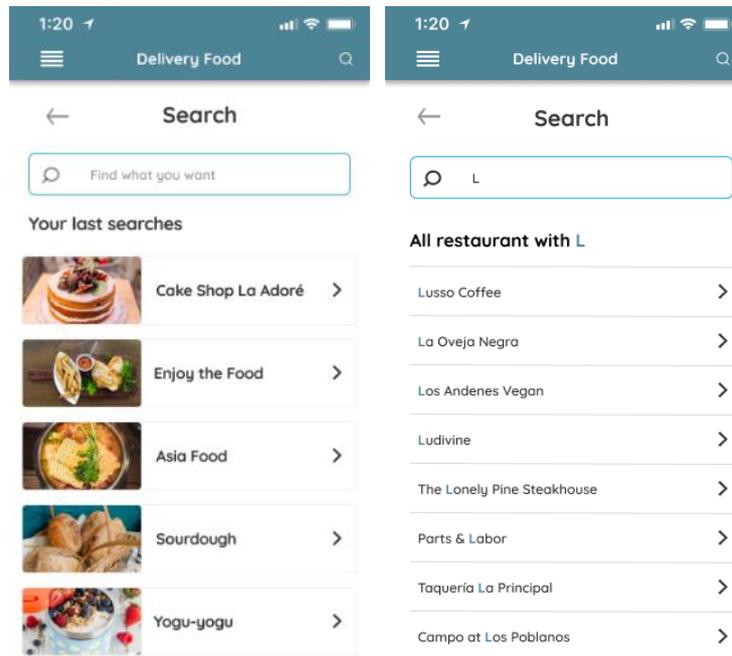


Figure 30. Design examples for search

Filters - General

The filters depend on each app and their type of service. In the case of a food delivery application, it is possible to include the type of filters that are shown.

In this example, the boxes are repeated, the difference between them is that a content selector is integrated.

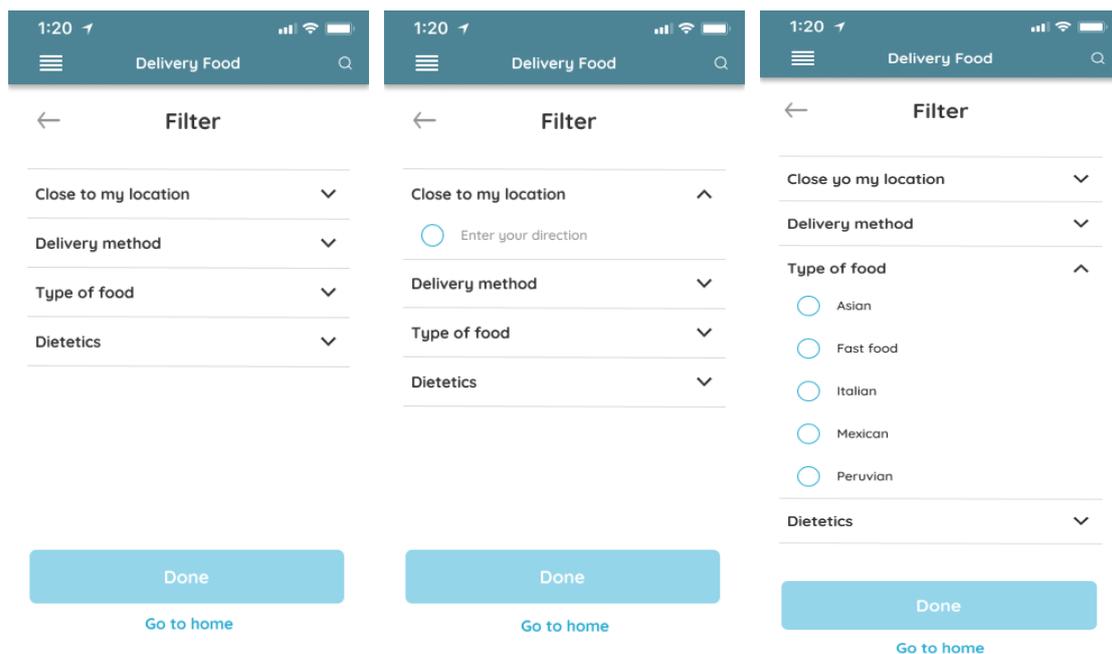


Figure 31. Design examples for filters - general

Filters - Flow

A flow is shown, in order to see how the filter selection behaves. In this case, the user has selected vegetarian food. The result is that the home page changes its format in restaurant recommendations. In these cases, “nomenclatures” can also be combined; for example: select a location and vegetarian, so the interface recommends content according to both filters.

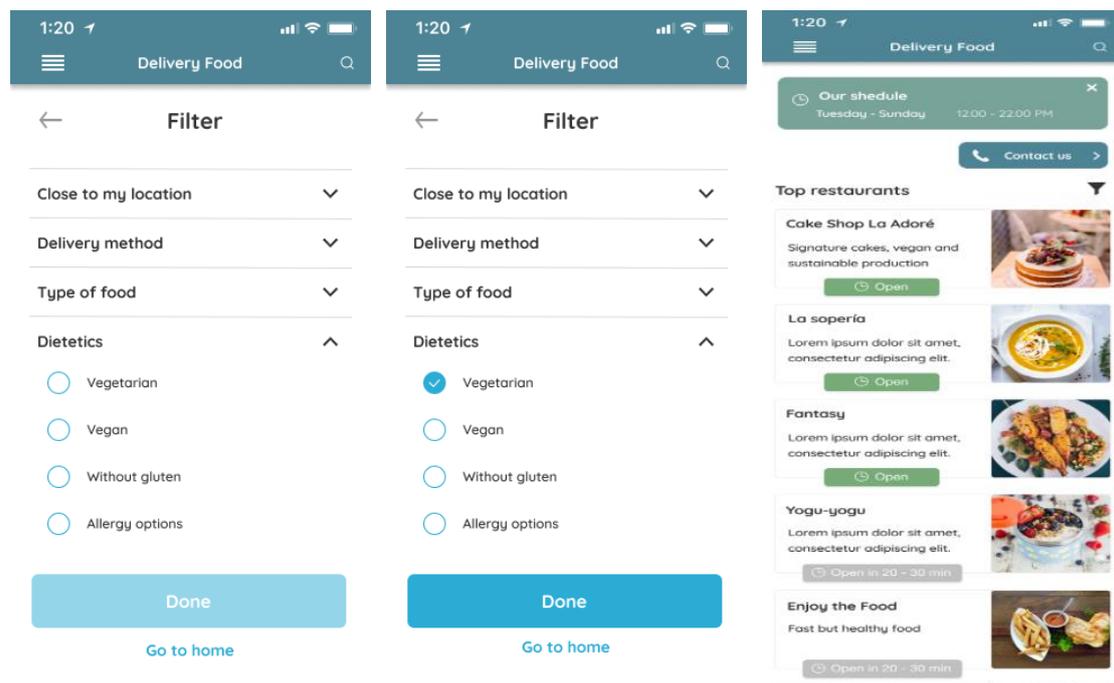


Figure 32. Design examples for filters - flow

Home restaurant + food

Home restaurant: each product has its home with its specific content. In this case, it contains the payment method, schedules and menu. In any case, comments can also be integrated at the end of the page so that the user can notify the app.

Food: before ordering the food, there is a page showing what has been selected. Here the user finds more details about the order, including a calculator.

If the user modifies the quantity of products, the price is consequently modified.

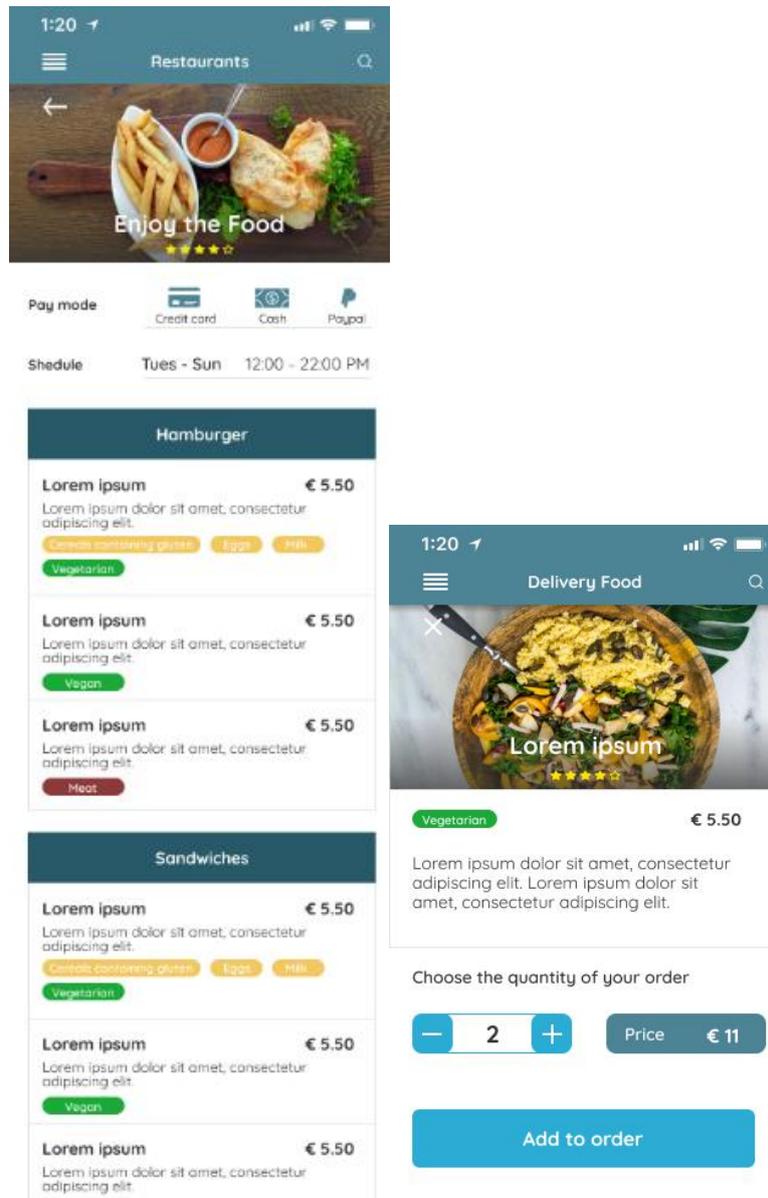


Figure 33. Design examples for home restaurant

Step 1 - Order food

In these screens we have the first step to order food. It contains the following functionalities:

Progress bar: it varies according to the step the user is at. It is only informative.

Content selector: as before, there are three drop-down options that the user can look at. This is done to tailor the user's order.

Buttons: the main one that is activated by selecting one or more options, which leads to the second step; and the second, which has the purpose of saving the order and exit.

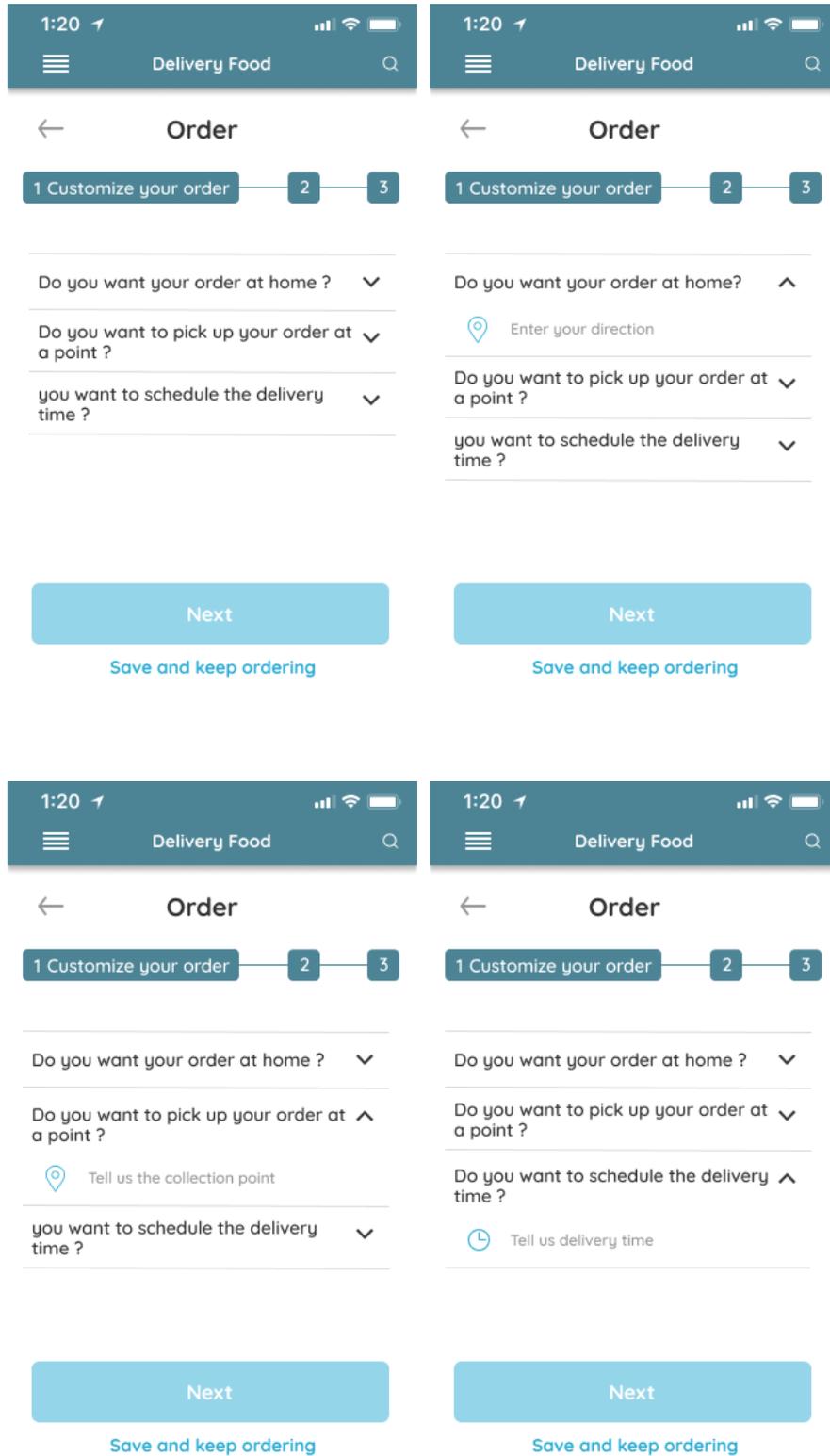


Figure 34. Design examples for step 1 – order food

Step 1 - Error correction flow

In this flow, we can see the detection of an error in the information provided by the user. Basically, an error message appears with the option to click on the box so that the information is automatically modified.

