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Abstract	The deliverable describes the inclusive digital mobility solutions designed, developed, and tested by the pilot cities. The activities were led through 1) co-design workshops, 2) developing and validating high-level prototypes and/or solutions (TRL3-7) and testing solutions in situ where possible or 3) validating them via UX research/testing.
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Executive Summary

This document will describe the work done in Task 6.1 “Developing the Pilot Case Study briefs” (lifetime M14-M18) and task 6.2 “Conducting Pilot Case studies” (lifetime M19-M31) by the city partners, making use of the Co-Design-for-All methodology (WP5) developed throughout the project.

This deliverable is based on the results of the following activities in the WP6 “Pilot Case studies and Business Case Development” framework (started at M14 and it will end at M34):

- The pilot case study briefs, where the city partners provided information on their focus in terms of digital mobility solution/s and why;
- The digital mobility solutions, designed, developed (in some cases) and tested by the city partners, in accordance with the pilot case study briefs.

The information collected in this deliverable will be used in task 6.3 “Business Case Development for Full-scale Deployment”.

This deliverable was initially due to be submitted at M31 (August 2022) but, due to the holiday period, the local WGs experienced recruitment issues with industrial and societal partners, and therefore, we requested the submission to be postponed until M33 (October 2022).

In addition to the description of activities performed in this period, this deliverable also includes a set of descriptions of lessons learnt from the process.

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List of acronyms/abbreviations

Abbreviation	Explanation
AAATE	Association for the Advancement of Assistive Technology in Europe
CUT	Core User Team
CTM	Consorzio Trasporti e Mobilità (Transport provider in Sardinia)
DLR	Deutsches Zentrum für Luft- und Raumfahrt
ENIL	European Network on Independent Living
LUL	Local User Lead
MDI	Mobility Divide Index
SRM	Reti e Mobilità Srl (Transport provider in Bologna)
TB	T Bridge (Management and ICT consultancy company in Italy)
TRL	Technology Readiness Level
TUE	Eindhoven University of Technology
UITP	The International Association of Public Transport
UMC	Urban Mobility Center (Transport provider in Sofia)
UX	User Experience
WG	Working group
WP	Work Package

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1. Introduction

The goal of the TRIPS (*TRansport Innovation for vulnerable-to-exclusion People needs Satisfaction*, https://trips-project.eu/) project is to design, describe and demonstrate in practice how to empower persons with disabilities to play a central role in designing the inclusive digital mobility solutions. It puts forward a co-design approach that underpins Mandate 473: *Design for All* to eliminate discrimination and improve Access-for-All to mobility services[1]. This project seeks to understand important and often overlooked aspects of user's ability and readiness to take advantage of new mobility opportunities by undertaking in depth targeted user involvement in the co-design of urban mobility solutions during the pilot studies.