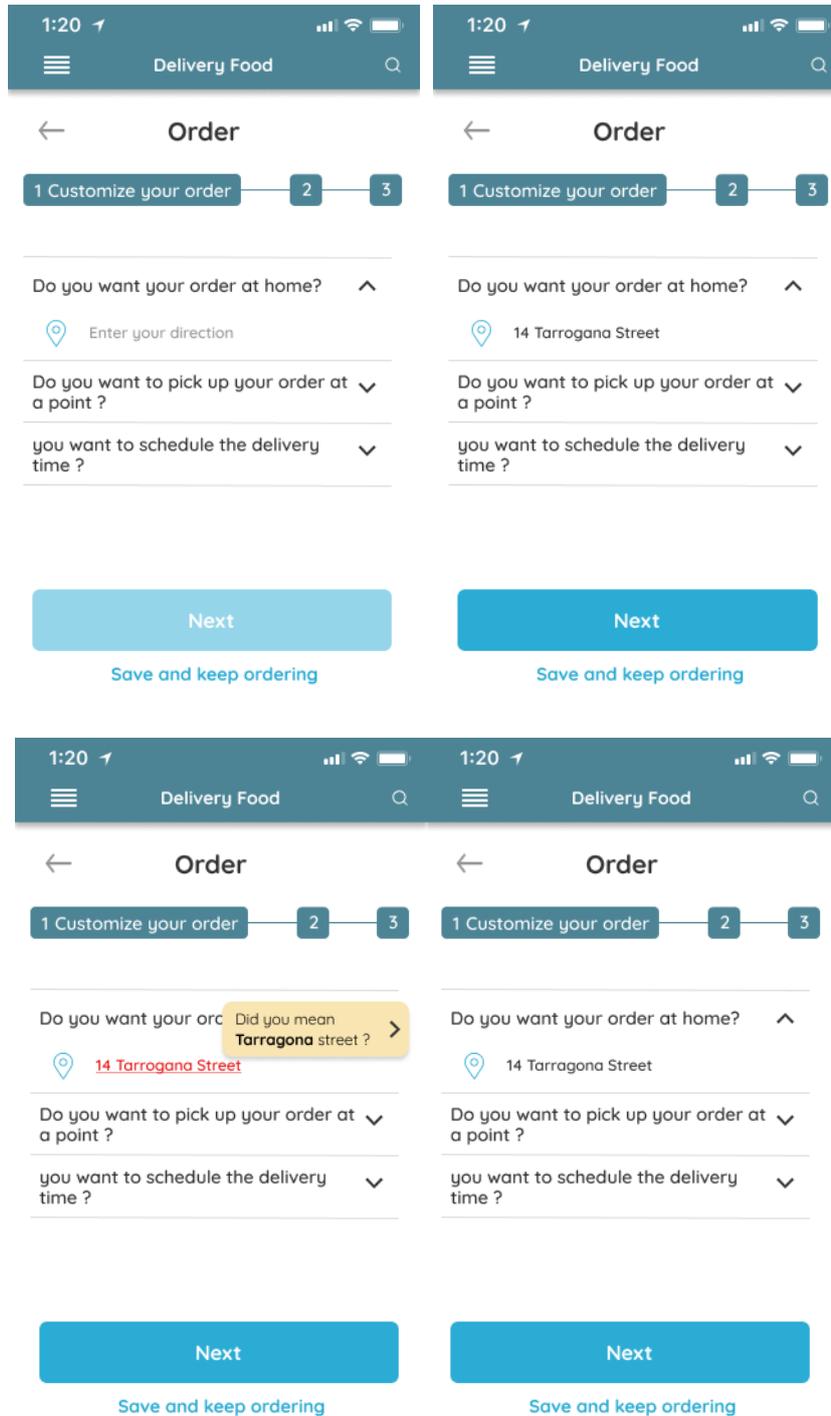


Figure 35. Design examples for step 1 – error correction

Step 2 - Purchase summary

Here is shown, in a simple and clear way, the screen before going to the payment of the purchase. It contains a first box with the summary of the product, the cost of delivery and the final price. If the user agrees with it, they can directly go to pay or leave.

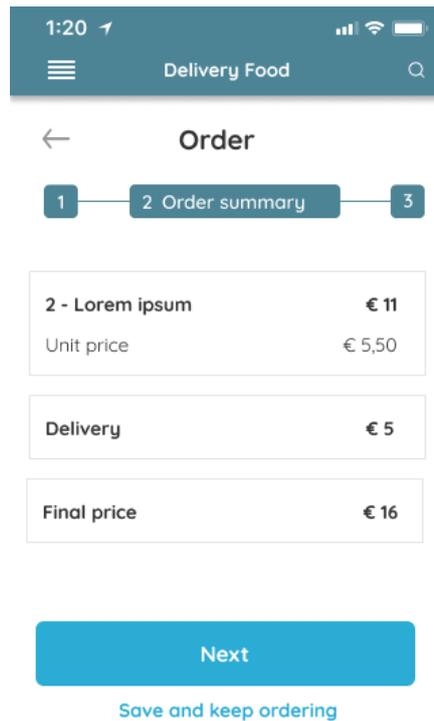


Figure 36. Design examples for step 2 – purchase summary

Step 3 - Payment of the purchase

Selection of the payment method. Although the user's card is found, they can also pay in other ways. The user just has to select the preferred option and confirm the payment. It is already processed to begin with the delivery of the order.

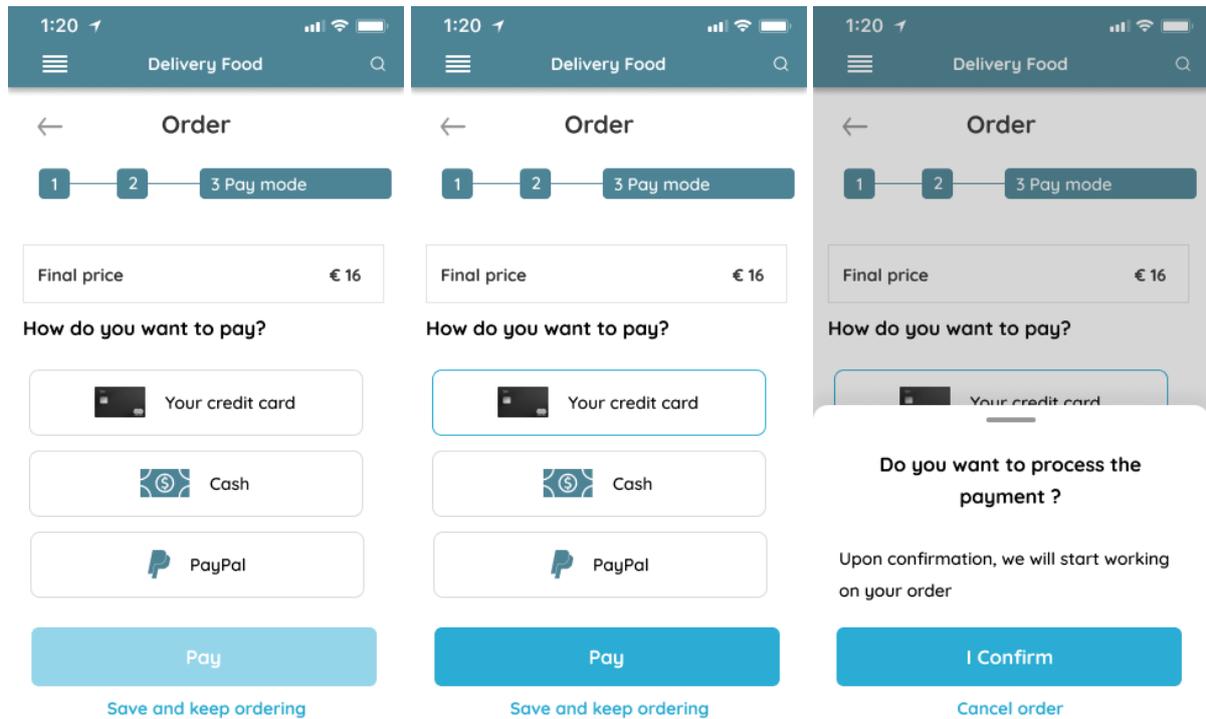


Figure 37. Design examples for payment of the purchase

Order tracking

Once the payment has been processed, the option appears in the app to follow in real time the arrival of the order.

After tracking, you can see the remaining time and the estimated time of arrival. In the case, that the user does not want to see the process, it can also be programmed to trigger a notification that their order will arrive soon.

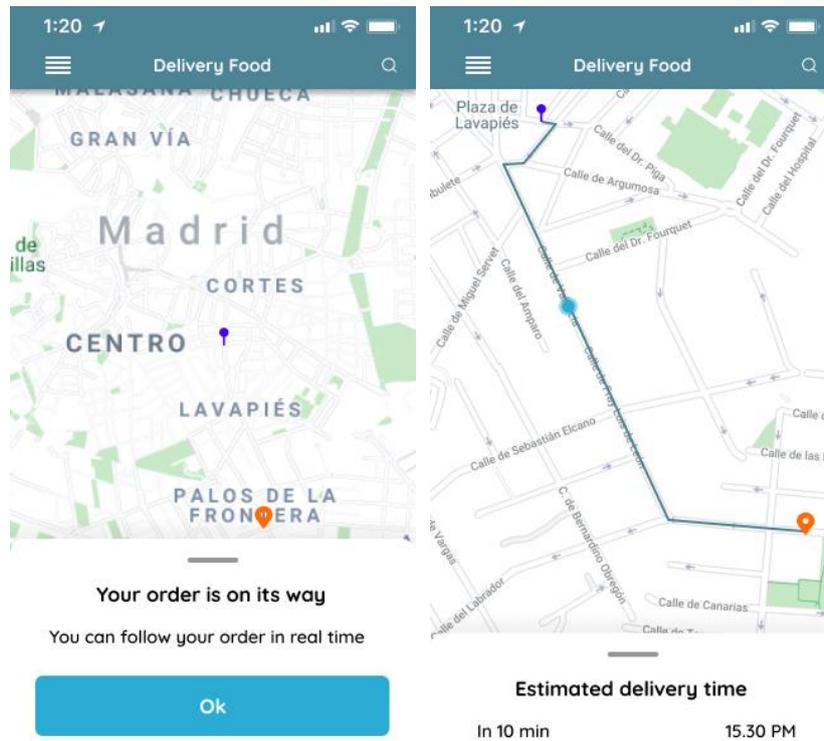


Figure 38. Design examples for order tracking

Service rating

Once the order has been received, the user can provide a rating, which is saved in the record found in the menu.

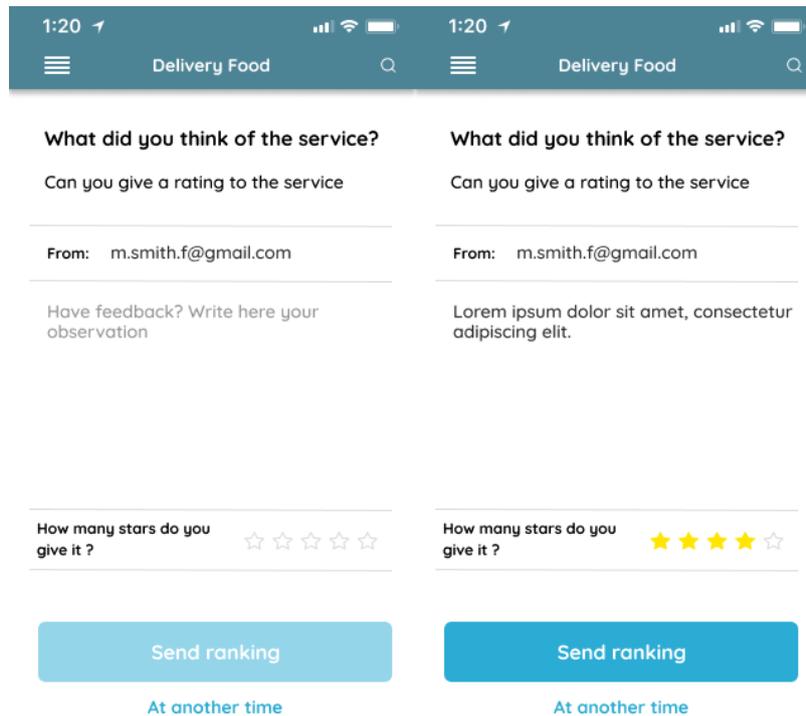


Figure 39. Design examples for service rating

Location of points on the map

You can see 3 different points so that the rider / driver can locate himself.

In the case of profiles dedicated to driver / rider, it would be good to recommend routes to reach the destination in the same app. The example shown is Google Maps style (but it is just an option)



Figure 40. Design examples for location on points on the map

Alternative location name

Tagging with the official name could be more straightforward for programming. But the designers can generate functionalities for users to suggest and write the alternative names of a street.

Two examples are given.

- 1 The user can directly type the alternative name
- 2 When searching for the place, a notice appears where the user can type the alternative name of the site.

With that information, the alternative name or both the alternative and the official could be programmed.