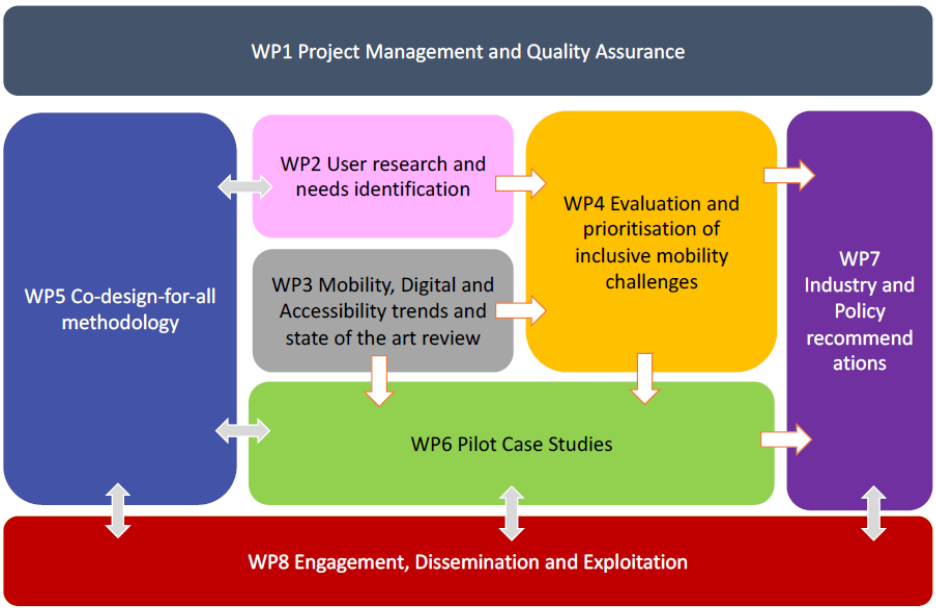

Figure 1: Workstream within the TRIPS project

The TRIPS project brings together users with different disabilities and access needs, transport providers, assistive technology experts and municipalities to engage in open innovation on mobility. Supported by design methodology experts, systems integration experts and privacy experts, the TRIPS project are deploying a *Co-design-for-All methodology* in seven project cities – Bologna, Brussels, Cagliari, Lisbon, Sofia, Stockholm and Zagreb - to develop selected inclusive digital mobility solutions and their respective business cases to support their subsequent adoption. The project is also bringing users and transport experts together to discuss institutional barriers to adoption, agree innovation priorities and policy changes, co-develop an innovation roadmap. In doing so, the project reaffirms the role of users with disabilities as drivers for change and active citizens alongside with regional authorities and businesses in designing digital transport solutions,

[1] European Commission (2010). Standardisation mandate to CEN, CENELEC and ETSI to include "Design for All" in relevant standardisation initiatives. Available from: https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=461# Last accessed on 19/06/2022

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and policy-makers in designing appropriate regulatory frameworks and social and educational strategies.

WP6 is strongly related to almost all work packages (WPs) of the project, but especially with WP5: after the TRIPS consortium and Local User Leads (LULs) have co-developed a co-design-for-all methodology with citizens with disabilities and transport experts in WP5, they are using this methodology and way of working to develop digital, mobility solutions in pilot cities in WP6.

In general, **WP6 serves two purposes**. On the one hand, it applies **the developed Co-design-for-All methodology in practice** with local users and transport ecosystem in context. By doing so, it provides the opportunity to test and validate it and elicit lessons learned from this practical application. It also applies the accessibility metrics methodology developed in WP4 in order to outline the ex-ante and ex-post mobility divide values for each pilot case. These values are fundamental to verify that all the solutions which are designed and eventually implemented, can practically have a positive effect in terms of accessibility of transport services for vulnerable users, reducing as much as possible the gap with "normally-endowed".

On the other hand, the resulting mobility solutions (both designs and demonstrators), along with associated business cases for their full-scale deployment (Task 6.3) **become an asset of the local transport ecosystems and an example to imitate and learn from for other cities and regions.** Lessons learned and outcomes, as well as policy, institutional and other challenges encountered will also inform the comprehensive roadmap (incl. policy and industry recommendations) in WP7, which will be widely disseminated in WP8.

2. The context

2.1. The local teams

As mentioned, there are local teams in seven project cities, which are usually led by the Core User Team (CUT) composed of users with different disabilities and access needs and led by a local user lead (LUL). The enlarged working group (WG) brings together the CUT and transport providers, representatives of municipalities and researchers. A short introduction of each local team is provided below:

- **Bologna:** The CUT in Bologna is made up of 8 members, of which 7 are persons with mobility and visual disabilities. The enlarged WG consists of members of SRM (Agency for Mobility of Bologna metropolitan city (Public Authority), municipality of Bologna - Mobility Department (Public Authority) and representatives of TPB (Transport service provider). Their participation in this project is motivated by the desire to actively participate in the improvement of public transport in their city to make it accessible for everyone. The CUT members are interested in participating in all meetings that can lead to a real improvement of personal autonomy, and they agree that it is important to establish a dialogue between persons with disabilities and decision makers.

- **Brussels:** Brussels CUT is made up of 8 persons with physical, visual and hearing disabilities. Most of them are already engaged in other actions in Brussels, besides the TRIPS project, to promote inclusion and mobility for persons with reduced

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mobility, such as discussions and advice to municipalities or various projects supported by Belgian non-profit organisations for persons with disabilities. Their participation in the European TRIPS project is motivated by the will to improve the Brussels public transport accessibility by including persons with disabilities in the reflection and decision processes.

- **Cagliari:** Their CUT is composed of 7 persons, including the LUL, representing three types of disabilities (visual, hearing and mobility). The extended WG includes 4 members from CTM, the local public transport provider for Cagliari. Other partners like fellow transport operators and political actors have been involved at different stages of the project. The Municipality of Cagliari has also stated its interest in creating some form of partnership for matters pertaining to universal accessibility

- **Lisbon:** There are 6 persons with different mobility impairments, from wheelchair users, to those who have difficulties while walking, and blind people in the CUT. The extended WG is composed of representatives from the Bus and Trams operator, Carris, City of Lisbon, Lisbon's Metropolitan Ticketing System, and some other operators in Lisbon. Their motivation to be a part of the project arises from the ambition to improve rights of persons with disabilities, passion for a more sustainable mobility, interest in shifting the way transport networks are designed and operated, and a desire of improving the way we move out and about.

- **Sofia:** Their CUT is made up of 6 persons with physical, visual and hearing disabilities. In the extended WG they are having representatives from Urban Mobility Center and Bulgarian State Railways. Their main motivation to be part of TRIPS project is improved communication between passengers with disabilities and the system of the Urban Mobility Center, and the accessibility of the public transport stops too. Current existing mobility solutions in Sofia are not fully accessible and have limited possibilities for persons with different access needs, and there is a high need for improvement.

- **Stockholm:** The CUT in Stockholm consists of 9 persons with visual, mobility and intellectual disabilities. The extended WG has 3 representatives from the academic sector, 3 representatives from various transport companies, 2 city authorities and one representative from another NGO. Their motivation is driven by the willingness to see if they can contribute to any improvement in Stockholm's public transport and to promote co-design as a methodology. Their priorities are what drives the process of improvement, and it is important that the CUT can contribute to this process by identifying their conditions and knowledge on what works and what does not work for persons with different disabilities.

- **Zagreb:** The CUT is made of 7 persons with disabilities who are working together to develop a digital solution to improve the mobility of persons with disabilities in public transport. In the TRIPS project they aim is to design, describe and demonstrate the practical steps to empower persons with disabilities to play a central role in the co-design of inclusive digital mobility solutions. They would like to use their experience to contribute to the project, so that we can all enjoy a better society in the future, which will accept differences and make sure that those who are different have equal opportunities.

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All of these seven cities have joined the project in order to improve the accessibility of public transportation in their cities by implementing the Co-design-for-All methodology in their WGs.

2.2. Co-Design-for-All methodology

In the TRIPS project, Co-Design-for-All methodology is a way of working which empowers all actors in the process to participate fully on the basis of shared knowledge and equal partnerships. TRIPS takes the stance that to develop inclusive digital travel ecosystems persons with disabilities should be active participants in the process of designing them. Their participation in the innovation process is driving the development of intuitive designs that place minimal requirements for upskilling and respect users' range of abilities. The development of Co-design-for-All methodology enables users with different disabilities to become active participants in open innovation. It also accounts for stakeholders' specific skills, willingness and ability to assume a new role as an active participant of the digital travel ecosystem.

The Co-Design-for-All process in TRIPS is divided over four phases based on an iterative approach. In the **Prepare** phase (WP2), working groups were formed to facilitate citizens of the seven cities to participate in the project. In the **Co-produce** phase (WP2 and WP3), the barriers identified and the end-user perspectives were examined based on the findings of the social media content analysis and qualitative interviews. The aim of the third phase -**Co-create** (WP4 and WP5), is together with users to find possible solutions of the Technology Readiness Levels 3+ for the previously identified barriers and challenges. These solutions are supposed to help municipalities on their journey to accessible inclusive digital mobility. The methodology is described in the section concerning the planned activities. As the last step of the Co-Design-for-All process, the created solutions are implemented and evaluated in the **Co-evaluate** phase (WP6). The created products will be tested by the users in pilot studies in the seven cities. Furthermore, the project is developing the **Mobility Divide Index** (MDI) as a set of comparable indicators for evaluating transport systems and creating new, user-centric standards for researchers, policy makers, transport and urban planners.