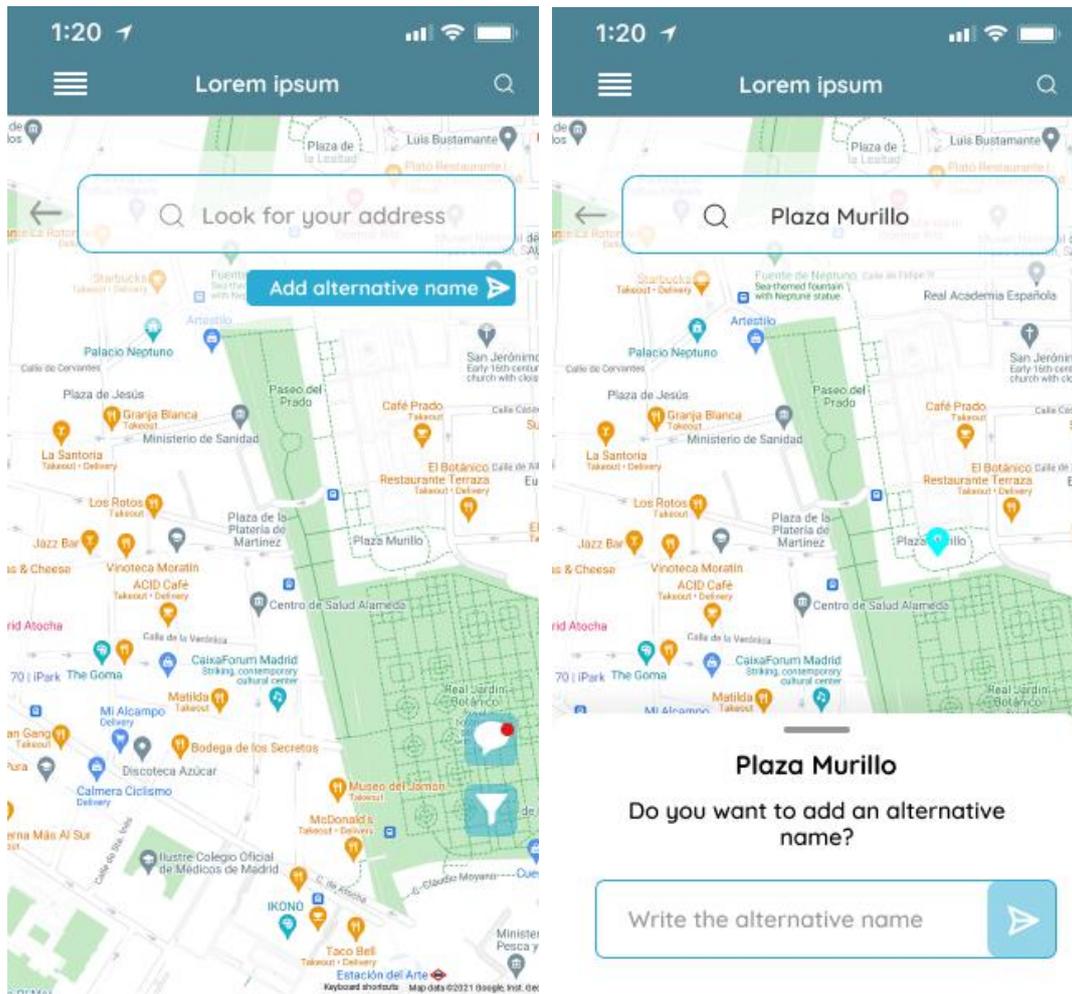


Figure 41. Design examples for alternative location name

Map filters

On the map, there is a floating button with a filter. From there the user can go directly to configure the vision filters on the map. Once the configuration is done, the points indicated on the map change and the configuration is saved until the user decides to modify the filters again.

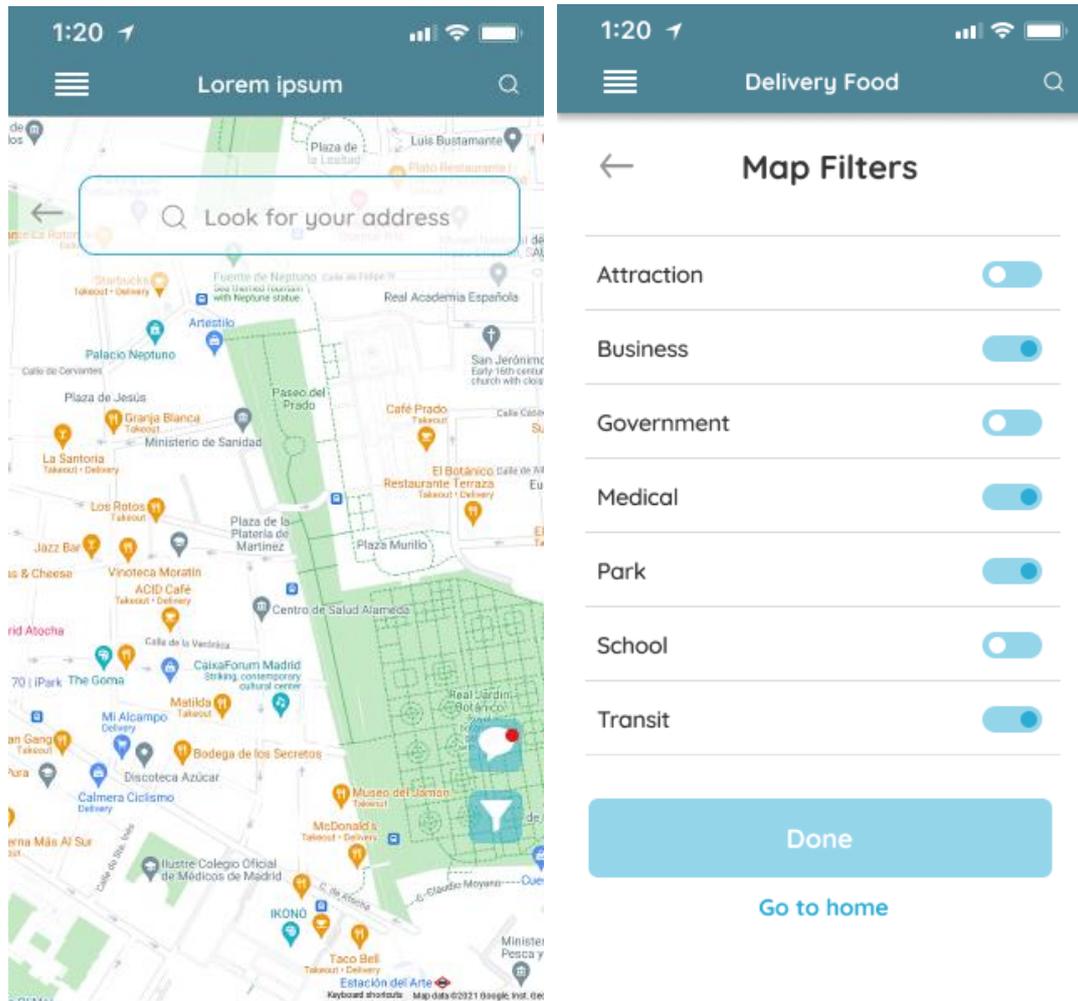


Figure 42. Design examples for map filters

Travel reservation

In this flow we have the process of booking a trip. It contains the following functionalities:

Reservation: The user has to answer some questions to book their trip. When selecting the accompaniment option, the option to write the needs of your traveling peer is activated; it is optional.

Trip confirmation, instance 1: when a trip already has passengers at the time of booking, the user is notified who are traveling with in order to confirm (like screen 3)

Trip confirmation, instance 2: once it is already booked (generally this notification occurs when the trip is ready after booking)

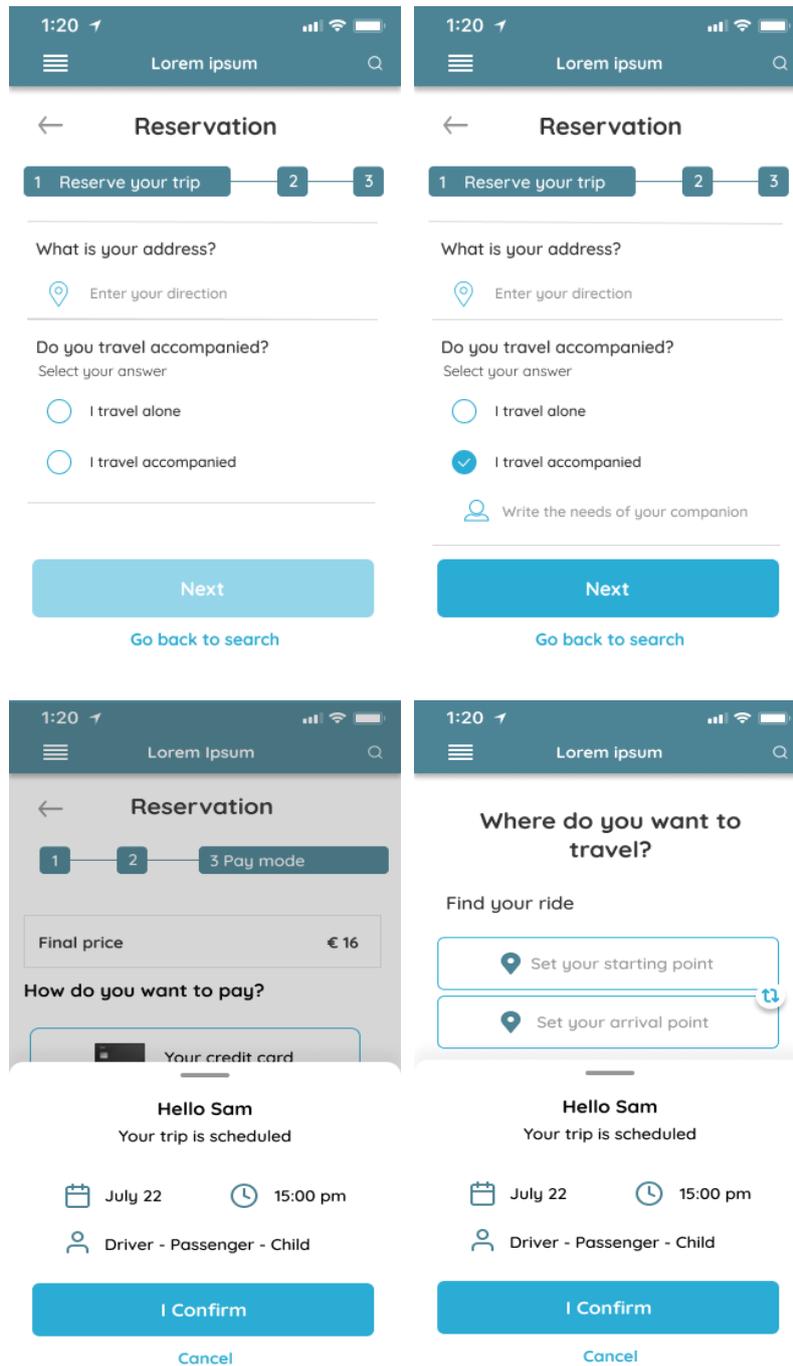
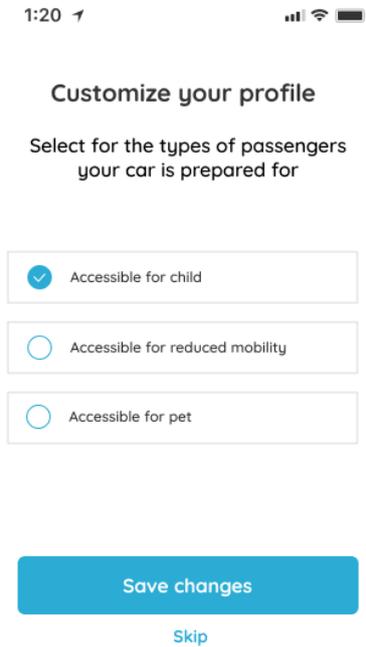


Figure 43. Design examples for travel reservation

Driver registration - questionnaire

At registration, it is asked for what kind of passengers the driver has the car prepared for. This can be seen later in the driver's profile, as can the information about his car.

It can also integrate the format of the previous point (user selects who is accompanied and the driver accepts).



1:20    

Customize your profile

Select for the types of passengers
your car is prepared for

Accessible for child

Accessible for reduced mobility

Accessible for pet

Save changes

[Skip](#)

Figure 44. Design examples for driver registration

Comments - Comment filter

In this flow we have the process of viewing and filtering comments. It contains the following functionalities:

Floating comment button: There is a floating comment button, which is activated every time there is a new comment.

Comments: All the comments given by others of the route that the user will make. The type of comments and their modification, depending on the part of the journey in which the user is, is made by programming (e.g. Waze could be a reference). With this information, you can complement the instructions that will be given to people who need assistance.

Filters: A filter is added in the comments part, in which the user can choose the desired type of comments.

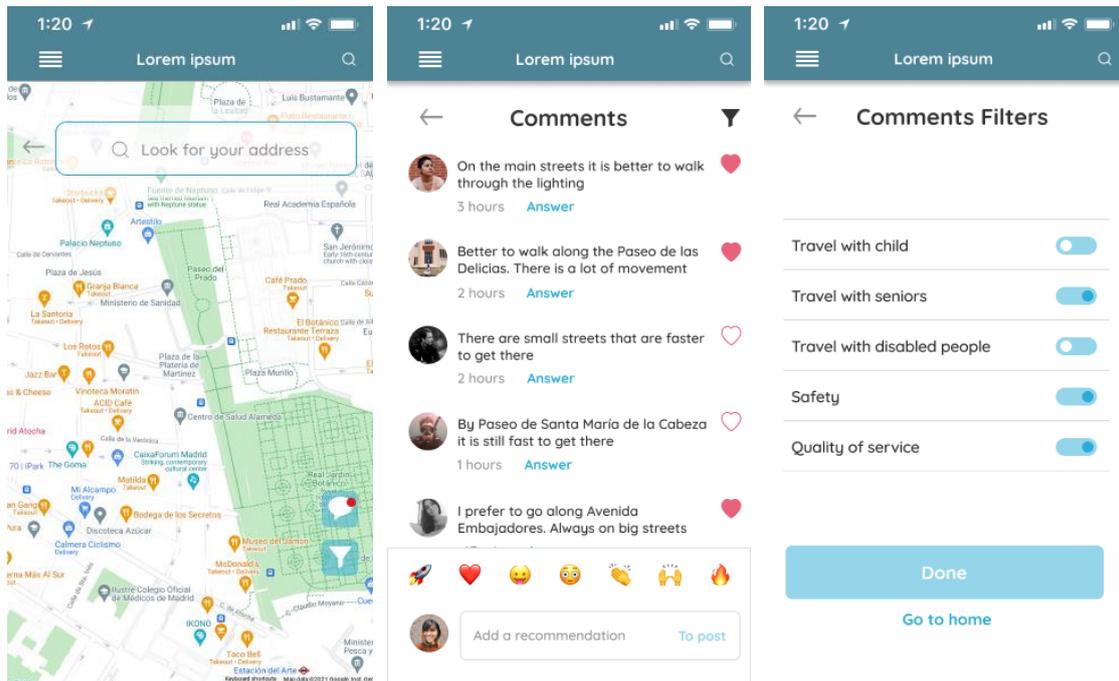


Figure 45. Design examples for comments filters

Rider / driver profile

The information asked in the profile of a rider or driver can be selected in an initial form, when registering. Or it can also be completed in the profile after registration.