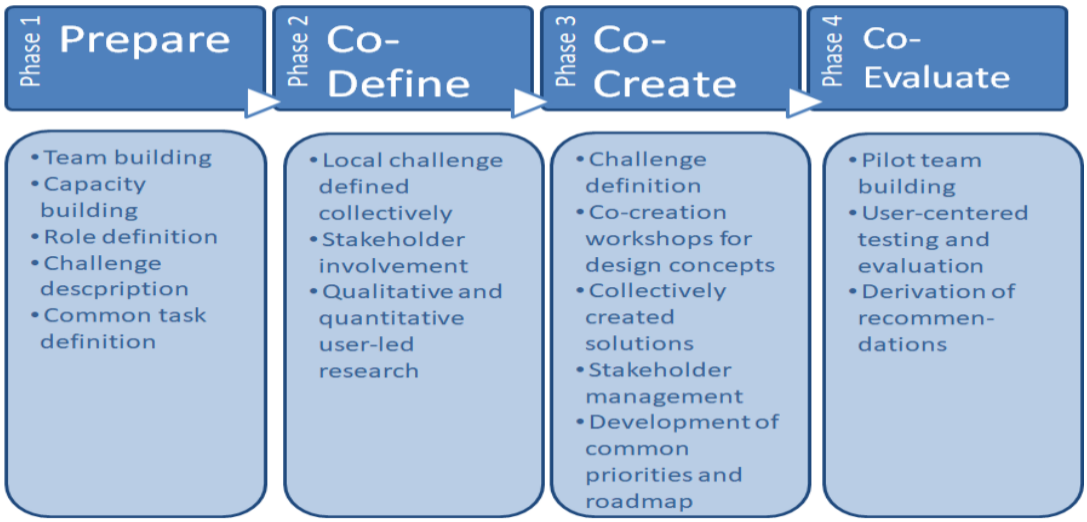

Figure 2: Four phases of the co-design process of the TRIPS project

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The work to co-design and deploy collaborative methods with the teams in the seven cities was initially intended to be developed through a string of in-person activities allowing for the methodological approach to be designed in short bursts of engagement. However, due to Covid-19 pandemic related restrictions, almost all the project activities have been conducted online. Therefore the Co-Design-for-All has taken on a much more elaborate and personalised form. To make up for the loss of in-person activities, we engaged each city WG in a string of conversations to anchor the methodologies into strongly held local concerns and to guarantee that the processes remain within our understanding of co-design and co-production, despite the clear limitations of online work.

This work unfolded as a series of regular 1:1 sessions, where we used a combination of qualitative research methods: semi-structured interviews, open-ended activities, writing exercises, surveys, offline activities, etc. Our focus was on creating a dynamic working rhythm and generating mechanisms to allow for heterogeneous interests and in-depth understandings to come forward. In these sessions, we regularly had two to four participants, and the workshops were open to the full local CUTs in each city. The number of activities varied per group, because in this work we recognise that not all cities arrive at this process on the same footing: their needs, wants and challenges are unique and contingent to their local contexts, and therefore require ways of working that emerges from within each one of the groups involved. As a result, our methods are situated in the lived context of each group.

3. The Approach

Task 6.2 is about developing the **inclusive digital mobility solutions and pilot testing.** It involves organising and conducting 1) Co-Design-for-All workshops, 2) developing and validating high-level prototypes and/or solutions (TRL[2] 3-7) and testing solutions in situ where possible or 3) validating them via UX research/testing. T6.2 is based on the results carried out in the previous **Task 6.1** ("Developing the Pilot Case Study briefs") whose aim was to define the scope and focal inclusive digital mobility challenges, and the overall methodology of conducting the pilot case studies. This was a productive exercise for the cities (who produced their pilot case study brief based on a provided template, attached in the Annex 1) to focus on what they wanted to propose as solutions (by identifying the transport services and kinds of impairments and/or disabilities that should be affected by the change propositions), which then became the subject of their pilot case studies. Each city WG initiated a set of meetings to discuss and agree on which mobility challenges they wanted to focus on in order to identify the solution/s aimed to overcome them. For each solution they identified a Starting TRL and a Target TRL. This was useful in order to understand the initial technology maturity of the solutions proposed and the target technology maturity to be achieved at the end of the pilot case study stage. A similar approach was taken on the MDI (Mobility Divide Index). The MDI (see D4.1 "MDI - Mobility Divide Index") provides a measurement of the accessibility level of transport services and was used to investigate the current accessibility level of the transport services involved in the change propositions and then to define a target accessibility level (in theory an

[2]Technology Readiness Level (2017). HORIZON 2020 – WORK PROGRAMME 2018-2020 Available from: https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf Last accessed on 28/08/2022

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improvement) for the solution/s implementation. Within the brief, the local WGs worked on the UX research activities, and identified the phases and subphases of the journey on which they wanted to focus and defined the current barriers (for each specific impairment) and possible improvements for overcoming them.

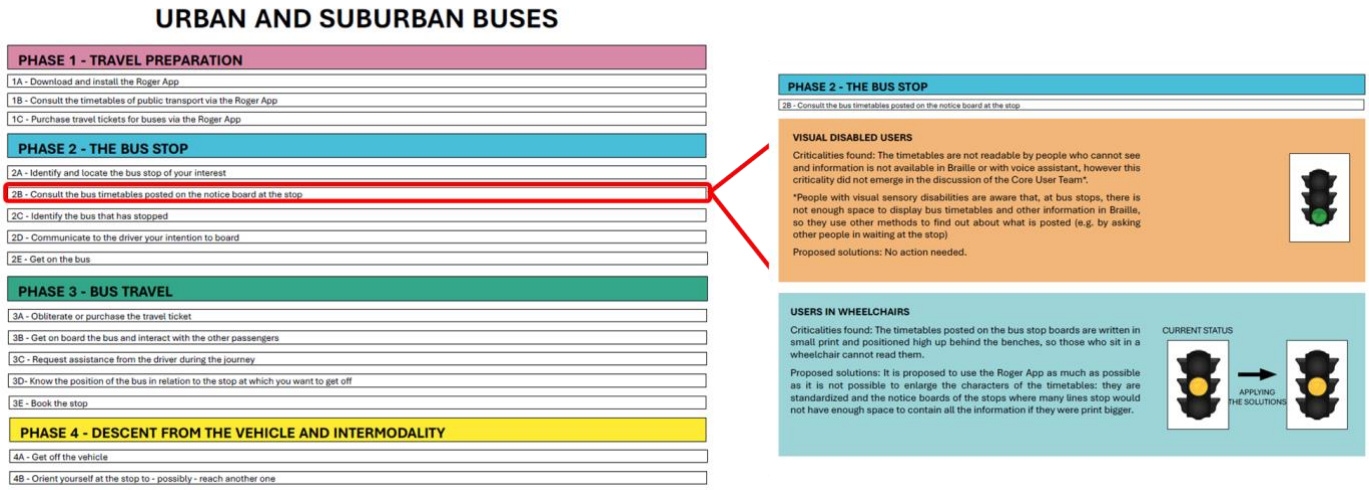
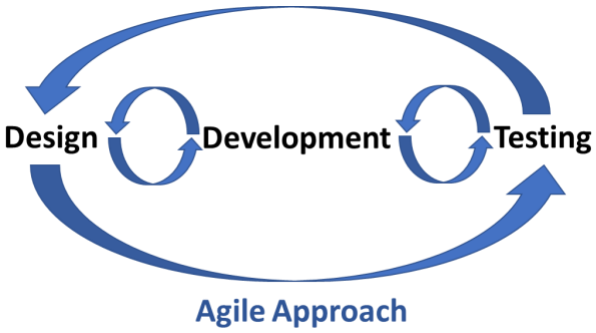


Figure 3: Example of UX research activity

Also a PEST analysis on the solution/s and pilot case study planning was implemented. The whole pilot case study briefs were shared and approved by the local stakeholders who make up the enlarged WG. All pilot case study briefs are attached in Annex 1 for further details.