For the latter, constant feedback from the app is needed, such as notifications, so that the user completes their profile (e.g., as in LinkedIn).

Comments work like the rest of the comment screens. Here the user can read, but also write a comment. In the case shown, it is focused on a driver, this can be easily adapted to all profiles.

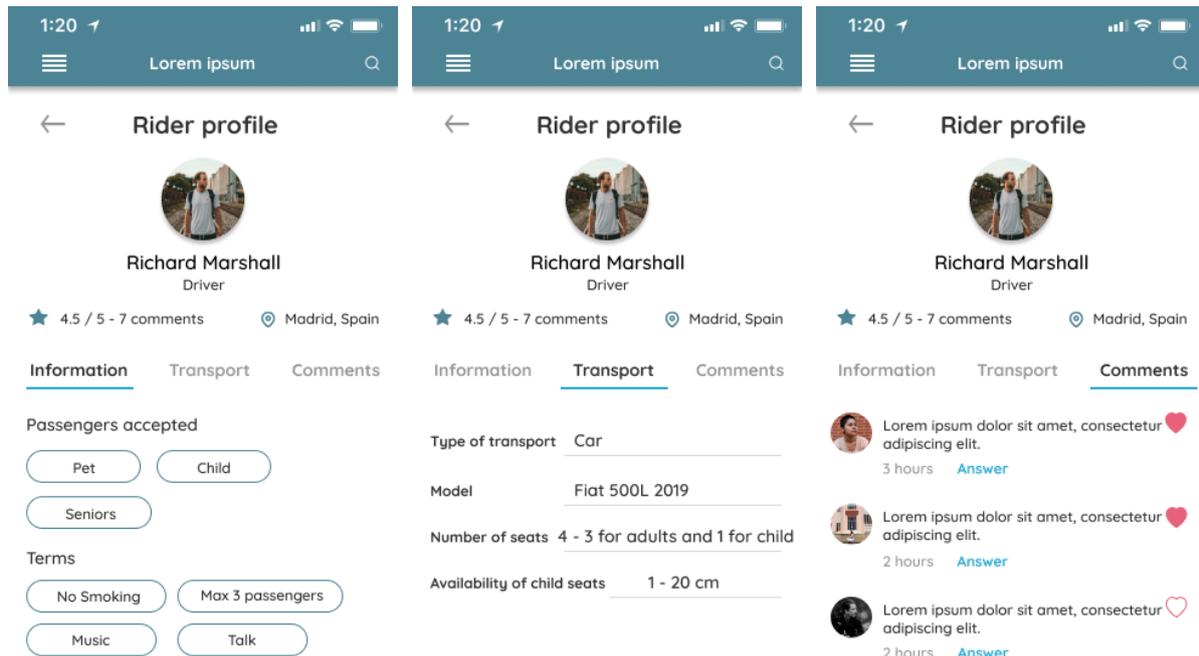


Figure 46. Design examples for rider/driver profile

Travel recommendations

Travel recommendations are oriented towards the driver, but it would also be interesting if they are proposed to the user.

To see these recommendations, a notification in the app: “your trip is coming” should be activated. In that way, the driver can see the information and recommendations.

In the case of users, a travel reminder is activated, with the relevant recommendations for them. Example: mailing to check in for the trip.

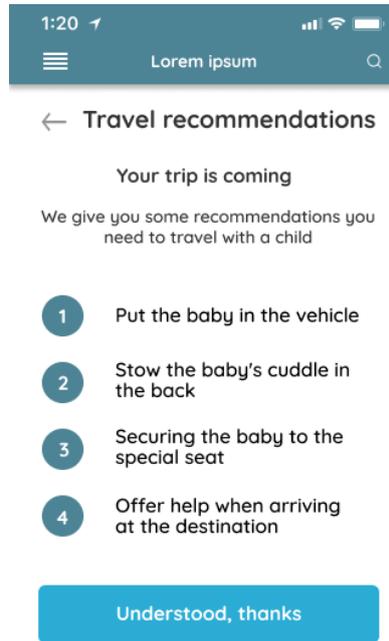


Figure 47. Design examples for driver recommendations

Annex A4

Universal Design Manual –version 1

Concise guidelines for developers



1. Introduction

1.1. The aim of this concise manual

The aim of this Universal Design Manual to provide practical guidelines to developers, graphic designers, UX/UI designers, transport operators and policy makers to make digital mobility and delivery services more accessible and inclusive. This is the first version of this manual, that will be tested in the five INDIMO pilots and revised based on the feedback and published at the end of the INDIMO project (Month 34). The manual covers essential guidelines and recommendations that address the needs of the vulnerable groups present at the INDIMO project locations.

This is the concise version of the manual that summarises the concrete guidelines and recommendations for developers and operators in an easily accessible way.

1.2. Who is this manual for?

This first version of the manual is primarily aimed at the developers and operators of digital mobility and delivery services in the five INDIMO pilots. The manual will be used to redevelop the pilot applications and services taking into account the principles of universal design.

1.3. What is covered in this manual?

The manual primarily focuses on the interaction between users and the digital transport system through user interfaces on multiple devices (e.g., mobile, desktop, interactive equipment or information display). Additionally, we also provide a checklist to assess if an actual service (including the infrastructure, vehicles and personnel) is accessible and inclusive. Furthermore, recommendations are given on the process of including vulnerable-to-exclusion persons in the development process of digital applications and services.

1.4. How to use this manual?

The manual is complementary to a longer version of the INDIMO deliverable D2.1 Universal Design Manual – Version 1, where more details can be found about the methodology of developing the guidelines, the legal and scientific background as well as concrete examples of the application of the elements of these guidelines in the INDIMO pilots.

1.5. The structure of this manual

The manual is structured as follows. The following elements of the manual can be used independently from each other as they address different aspects of inclusivity and accessibility at different stages of the development process.

1. **The principles of Universal Design in digital mobility**: a short introduction to the concept and how it can be applied to digital mobility services.
2. **Analysis of the capabilities and limitations of users**: a method to identify which capabilities and limitations of users a digital application or service should account for.
3. **User requirements and design guidelines**: validated requirements and a proposed path for UI/UX designers, developers and operators to deal with them, linking requirements, details of development and design examples.
4. **Checklist for the assessment of digital mobility services**: a checklist to ensure that not only the digital interface but also the infrastructure, the vehicles and the personnel are inclusive and accessible.
5. **General recommendations**: a list of general recommendations for developers and operators on how to approach an inclusive design process for digital mobility services.

2. Applying the universal design principles in digital service design

This section gives a brief introduction to the principles of universal design and explains how these principles can be applied to digital mobility applications and services.

Universal design is defined as the **design of products and services that may be employed by people with a wide array of characteristics, abilities, and disabilities**. It also implies a type of use that **does not require adaptation or specialized design**. The seven principles of Universal Design - designing for people of all ages, abilities - allow to create services whose design will:

1. be useful and marketable to people with diverse capabilities.
2. accommodate for a wide range of individual preferences and capabilities.
3. understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. communicate necessary information effectively to the user, regardless of environmental conditions or the user's sensory capabilities.
5. minimize hazards and the adverse consequences of accidental or unintended actions.
6. allow the service to be used efficiently and comfortably and with a minimum of fatigue.
7. provide by design appropriate size and space, reach, manipulation, and use regardless of the user's body size, posture, or mobility.

The original seven principles are as follows, followed by a short explanation how they can be used in the design of digital mobility applications and services.

1. **Equitable use.** The design is useful and marketable to people with diverse abilities.
 - 1a. Provides the same means of use for all users: identical whenever possible; equivalent when not.
 - 1b. Avoids segregating or stigmatizing any users.
 - 1c. Provisions for privacy, security, and safety should be equally available to all users.
 - 1d. Makes the design appealing to all users.

The first principle of **equitable use** is brought into the field of digital platforms in the combination of universal features plus special adaptations when required. The equivalent use is achieved by the available customization options (enlarging fonts, captions or transcript for audio contents, for example) or the adaptation to requested devices (for instance, compatibility with an external reader). Universality and customization, when needed, are not contradictory elements, but go hand in hand in this implementation. The purpose is to cater for all the users, but also making the design appealing to different



individual characteristics. This last principle is especially relevant in digital platforms, to avoid an aesthetic and general image that addresses the younger segment or builds some specific aspirational imaginary that is not appealing for all types of population.

2. Flexibility in use: The design accommodates a wide range of individual preferences and abilities

- 2a. Provides choice in methods of use.
- 2b. Accommodates right- or left-handed access and use.
- 2c. Facilitates the user's accuracy and precision.
- 2d. Provides adaptability to the user's pace.

With regards to the second principle of **flexibility in use**, it is especially considered at the time of digital mobility and delivery services that offer a variety of options. For example, payment options may be a barrier to the access to products and services. The point of the adaptability to the user's pace, present within the second principle, is very clearly translated into the smart traffic lights proposal, where one of the studied benefits was the recognition and adaptation to the user's speed of crossing. This aspect considers that each person has their own speed to cross a street as a result of different levels of physical ability, age and health condition. There is not a clear distinction between capability and impairment, but it is rather a continuum line where all the individuals are placed with different levels of ability. If a portion of the population is excluded from a system or structure, the problem is not the population but the design.

3. Simple and intuitive use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

- 3a. Eliminates unnecessary complexity.
- 3b. Be consistent with user expectations and intuition.
- 3c. Accommodates a wide range of literacy and language skills.
- 3d. Arranges information consistent with its importance.
- 3e. Provides effective prompting and feedback during and after task completion.

With regards to the third principle of **simple and intuitive use**, it is very much associated with the simplification of complicated information in order to facilitate orientation and comprehension. It is also related to the shortening of the workflow, attempting to recover information automatically every time that this is possible. And, of course, the visual aids, the description of products associated to images is a way of eliciting meaning in the most intuitive way. The intention to accommodate a wide range of literacy and language skills can be facilitated by using pictures, images and icons as a core element of the linguistic environment of the digital interface design of the mobility or the delivery service; as well as by using simple language avoiding foreign words that may add unnecessary complexity; and the availability of language options, considering the idiomatic variety that always exists in a given territory. All these aspects will be addressed in this manual.



4. Perceptible information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

- 4a. Use of different modes (pictorial, verbal, tactile) for redundant presentation of essential information.
- 4b. Provides adequate contrast between essential information and its surroundings.
- 4c. Maximize "legibility" of essential information.
- 4d. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).
- 4e. Provides compatibility with a variety of techniques or devices used by people with sensory limitations.

Related to the fourth principle of **perceptible information**, this guide provides a consistent orientation about the organization of information on the screen, i.e. the layout of the information that is offered to the user. The screen placement that includes the screen layout, for example, ways to make the most important pieces stand out, the use of typefaces and fonts are covered in this guide. The compatibility with techniques or devices required by specific forms of impairment (e.g., by using multisensory solutions) is also covered.

5. Tolerance for error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.

- 5a. Arranges elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.
- 5b. Provides warnings of hazards and errors.
- 5c. Provides fail safe features.
- 5d. Discourages unconscious action in tasks that require vigilance.

The fifth principle of **tolerance for error** will be treated with the account of different notifications and alerts that minimizes risks and consider the ubiquity of human errors of all kinds. The tolerance for error is present in the reinforced interaction with the platform in the most sensitive stages of a purchase or hiring of a service, such as the moment of entering credit card info or making the payment.

6. Low physical and intellectual effort: The design can be used efficiently and comfortably and with a minimum of fatigue.

- 6a. Allows the user to maintain a neutral body position.
- 6b. Uses reasonable operating forces.
- 6c. Minimizes repetitive actions.
- 6d. Minimizes sustained physical effort.

The sixth principle of **low physical and intellectual effort** concentrates on an important portion of the recommendations of the present guide. Some elements such as the auto-completion or suggestions made by the app have the goal of avoiding repetitive action and saving cognitive and attentional resources. Specifications on the condition of the physical environment where smart traffic lights or digital lockers are placed, following this guide, address the ease or orientation, the facilitation of navigation in the space and the greatest possible absence of obstacles. The minimization of intellectual efforts also implies minimizing the anxiety that is generated in the act of orienting oneself in space and also signage, posts etc. to support memory loss and calling for attention. All these actions will be covered along this guideline.

7. Size and Space for approach and use. Appropriate size and space are provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility

- 7a. Provides a clear line of sight to important elements for any seated or standing user.
- 7b. Makes reach to all components comfortable for any seated or standing user.
- 7c. Accommodates variations in hand and grip size.
- 7d. Provides adequate space for the use of assistive devices or personal assistance.

The seventh principle of **Size and Space for approach and use** is covered in the sections devoted to the spatial organization of information and elements in the digital platform, the recommendations relative to the vehicles and the use of space inside them and other elements of the general layout of the service.

In addition to the above seven principles, **the INDIMO project also recognizes the following as principles:**

8. Social, spatial and economic inclusiveness. This implies equal opportunities to access digital mobility services by all social groups, regardless of their age, gender, level of income, social background, literacy, digital literacy, ethnicity, language, or location. It addresses affordability, and different aspects of general inclusivity.

9. Security and protection of data. These aspects refer to all needed practices to protect digital information from unauthorized access, corruption, or capture along its lifecycle. Also, about preventing misuse of collecting information and unsolicited communications to guarantee individual privacy and responsibility from the side of organizations.