According to the stages identified **(Design, Development** and **Testing)** in the section of the pilot case study brief dedicated to the pilot planning, the methodology adopted in the task 6.2, respected this breakdown by keeping an iterative and agile approach[3].



The descriptions of each stage are provided below:

[3] "Agile Software Development Methodologies and Practices", L. Wiliams Department of Computer Science, North Carolina State University, Raleigh, North Carolina, USA, 2010, Available from: https://doi.org/10.1016/S0065-2458(10)80001-4. Last accessed on 18/08/2022

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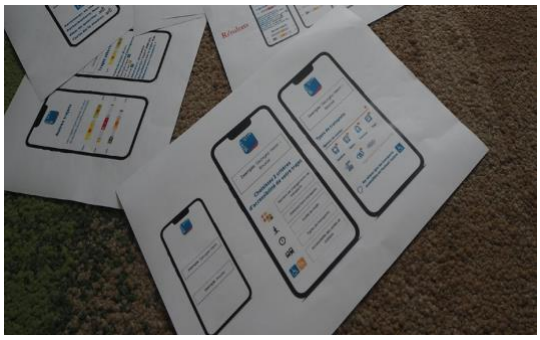
1) Design stage:



A design concept is the core idea driving the design of a product, explained through a collection of sketches, images, and a written statement. This helps the designers and later, the developers stay on track throughout the creative process, ensuring they bring a product to market with value to target users.[4]

The design stage is a little more fluid than other stages, because input from a later step might require going back to the drawing board to incorporate it. In the design stage the collaborative design process begins where all insights from the users are pulled together and refined into a unified design. This then delivers a finalised visual design, which can be combined with the UX flow to create a working **prototype**[5].

In this stage all WG members were supposed to describe the functional requirements for their envisaged mobility solution. The term **requirement** generally refers to the **user needs** (i. e. what do the users need to make their journeys more accessible and independent?). More specifically, a requirement describes how the user interacts with the solution to be able to use the solution itself in all its functionalities (e. g., in order to book the taxi through the app, the user opens the app, then he/she goes to the menu and selects the “Taxi booking” section). To describe the requirements, the local teams were asked to start with phases and barriers, which were already raised in the UX activity of Task 6.1, and begin thinking about how the solution should work to meet the users’ needs and to overcome the barriers raised in each phase of the journey. Since users with different disabilities are facing different barriers and have different needs, the CUTs were invited to describe the requirements separately for users with different disabilities (see the figure below for an example).

[4] What is a design concept? (2022). Available from: https://airfocus.com/glossary/what-is-a-design-concept/. Last accessed on 19/08/2022

[5] The 4 stages of app development (2022). Available from: https://www.businessofapps.com/insights/stages-of-app-development/. Last accessed on 19/08/2022