3. Analysis of the capabilities and limitations of users

Usually, applications and services cover the different needs on an average basis (often below the accessibility standards), which sometimes causes that it is only usable in ideal conditions, therefore it is not universal and/or accessible. To address this issue, we propose an approach of **assessment and development of accessible digital mobility and delivery solutions**.

This approach focuses on the identification of what people **can do** i.e. **their capabilities** and their current state with respect to the options available to them. It is based on the concept that people have different degrees of **visual, mobility, income, technical-digital, cognitive, attention and auditory capabilities** to which inclusive and accessible applications and services should cater for (Figure 48). The following sections explain each of these capabilities in the context of digital mobility. Developers are recommended to **explore the capabilities of the specific vulnerable target groups** of digital mobility services as part of the service design process to ensure the universal accessibility of the service.

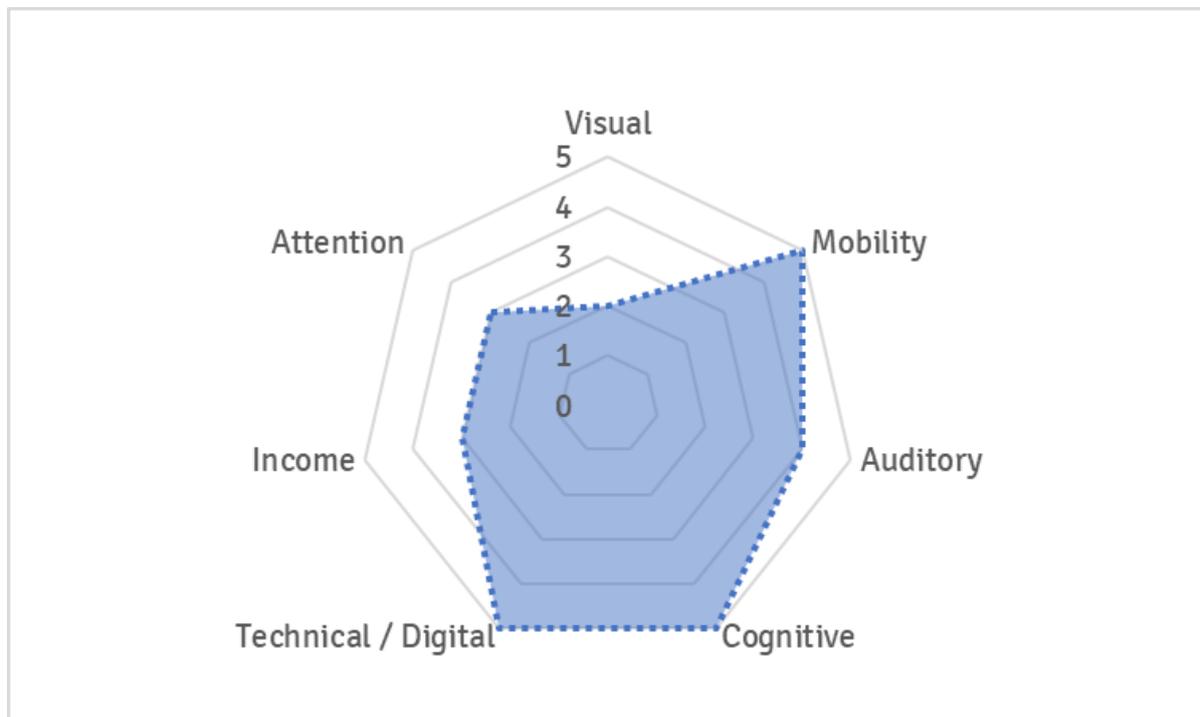


Figure 48. The axes with degrees of capability-limitation

3.1.1. Visual capability level

There is a spectrum of different severity of problems in the vision that require customised solutions for the users. This axis ranges from **people with minimum level of limitation**,

such as **difficulties to read from afar or at close distance** (who just need customizing the fonts) to **complete blindness**, where digital solutions require higher complexity.

The level of autonomy in people's everyday life is also sensitive to the degree of their impairment. In the extreme of the axis, corresponding to complete blindness, certain avoidance of screens by users has been observed, when this is an option. Also, when digital solutions do not address the needs of blind people, doing things on their own, without digital assistance, is feasible and the preferred option. The segment within this group that is not totally blind has full capacity of using mobility apps as long as they comply with a number of adaptations: enough contrast to help readability, colourful letters, customizable fonts and some characteristics that will be explored in detail later on. However, not all people with reduced vision are able to use a smartphone and its apps.

Based on INDIMO research, those who are completely blind have the ability of quick learning in the search for independence. For instance, they learn routes to go to relevant places, such as a job, and tend to repeat routes they are familiar with. They are not afraid or ashamed to ask for help on their way, and they consider that a good portion of the assistance that is provided by passers-by could be given by an app. The condition for this is that the software works properly and fits organically into their routines. If the use is complicated, they rather see it as "another gadget".

3.1.2. Mobility capability level

This axis goes from **people with a slower motion** due to temporary limitations such as **injuries** to people who need **special equipment and conditions to move on their own** (such as a wheelchair). Depending on the level of limitation, users may need the assistance of family and friends to complete some activities. Some users may require **special assistance** when they come across infrastructure or pavement in a bad state. Usually, these users value how route planner apps could contribute to their mobility if they informed them about these disturbances in the public space.

Similarly to the people with reduced vision, people with reduced mobility are not afraid of asking strangers for help, and think that it would be great if apps could relieve them from this external aid. The use of the app while they are using a wheelchair may cause certain complications.

3.1.3. Income capability level

It is well known that the population show very **heterogenous levels of income**, which are correlated with their educational level and that may be correlated with their connectivity, access to equipment and level of digital skills. Even low-income groups can be heterogenous segments of the population. Despite their economic condition, there is a widespread use of apps and familiarity with the digital environment. In more extreme cases of poverty there are limitations arising from the equipment (e.g. smartphone), which does not have enough storage space to install new apps, and with connectivity, since they tend to have phone plans with a limited or no mobile internet access.



3.1.4. Technical/digital capability level

Although many users do not have a fully flexible **mindset towards digital technologies**, a great portion of the population use apps to communicate with their relatives (mainly instant messaging) and some social networks for entertainment (e.g., Facebook). Their incorporation of technology tends to be driven and guided by a relative or someone of their trust, for instance, a family member that encourages them to have WhatsApp to communicate more easily. The word-of-mouth appropriation is specially highlighted in people with low-digital skills. But mechanically learning the basic features of one app does not mean the ability to automatically transfer that knowledge to another app or environment.

3.1.5. Cognitive capability level

The cognitive axis moves from **slight difficulties for understanding** due to normal age deterioration of faculties or lack of proper education to more severe states of **confusion, loss of memory or limitations to recognize people or places**. Cognitive barriers imply a wide array of conditions, which render a heterogeneous landscape. Even within one impairment, there are different levels which involve different functionalities and practical guidance. The apps and other digital interfaces have the aim of enabling users to face the lowest number of possible choices. Choices in general may be associated with stress and the possibility of losing orientation. A straightforward line of workflow and the simplification of procedures may help release anxiety. Auto-filling, suggestions, recovering previous orders and indications are contributions for the simplification of cognitive processes in the user. It is suggested also to avoid the excess of texts and the simplification of concepts through images and icons. Even in severe cognitive impairment cases, familiarity with intuitive apps and apps based on icons and steps (such as Instagram) was found.

3.1.6. Attention capability level (distraction level)

This axis moves from **circumstantial losses of focus** as a result of the presence of other stimuli to a more permanent **inability to clear the attention when facing irrelevant distractions**. Different distraction levels can be observed associated to age, dementia condition and also to people under medical treatment. Distraction level can increase when travelling with children or people in need of assistance. Due to the shared attention on a navigation application and the assisted person, hands-free or voice-controlled options may be helpful. In the INDIMO Madrid pilot, it appeared that cooking may be an activity that implies a higher level of risk for people that have memory or attention problems. Thus, a food delivery service provides a new and appropriate solution for this specific scenario.

3.1.7. Auditory capability level

This axis ranges from **partial deficit of auditive ability**, for instance, due to the deterioration of ageing, to a **deaf or hard of hearing** person. The auditory impairment from early ages may imply a deficit in the access to oral language.



3.2. Implementation of the capability-limitations spectrum

In this section, we propose an exercise that can be implemented by any developer, operator or service provider. The purpose is to **assess the capabilities/limitations of their potential users and think of how to make their services universal** (or, at least, with a higher degree of universality).

1. The first step is **identifying a spectrum of capability-limitations** where people can be characterized.
2. In the second step, the operator or developer **visualises the scope of the spectrum that is covered by the usability characteristics of the service**. A hint to start with this visualization work is to think how the proposed axes would fit into different profiles of potential users.

Potential users can be represented by **personas**. A persona is an imaginative, but accurate, representation of the user profile and all of its characteristics. This representation enables designers to think of the user as a specific person with a name, face, and life frame, instead of treating users as a faceless profile with no identity. These creations capture the most relevant user profiles and characteristics.

3.3. An example: Marie in Berlin

This section presents an example of the capabilities-limitations assessment on one of the INDIMO personas that was used in the Berlin pilot (ridesharing service).

Persona: Marie

Bio: Marie is a 30 year old woman. She is married, has two children, one toddler and one baby. She usually works part-time; however, she is now on maternity leave. She lives in the peri-urban location of Berlin with her husband, who needs the car to get to work. Her husband is very busy, and her parents live an hour away, so she has little support from others to take care of her child and the husband.

There are only limited public transport options in her neighbourhood, so it is more convenient to use the ridesharing option as she wants to bring her children along. She is already a user of the ride sharing service as it helps her get everyday tasks done more swiftly and with less frustrations as the public transport is inadequate. She is now able to plan her trips to the grocery store, doctor, school etcetera without too much hassle.

She is an open-minded woman who does not mind sharing with people she does not know, and she is not afraid to try out new technologies. However, she is not an explorative person and will not actively look for certain things as she is quite busy, she relies on information from others.

Spectrum capability-limitation representation and explanation (Figure 11):



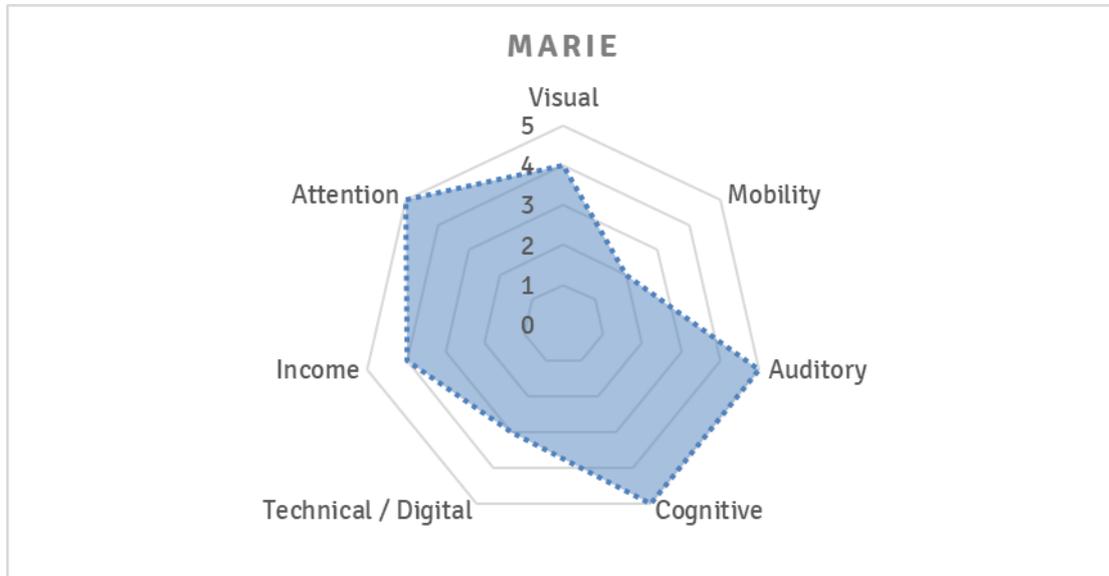


Figure 49. Spectrum capability-limitation area for Marie

Visual capability: 4 out of 5. She has never worn glasses. Some weeks ago, she noticed she saw signs from afar in a blurry way. She made an appointment with the optician to have a check.

Mobility capability: 2 out of 5. Regarding mobility her main issue is the inadequacy of the service of public transport in her area for her travel purposes, and the difficulty of using the public transport with two children. Her children are very energetic, they move, they shout, and she feels that other passengers may be disturbed. That is why she started to use ride sharing where there are fewer passengers. But she has some doubts about it every time the driver is not as willing to provide help with the two children as she would expect.

Cognitive capability: 5 out of 5. Her work implies complex reasoning and mental operations. She exercises her cognitive skills very often.

Auditory capability: 5 out of 5. She does not have any auditory problems. She hears perfectly sounds of all ranges and pitches.

Digital/Technical skills: 3 out of 5. As we have already presented, even when she is skilful with digital tools, she has no problem to download, install and execute any type of mobile app, she is not very explorative. This implies that she devotes a long time taking care of the children, working, carrying the children to places, that she does not have the strength, willingness and time to spend searching for new solutions for her life. She is busy and she relies on information provided by others.

Income level: 4 out of 5. Both she and her husband are employed, so they do not have big financial issues. However, raising two children entails a moderate level of fixed expenses and, because she has to devote time to taking care of them, she can only work part-time. Saving money is important for her to find a balance.

Attention level: 5 out of 5. She is a very concentrated, detail-focused person. She memorizes even small facts and is very attentive to her surroundings.

4. Requirements of vulnerable users and non-users

4.1. List of user and non-user requirements

In the INDIMO project we have identified several **key requirements of users and non-users** of digital mobility services. These requirements have been prioritised in the INDIMO pilots to select the ones that have the **highest value for users** and the **lowest effort that their implementation would take for developers, operators and policy makers** (Table 8). This list can be used by any developer or operator of digital mobility services as fundamental requirements when developing inclusive and accessible services and applications.

Section 4.2 provides **detailed design guidelines** to address these requirements.

ID	INDIMO Requirements prioritized in all pilots
R1	ACCESSIBILITY
R1.01	Anticipation and control over the graphic interface: Uniformed icons and spatial organization
R1.02	Anticipation and control over the graphic interface: Avoid automatic updating of the version (labels or button may be missing afterwards)
R1.03	Include map visualization with the real time position of driver/rider
R1.04	Matching the digital mapping with the real geography using the colloquial variety of local language
R1.05	Trip chain possibility
R1.16	Extend length of light according to user's needs and indicate how much time of green is left (ONLY FOR TRAFFIC LIGHTS)
R1.17	Communicate status of lights (red/green) to users (ONLY FOR TRAFFIC LIGHTS)
R1.20	Preferably, no action demanded from user (ONLY FOR TRAFFIC LIGHTS)
R1.22	Traffic lights should have auditive signal so people with reduced vision places themselves in the surroundings (ONLY FOR TRAFFIC LIGHTS)
R1.51	Service to increase the independence of the users

ID	INDIMO Requirements prioritized in all pilots
R1.52	Install audio options and/or auditive support for people with a visual impairment
R1.53	Possibility to enhance the font
R2	MORE OPTIONS
R2.01	Options for courier and fresh-food delivery and not only cooked food. (ONLY FOR FOOD DDS)
R3	INCLUSIVENESS
R3.01	Humans behind; there should always be the possibility of getting human assistance.
R3.02	Possibility of calling the driver/rider to arrange place of pick up (either to facilitate mobility or avoid exposure, or to clear doubts).
R3.03	There should be no foreign/technical words on the platform
R3.04	Availability of language choices (considering foreign people)
R3.08	Training to support service introduction (ONLY FOR LOCKER DDS)
R3.51	Some sort of remote support function provided by the service, preferably in the form of a helpdesk of which the contact information is provided by the digital interface. This should be available 24/7
R3.52	Service needs to be affordable or at least offer transparent pricing
R3.53	Users should be able to contact the service agent
R3.54	Work together with organisations or associations with ties to the target audience
R4	WORKFLOW
R4.01	Very important information (i.e. working hours, contact phone) should appear very big at the beginning
R4.02	Many visual aids (for instance, every payment method should have an icon).
R4.03	Include the possibility of viewing user's ratings.
R4.04	A completion bar, so people not familiar with apps do not feel anxious nor uncertain about the end.
R4.05	There should be a calculator or estimator of the order/trip price.
R4.06	Error detection (by the system) and help offer
R4.07	To clarify what equipment the vehicle has and what to expect when booking a ride with children or with disable people
R4.08	To be able to add child age information, know if the car will have the right child seat
R4.09	Adding to favourites their home or work address
R4.51	An easy one-time registration
R4.52	Service to be reliable at all times
R4.53	Easy to use interface that does not include too many steps to activate or use the service
R5	PRIVACY AND DATA SECURITY
R5.01	Terms and conditions summarized in checkboxes

ID	INDIMO Requirements prioritized in all pilots
R5.51	Offer a transparent privacy policy in line with the regulations
R5.52	Certain security measures to be taken to keep the users and their data safe
R5.53	Provide the option of an anonymous or discrete profile, which can be compared by the aforementioned requirement
R5.54	Service should require as less personal data as possible to function properly
R6	SAFETY & SECURITY
R6.01	Include emergency button in case of physical/ sexual attack
R6.51	Service provided by or endorsed by a trusted and reliable organisation
R7	PHYSICAL INTERFACE
R7.01	Riders/drivers should introduce themselves and know the user's name. Possibility of uniform (to be easily identified).
R7.51	Service agent should be reliable, friendly and empathic
R7.52	Service agent too should be child-friendly
R7.53	Service agent needs to have a profile showing the reviews of other users and giving a feedback option
R8	COMMUNICATIONS
R8.01	The graphic interface should look that is made for everyone, not only young people
R8.51	Recognisable and easily identifiable service tool
R8.52	Awareness campaign that targets their user audience and stresses the benefits of the service
R8.53	To organise some sort of teaching method for the target audience (e.g. Educational session)
R8.54	Campaign and training sessions as mentioned above, Emilia-Romagna, Antwerp, as well as Galilee and Berlin see the benefit of developing an introductory video tutorial that explains the service step-by-step
R9	COVID-19 RELATED
R9.01	Establish a COVID-19 protocol and communicate it.

Table 10. INDIMO | Requirements prioritized in all pilots

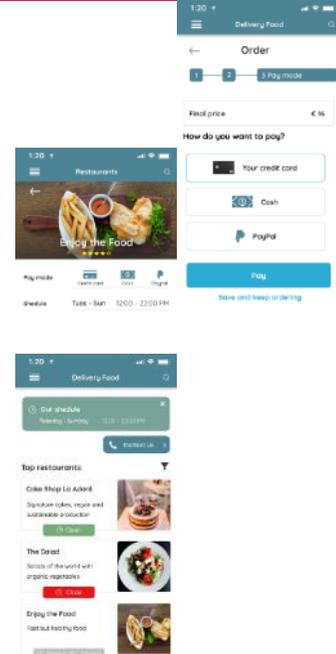
4.2. Design guidelines for developers and operators

This section links the above requirements with a proposed path for UI|UX designers, developers and operators to deal with them, connect requirements, details of development and design examples (Table 9). Annex A3 contains further images to accompany the design guide.

Table 11. Details of requirement development

Type of Requirement	Requirement	Detail of development	Design examples and references
1. Digital interface			
a. Fonts	Possibility to enhance the font (MR) (P3:B, P4:A)	When clicking on Setting (horizontal bars visible on the screen), there is an alternative to adjust the font size with easy-to-understand options, for example, Small, Medium, Large, Very Large. (for all kinds of services)	 <p>See Figure 26</p>
b. Colors	High contrast mode	When you click on Setting (horizontal bars in a visible place on the screen), there is an alternative to adjust the contrast of the colors of the app and the result it produces. Example: display an image with more contrast and another with less contrast side by side. (for all kinds of services)	 <p>See Figure 26</p>
c. Icons (see UIL)	Uniformed icons and spatial organization (MR) (P2:A, P4:D, P5:D)	This is worked more in detail in the UIL (see D2.2). Each payment option has its own clearly identifiable icon (icon for credit card, icon for	See Figure 33 and Figure 37



Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>Many visual aids (for instance, every payment method should have an icon). (MR) (P4:B, P5:A)</p>	<p>PayPal-type electronic payment, icon for cash payment, icon for vouchers, etc.) (for all types of services)</p>	
<p>d. Spatial organization and flow</p> <p>Uniformed icons and spatial organization (MR) (P2:A, P4:D, P5:D)</p> <p>Very important information (i.e. working hours, contact phone) should appear very big at the beginning (MR) (P3:D, P4:A, P5:C)</p>	<p>The essential information (hours of operation, direct contact channels) is standardized in a prominent place on the screen, preferably at the top, and with graphic characteristics that highlight it. (for all kinds of services)</p>	<p>See Figure 23</p>

Type of Requirement

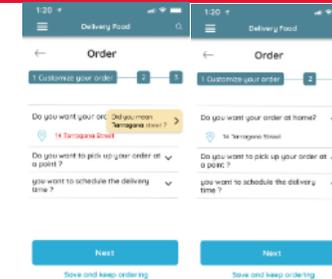
Requirement

Detail of development

Design examples and references

Error detection (by the system) and help offer (MR) (P4:C, P5:D)

Showing how error detection works. For example, if a person writes "Medrid" instead of "Madrid", a sign appears that asks: "Did you mean Madrid?" The same in front of or an address that the system does not recognize, or other pertinent information that can be automatically detected. (for all kinds of services)

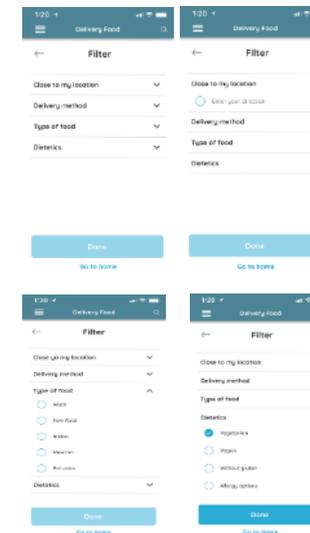


See Figure 35

-Step-by-step flow solved with questions (OR)

-Easy to use interface that does not include too many steps to activate or use the service (MR) (P1:A, P2:A, P3:B, P4:C, P5:C)

The succession of screens to exemplify the step by step solved with questions. Delivery example: first screen: What is your address? (filter the stores that have that scope), second screen: what kind of food do you want? - filter the corresponding stores), third screen: shows the filtered restaurants with their corresponding photos. (for all kinds of services; in this case, delivery example)



See Figure 31 and Figure 32



Type of Requirement

e. Maps and indication of location

-Include map visualization with the real time position of driver/rider (MR) (P3:C, P4:C, P5:A)

Requirement

Detail of development

The different visual elements used to indicate on the map: the pin that indicates the real-time location of the rider / driver, a different pin to indicate the place of origin and destination, the important milestones of the neighborhood marked; the route offered by the app indicated with a dotted line or some similar resource. (important for ride-sharing / ride-hailing and delivery)

Design examples and references



See Figure 40

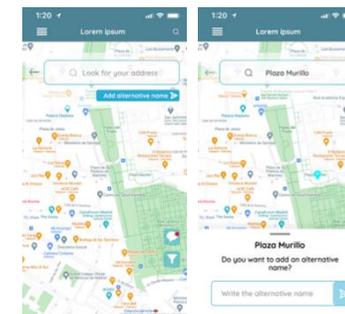
-Matching the digital mapping with the real geography using the colloquial variety of local language (MR) (P3:D, P5:D)

The coincidence between the pragmatic nomenclature that a street receives and how it is indicated on the map. (important for ride-sharing / ride-hailing and delivery)

The design solution is to generate functionalities for users to write the alternative name of the street. Two examples are given.

3. The user can directly type the alternative name
4. When searching for the place, a notice appears where the user can type the alternative name of the site.

With that information, using the alternative name or both could be programmed.



See Figure 41



Type of Requirement

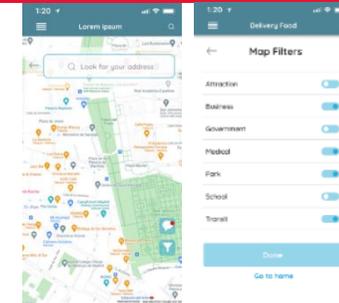
Requirement

-Attracting routes/locations to support educational and caring mobility needs (MR) (P5:B)

Detail of development

Possibility to highlight the care sites. The ride-sharing / ride-hailing / lockers maps show nearby places that are of interest to a caregiver (schools, hospitals, medical clinics, pharmacies, supermarkets). It is contemplated that the location of these places can also condition the trip (example, chained trip) (important for ride-sharing / ride-hailing and delivery). On the map there is a floating button with a filter. From there the user can go directly to configure the vision filters on the map

Design examples and references



See Figure 42

f. Visual aids

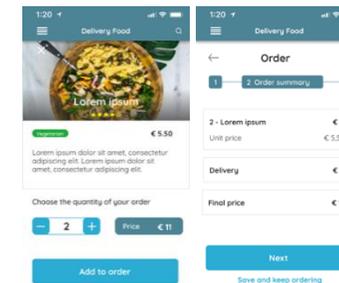
i. Calculator

-There should be a calculator or estimator of the order/trip price. (MR) (P4:A, P5:A)

Showing the characteristics of a calculator: large and visible figures, univocal (without confusion between 8 and 0, or 0 and 0, for example), and the total is broken down with the value of each item. (for all apps).

Two design examples are proposed:

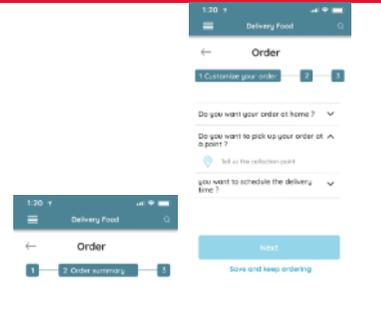
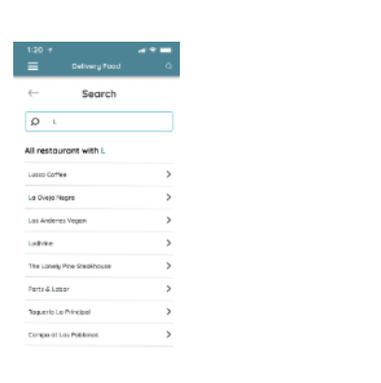
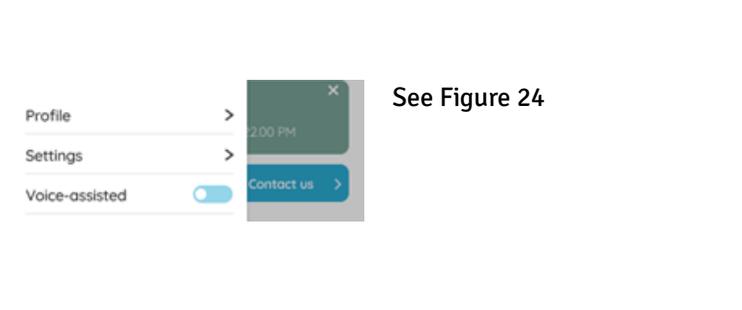
1. When ordering a meal, the user, by increasing the number of dishes, modifies the final price.
2. The second corresponds to the order process, where the price is broken down between food, delivery.



See Figure 33 and Figure 36

ii. Completion bar



Type of Requirement	Requirement	Detail of development	Design examples and references
	<p>A completion bar, so people not familiar with apps do not feel anxious nor uncertain about the end (MR) (P4:D, P5:B)</p>	<p>What a completeness bar looks like, with the % or number of steps remaining to complete the order. (for all apps)</p>	 <p>See Figure 34</p>
<p>g. Autocompletion/ suggestions by the app</p> <p>Include auto-filling/ suggestions by the app (for visually and cognitively impaired) (OR)</p> <p>Autocompletion with the past order/service, with the possibility of modifying it. (OR)</p>	<p>Showing how autocompletion works, although it is a well-known operation in the web world. (for all apps)</p>	 <p>See Figure 30</p>	
<p>h. Compatibility with devices</p> <p>i. Voice-assisted menu</p> <p>Add a voice-assisted menu (for people with reduced vision) (OR)</p> <p>ii. Low-tech equipment</p> <p>Produce a light version of the app which is acceptable for a variety of equipments. (WS)</p>	<p>When clicking on Setting there is the option to activate external aids such as the voice-assisted menu (more technical detail is required on how this utility is activated). In the Registration phase there should be a question of do you want to activate mobility, vision, hearing (for all apps). Two design examples are proposed.</p>	 <p>See Figure 24</p>	



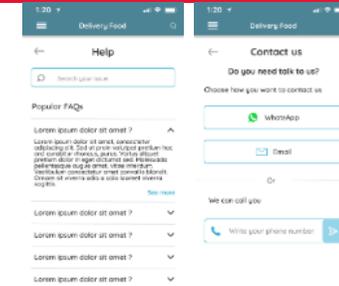
Type of Requirement

Requirement

Detail of development

Design examples and references

Also, a WhatsApp icon for people to communicate may be added. That is always at the discretion of each programmer.



k. Information

i. Real-time information provided by the app

Include map visualization with the real time position of driver/rider (MR) (P3:C, P4:C, P5:A)

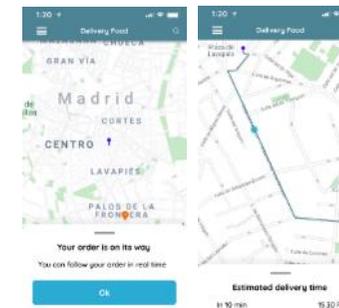
Real-time information of the location of the parcel (for lockers) (WS)

Include route planners with real time info (so blind people can trust them to get off the bus/train) (OR)

Include a real-time estimation of occupation and travel time (WS)

ii. Information requested about people in charge

How the map shows in real time the location of a package / product in the case of delivery / locker. Along with that the estimated delivery / arrival time. (Important for lockers and delivery)



See Figure 38



Type of Requirement

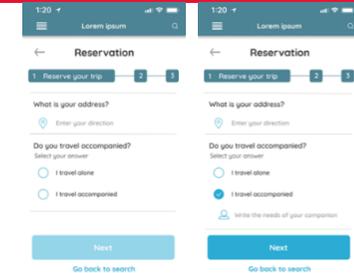
Requirement

Detail of development

Design examples and references

To be able to add child age information, know if the car will have the right child seat (MR) (P5:A)

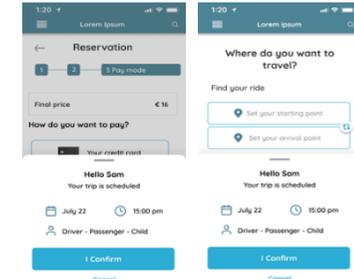
When a ride-sharing / ride-hailing vehicle is requested, a box opens that asks if you are traveling with a person in charge, if it is a child, how old is it, to offer you a seat of adequate security. (important for ride-sharing / ride-hailing). The user has to answer some questions to book his trip. By selecting the companion option, the option to write the needs of his travel companion is activated.



See Figure 43

The app should give the option of selecting “service with children”, indicating the number of children and the age (OR)

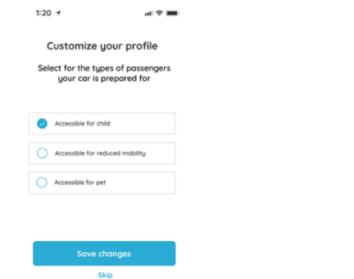
Showing the message that reaches the other passengers advising that a child is traveling in the same vehicle. (important for ride-sharing / ride-hailing).



See Figure 43

Direct a car whose driver is tolerant to children and willing to provide the required assistance (OR)

Two examples are shown in which the user is notified of his trip. The first is at the time of booking the trip; the second, once it is already booked (generally this notification is when the trip is ready after booking)



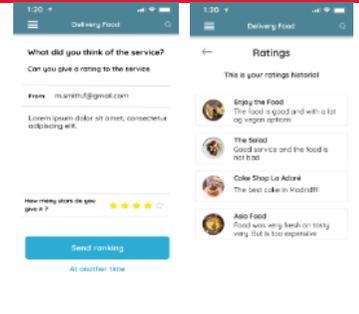
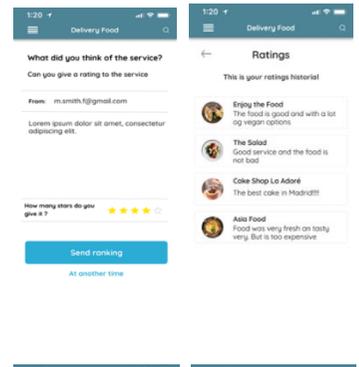
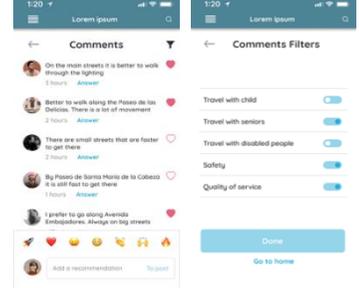
See Figure 44

Showing the message received by the caregiver informing that a vehicle was directed to him with a driver who is tolerant towards children and who is trained to offer adequate assistance for this type of trip. (important for ride-sharing / ride-hailing).

In the registration process, user is asked what kind of people he/she has the car prepared for.

I. Ratings and users’ feedback



Type of Requirement	Requirement	Detail of development	Design examples and references
	<p>Include the possibility of viewing user's ratings. (MR) (the rating that the user gives the service) (P2:A, P3:C, P4:D, P5:A)</p> <p>At the end, the user should be asked for suggestions or complaints (OR)</p>	<p>Showing how to agree to give a score to the service. For example, a poster after the end of the service, an email with a link, an option in the Setting. (for all apps)</p> <p>In the following examples the user can give feedback from their menu, that is housed in the rating history.</p>	 <p>See Figure 27</p>
	<p>The day after the order, the app should mail the user and require them to rank and comment about the restaurant/service (OR)</p>	<p>Showing how the scoring system is expected to be: simple, from 1 to 5 stars, plus a comment indicating some characteristics of the user who offers the evaluation, for example, if it is a woman or a man, yes the service was daytime or nighttime (the latter, if applicable). (for all apps)</p>	 <p>See Figure 27 and Figure 39</p>
	<p>Comment is requested in order to be able to rate a driver (WS)</p> <p>Service agent needs to have a profile showing the reviews of other users and giving a feedback option (MR) (P3:C, P4:E, P5:D)</p>	<p>Comment filter system. Possibility of filtering the comments of other users according to these characteristics (for example, a woman's interest in knowing the comments made by other women about an X-driver working at night). (for all apps)</p> <p>In the examples, a filter is added in the comments part, in them user can choose the types of comments that he/she wants to show</p>	 <p>See Figure 45</p>

m. Privacy and data security



Type of Requirement

Requirement

Detail of development

Design examples and references

i. Terms and conditions

Terms and conditions summarized in checkboxes (MR) (P2:B, P3:B, P4:B, P5:D)

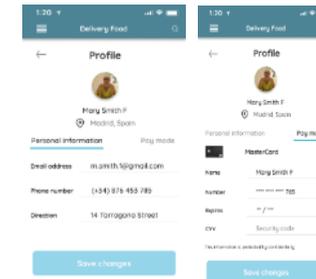
Example of how the Terms and conditions are synthesized in 3 or 4 boxes. (for all apps)

Offer a transparent privacy policy in line with the regulations (MR) (P1:B, P2:B, P4:B, P5:D)

ii. Data storage characteristics

Checklist of what data is stored and for how long. (OR)

Example of how the list is showing what information is stored and for how long. For example, Name and email, 6 months; address and phone, 3 months; order detail, 1 month; credit card details, 3 months. This is just an example. (for all apps)



See Figure 25

iii. Feedback on transactions



Type of Requirement

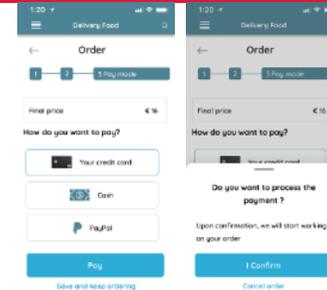
Requirement

Detail of development

Design examples and references

Feedback, such as notifications and warnings, to reassure online payments (OR)

Example of how the poster is to ensure (double check) the completion of a payment. For example, do you want to move forward with the payment process? (for all apps)



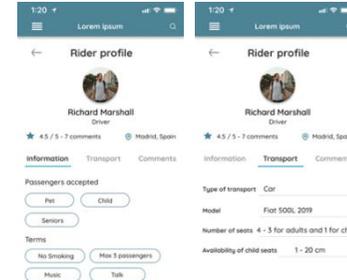
See Figure 37

n. Security

i. Emergency/Help button

Include emergency button in case of physical/ sexual attack (MR) (P2:D, P3:C, P5:B)

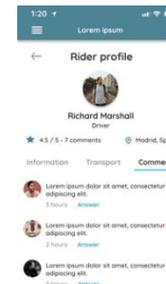
How the profile of a driver / rider should look, with his photo, his full name, pertinent information (such as whether he smokes or not in the case of a driver) the average score that other users have given him and the ability to open and view the comments that other users have written. (important for ride-sharing / ride-hailing and delivery)



See Figure 46

Create help button (OR)
Service provided by or endorsed by a trusted and reliable organization (MR)(P3:D, P4:B, P5:A)

The information required for a driver / rider has been joined in the three examples shown. Although it is focused on a rider, it can be easily adapted to all profiles.

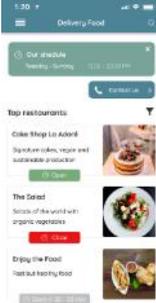


See Figure 46



Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>Add a photo of the rider/driver that will serve the user for better identification (WS)</p>	<p>How the profile of a driver / rider should look, with his photo, his full name, pertinent information (such as whether he smokes or not in the case of a driver) the average score that other users have given him and the ability to open and view the comments that other users have written. (important for ride-sharing / ride-hailing and delivery)</p>	
<p>o. Communication</p> <p><i>i. Channels for communication</i></p> <p>Importance of local peer volunteers as trusted communicators (OR)</p> <p>Promote the services “offline”: events and flyers (OR)</p> <p>Awareness campaign that targets their user audience and stresses the benefits of the service (MR) (P1:B, P2:B, P3:C, P4:C)</p> <p><i>ii. Values communicated</i></p>		



Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>The graphic interface should look that is made for everyone, not only young people (MR) (P2:A)</p>	<p>At this point, give an example of how it should be done vs. how it shouldn't be done. For example, HOW NOT: a fictional illustration of the home page of an app that is openly designed for young people (with hashtags, words in English, technical or generational words, very niche images) vs HOW YES: the image of a home page of a fictional app that produces a “neutral from a generational point of view” result. (for all apps)</p>	 <p>See Figure 23</p>
<p>Create a positive attitude through communication (OR)</p> <p>Highlight the environmental and social values behind the service. (OR)</p>		
<p>Communicate the social project behind the service and the benefits of workers (OR)</p> <p>Do not communicate ride-sharing/ ridepooling as a replacement of bikes or public transport, but as a complement. (OR)</p>		
<p>p. Language</p> <p>There should be no foreign/technical words on the platform (MR) (P2:A, P4:B)</p>		

Type of Requirement	Requirement	Detail of development	Design examples and references
	<p>Availability of language choices (considering foreign people) (MR)(P1:B, P3:C)</p> <p>q. Payment options</p> <p>There should be no minimum amount of purchase (MR)</p> <p>Service needs to be affordable or at least offer transparent pricing (OR)</p> <p>Allow payment alternatives, especially cash but also digital wallets payments (such as PayPal). (OR)</p> <p>The user should indicate in the app how they will pay and with which bill (WS)</p> <p>Offer the possibility of buying coupons for the service to allow cash payments but avoiding the rider/driver to have cash on him. (WS)</p> <p>The riders/drivers have a card reader machine (WS)</p>		

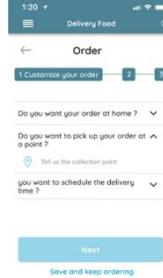
2. Physical Interface

Ridesharing/ ride-hailing services

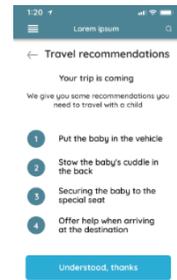
a. On Boarding/ Off Boarding

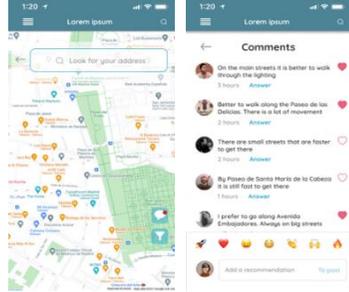
i. Safe spots



Type of Requirement			
Requirement	Detail of development	Design examples and references	
Identify safe spots for boarding (e.g. a quiet side street instead of a multi-lane avenue) (OR)	Showing the alternative that the user of ride-sharing / ride-hailing has: indicate the pick-up point at the indicated address or choose a point close to the address. The map recognizes and shows places near the home that offer greater public safety (for example, avenues where there is good lighting, or a lot of movement, or many shops) or greater road safety (for example, calm and internal streets with a single lane Low traffic). The user can choose. The same for the descent of the user.		See Figure 34
Generate meeting points or use existing bus stops to pick up users. (WS)			
Include the option of picking up the user at the corner or some blocks away (WS)			
<p>b. Booking a service</p> <p>Possibility of booking service in advance (important for people with children) (OR)</p> <p>Alternative channels to order: WhatsApp number or phone number. (OR)</p> <p>Possibility of choosing the gender of the driver/rider through the app (WS)</p>	Showing where the telephone number should be located and the indication to request a service by WhatsApp.		

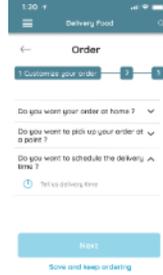


Type of Requirement	Requirement	Detail of development	Design examples and references
<p>c. Contact with user</p> <p>Drivers should call the user some minutes before arriving to ask whether the user has an intercom or whether they should announce it by a phone call.</p> <p>Drivers should speak slowly and in a clear way. (OR)</p> <p>Drivers should offer support when necessary (for example, when passenger has a child) (OR)</p> <p>Drivers receive training about inclusivity (WS)</p>	<p>Showing the different actions in which a trained DRIVER must provide assistance: putting the baby in the vehicle, putting the baby's cot in the back, securing the baby to the special seat, offering the woman carrying a child or stroller helps to enter the origin / destination.</p>		<p>See Figure 47</p>
<p>Smart traffic lights</p> <p>d. Communicating status of the light and other features</p> <p>Communicate status of lights (red/green) to users (AMR) (P2:D-)</p>	<p>Showing the different ways of communicating the status of the traffic light: a) sound that differs from ambient sound; b) sound and vibration from the mobile; c) dynamic poster that tells how much time is left for the pedestrian crossing.</p>		<p>See Figure 45</p>

Type of Requirement		
Requirement	Detail of development	Design examples and references
Road works should be clearly communicated (WS)	<p>Showing how the map of the associated app indicates incidents / works that may represent an obstacle in the navigation of the space: a) closed streets, b) infrastructure works; c) small maintenance work; d) machinery working that makes ambient noise and prevents clear hearing of the traffic light signaling; e) other incidents. In the image where the map is, there is a comment button.</p> <p>Here the user can write his comments about the route, but also, he can see the comments of other users.</p> <p>On the second screen, we see how you can leave a comment and read the ones that are already written.</p> <p>With this information, you can complement the instructions that will be given to people who need assistance.</p>	
<p>f. Surroundings/ quality of the road</p> <p>Offer the user extra info on the quality of the road (OR)</p> <p>Changes in the surface of the pavement to indicate proximity of the smart traffic light (WS)</p>	<p>Showing in a general way what accessibility elements should have a pedestrian crossing where an intelligent traffic light works: a) curb level with the road with adequate inclination; b) surfaces with tactile relief that indicate the</p>	<p>Programming: auditory with prompts</p> <p>Use user comments to feed the app with directions options</p>

Type of Requirement			
Requirement	Detail of development	Design examples and references	
<p>Accompany the installation of smart traffic lights with works of urban rehabilitation and modernization, focusing especially on crossings (OR)</p> <p>Integrate smart traffic lights in route planners such as Google Maps (OR)</p>	<p>presence of the smart traffic light; c) if it is defined that the traffic light requires pressing a button, it must be at an accessible height for a person of any height or in a wheelchair; d) clean corner of obstacles or additional signage; e) if the crossing is very long, with several lanes, offer some kind of rest in the middle.</p>		
<p>g. Notifying technical problems of the lights</p> <p>Button to notify problems with the lights (WS)</p>	<p>Showing how it is possible to enter the app to report a problem. For example, enter Settings, notification, and the app asks the intersection of streets where the traffic light with problems is and what is the problem it has.</p>		<p>See Figure 27</p>
Delivery/ courier services			
<p>a. Characteristics of the delivery packages</p> <p>Uniformed shapes of the packages, for instance, main dish in squared package, side-dish in a round package (for people with reduced vision) (OR)</p>	<p>Code suggestion for the shape of the containers. It should be very simple to facilitate the identification of the dishes to the touch: main dish in square container; accompaniment in round container; dessert in smaller container.</p>		
<p>b. Options of food</p> <p>Enlarge food options (vegetarian, healthy etc) (OR)</p>	<p>Showing that early in the purchase you should ask if you want to order a regular order or for a</p>		<p>See Figure 34</p>



Type of Requirement		
Requirement	Detail of development	Design examples and references
<p>Options for courier and fresh-food delivery and not only cooked food (MR) (P4:C)</p> <p>Separate regular orders from special occasions (OR)</p> <p>Budget menus (OR)</p>	<p>special occasion. This is to integrate new consumers and demands (for example, shopping at a nursing home).</p>	
<p>c. Contact with user</p> <p>Riders should call the user some minutes before arriving to ask whether the user has an intercom or whether they should announce it by a phone call. (OR)</p> <p>Riders/drivers should speak slowly and in a clear way. (OR)</p> <p>Riders should offer support when necessary (for example, when user has a child) (OR)</p>	<p>Showing the different actions in which a RIDER must provide assistance: contact the user in advance to arrange how the delivery will be made, leave the order on the portal if requested, go up to the door of the apartment if requested, help the user with the load of the product if it is heavy or difficult.</p>	



5. Checklist for service assessment

The above requirements and design guide primarily focuses on the digital interface part of digital mobility and delivery services, but the **service itself should also ensure accessibility and inclusivity**. The structure of the IT system usually derives from the physical system. Therefore, to provide an inclusive digital service the systems that facilitates the service itself should be assessed with an inclusivity and accessibility approach.

The main process of any service may consist of several subsystems, but the whole service can only operate in an accessible and inclusive way if **all of these subsystems are suitable and designed universally**. This checklist provides a quick way to check the main requirements for the potential components of a general service. Not every service will contain each subsystem but in order to effectively improve the service, those factors should also be assessed by the same manner.

5.1. Goal of the assessment

The goal of the assessment is to give operators and developers an **insight into universal design**, and as they perform the assessment process themselves, they obtain important information about inclusivity and get familiarized with the general needs and requirements of vulnerable-to-exclusion people.

5.2. Assessment outcome

As a result of the assessment, operators and developers can determine the **performance of their service** on the different axes of capabilities and limitations. On the one hand, this result may encourage them to improve the accessibility and inclusivity of the service if the scores prove to be low and it also aids to identify the main areas of possible improvement. On the other hand, it aids the development or updating process of the related application in terms of focusing resources: if the service itself could be reached with a specific level of capabilities but the application's insufficiency prevents it, actions should be taken to improve the related sub-systems. Ideally, both the service provided and the related digital interface should have similar ratings on every axe of the capabilities-limitations spectrum.

5.3. Service assessment checklist

5.3.1. Service access point

- Service location itself is accessible:
 - Visual impairment: tactile paths, signs, Braille displays, audible announcements (if possible)
 - Mobility impairment: barrier-free and spacious facilities, enough seats

- Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
- Accessible with children (enough space, child seat)
- Accessible with large baggage, pets (incl. guide-dogs) etc.
- Route to service access point is accessible:
 - Mobility impairment: barrier-free and spacious facilities
 - Careful placement of access point (e.g., point of aggregation of communities)
 - Connection to transport services (e.g., public transport)
 - Accessible with children, pets, baggage (enough space)
- User is led to the service access point:
 - Service point (if it is physical) itself is signed clearly, it is easy to identify
 - Clear and understandable information along the route:
 - Clear information about temporary changes, e.g., diversions, constructions, closures;
 - Accessible information on orientation:
 - Visual impairment: tactile paths, signs, Braille displays, audible announcements (if possible)
 - Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
 - Universal icons and signs
 - Texts are available in several languages
- Service time:
 - Service hours as long as possible
 - Allow users enough time for the service process, so they do not have to hurry
- Safety, security:
 - Safe and quiet place
 - Secure environment
- Coverage:
 - Geographical coverage as large as possible
 - Customizable access point (if possible, e.g., boarding point for ride sharing)
 - Personal access point (if possible, e.g., a locker)

5.3.2. Vehicle

- Vehicle itself is accessible (at least as an option):
 - Mobility impairment: barrier-free and spacious, enough seats, same level of vehicle floor and platform
 - Accessible with children (enough space, child seat)
 - Accessible with large baggage, pets (incl. guide-dogs) etc.
- On-board information is accessible:
 - Vehicle is indicated clearly, it is easily recognizable from outside
 - Vehicle characteristics are available

- Visual impairment: tactile paths, signs, Braille displays, audible announcements (if possible)
- Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
- Universal icons and signs
- Texts are available in several languages

5.3.3. Physical interface / Product

- Physical interface/product is accessible:
 - Visual impairment: tactile signs, Braille displays, audible announcements (if possible), different shaped objects/buttons for different parts/functions, touch-screen equipped with text-to-speech options (with physical button to switching it on), physical buttons for number input is preferable
 - Mobility impairment: interface/product can be used from wheelchair (adjusted height) and with one hand
 - Auditory impairment: texts /captions / visual signs for audio information, dynamic adaption of volume (if possible)
 - Description is available in several languages
- Contact to the interface:
 - As few actions needed from users as possible (e.g. activating interface)
 - Simple and understandable instructions
 - Clear feedback about the process
- Wide range of product options:
 - Options of users with health diseases, limitations, e.g. allergies

5.3.4. Service personnel (direct contact)

- Good manners, appearance:
 - Introduce themselves (if contact is direct)
 - Know user's name (if contact is personal)
 - Tidy outfit and appearance
 - Uniform or clearly distinguishable outfit (if possible)
- Contact with user:
 - Profile and personal data are displayed
 - Notifying user before arrival (if contact is direct)
 - Possibility of contact before use, to arrange details (if needed)
 - Speaking slowly and in a clear way
 - Offering support if needed
 - Trained about inclusivity
 - Assigning the same personnel for the same user if possible
 - Capable of communicate in English (or other additional languages)

5.3.5. Booking

- Option of booking in advance (if possible)
- Alternative channels to order:
 - WhatsApp/Viber/Messenger etc.
 - Phone number
- Customizable booking:
 - Accessibility options (if they are not universal throughout the whole service)
 - Special needs, e.g. children, pets, baggage
 - Choosing the gender of personnel (if contact is direct and can be relevant)
 - Available information about the presence of other occupants/users (e.g. children, pets; if it can be relevant)

5.3.6. Payment

- As wide variety of payment forms as possible:
 - Cash (if not increases security risk significantly)
 - Credit/Debit card
 - Digital wallets (e.g. Paypal)
 - In advance / after use
 - Personal account
- No minimum amount of purchase
- Affordable and transparent pricing:
 - Clear and understandable fares/prices
 - Indication of actual price
 - Budget options
- Secure place for payment
- Optional (and not mandatory) connection/integration of account with other services

5.3.7. Customer service

- Possibility of getting human assistance:
 - Assigning the same personnel for the same user if possible
 - Include person with impairment in staff
 - Reliable, friendly, and empathic staff
- Alternative channels:
 - Personal assistance, support (if possible) at contact points
 - Remote help via phone
 - Remote help online (in video, audio, or text)
 - Assistance chat for people who cannot speak / cannot speak the language
- Availability in 24/7 if possible, or at least during service working hours
- Accessible in several languages

5.3.8. Dissemination

- Letting know possible users about the existence of service via as many channels as possible:
 - Electronic media, online
 - Social media, influencers
 - Integration in electronic services, e.g., Google Maps
 - Local, printed media
 - Flyers, brochures
 - Local organizations, associations
 - Advertisements in local stores, services, schools
- Facilitating user involvement:
 - Clear communication of advantages
 - Clear description of registration process
 - Manual/guide available in own language

5.3.9. Covid-19 protocol

- Establishment and communication of cleaning protocol
- Actions to prevent infection:
 - Disinfection, ventilation of service area
 - Personal hygiene equipment
 - Control of crowd, keeping distance

6. General recommendations

This final section of the manual contains a **summary of the main requirements** that developers, operators and policymakers should bear in mind when creating digital mobility and delivery services and platforms, and when upgrading or updating existing apps/services.

6.1. Involvement of target groups

Target groups and a variety of citizens and relevant organizations should be involved and committed throughout the process. Users are a valuable source of insights and should accompany the design generation from the beginning to the end, through different instances of consultation.

6.2. Accessibility

6.2.1. Enable multichannel communication and feedback from users

Multichannel communication and feedback from users imply that different sensorial levels of interaction are considered. Channels of input-output should cover as many senses as possible. This point is addressed in the present document with different requirements, from the sound to confirm user's actions, the availability of captions for tutorial videos, the written chat with service agents etc.

6.2.2. Simplify the cognitive processes

The **simplification of the cognitive processes** contained in the use of the app covers all the requirements associated with auto-filling, completion, suggestions by the app, warning messages and error correction. Altogether, they aim at reducing the mental load and the complexity of mental work contained in the process of ordering or purchasing. It implies also relieving memory and enabling that several resources are invested in other mental tasks.

6.2.3. Ensure certainty

The **provision of certainty** aims at avoiding unexpected elements and generating uniformity and sense of anticipation. This is related to some requirements such as the uniformity of icons and spatial organization, the uniformity of shapes and packages, the presence of maps with the real-time position of goods and service agents, among other points.

6.2.4. Implement and communicate universality

The fourth recommendation concerns not only implementing **universality and adaptations for all users and related capabilities** when needed, but also **communicating** them. This means, that providing up-to-date or real-time accurate information about accessibility measures of the services is part of the accessibility condition itself.

6.2.5. Preserve the importance of human contact

Humans value other humans: humanity represents warmth and accompaniment and human contact is especially important for users who feel vulnerable when facing a challenging scenario. Therefore digital mobility services should be designed in a way that human contact is preserved.

6.3. Inclusivity

6.3.1. Consider caregivers

The first recommendation is to consider users who are looking after other people, who are responsible for others. **Caregivers** have special needs that should be explored at the time of designing, including their requirements with regards to equipment, onboarding and offboarding spots (in the case of mobility), contact with the driver/courier and other users etc.

6.3.2. Adapt language

Language options should be present, especially in multi-lingual societies or areas with many migrants. But, beyond that, it is important to build a neutral idiomatic interface, which is free of generational or technical terms, or words specifically associated with a niche of users.

6.3.3. Provide affordable services

Another key **recommendation for ensuring the inclusivity** is to provide **affordable services** or, at least, offer a wide range of products and services where different users can find the one that is suitable for their **level of income**. The requirement of no minimum amount of purchase or the availability of economic menus in delivery food for example addresses this point.

6.4. Usability

6.4.1. Simplify processes and resources

The first recommendation is the **simplification of processes and resources**: for instance, a step-by-step flow which is solved with questions directed to the user in a clear form.

6.4.2. Use visual aids

The second recommendation is the **graphic richness of the app**, the use of visual aids to simplify process of interpretation and decoding. In line with the last item, some **specific visual supports**, such as completion bar, may alleviate the feeling of anxiety and uncertainty about the end of the workflow.