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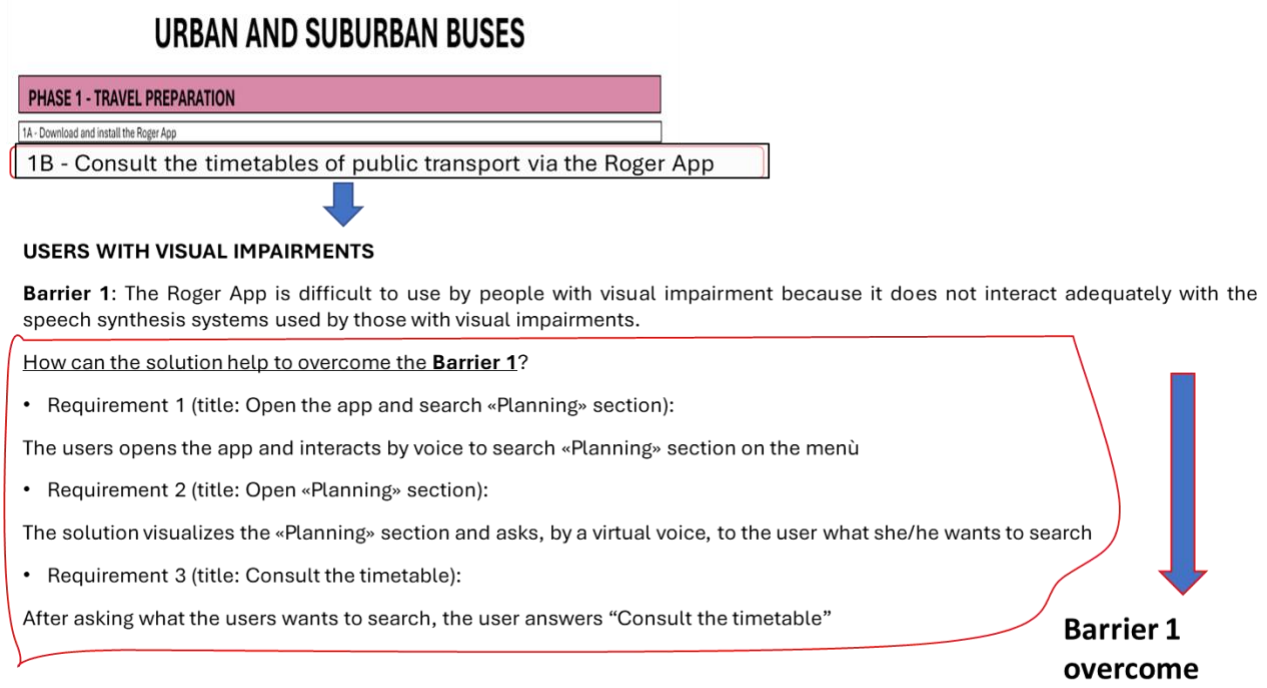

Figure 4: Example of requirement for persons with visual impairments

2) Development stage

This stage was about developing and working on the idea, designed by the team in the previous design stage. Development is an iterative process and will continue after the first launch as you receive user feedback potentially resulting in new functionality. The design stage should have provided the teams with a visual design and a wireframe, showing how the solution will work. In some cases, an interactive **prototype** might be built as it gives a sense of how using the solution will feel.[6]

A prototype is an early sample[7], model, or release of a product built to test a concept or process. A prototype is generally used to evaluate a new design to enhance precision by system analysts and users. The purpose of each prototype is to provide specifications for a real, working system rather than a theoretical one.In some design workflow models, creating a prototype (this process is sometimes called a materialisation) is the step between the formalisation and the evaluation of an idea (e.g. through the TRL).

[6] The 4 stages of app development (2022). https://www.businessofapps.com/insights/stages-of-app-development/. Last accessed on 19/08/2022

[7] What is a prototype? (2020). Available from: https://www.oceancommunitychallenge.com/post/what-is-a-prototype Last accessed on 19/08/2022

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The development stage has a vital component, situated at the crossroads between design and development: a detailed **technical specification**. This takes the wireframe and annotates it in more detail – how it will actually work, as well as how it looks. In this stage, the full partner cities were asked to provide the specifications for their designed mobility solution. Here, the **specification** refers to a detailed, usually technical description of how an identified need will be met with their developed mobility solution.

One of the most important aspects of development is to build an expert team that will help lead you through all steps of mobility solution development and ensure the solution's integrity. During development the experts are alert to the developed system's limitations and optimal UX solutions and can provide useful input to business analysts and designers.[8]

3) Testing stage

Solution testing is the process of evaluating and verifying that a product or application does what it is supposed to do, according to the specified requirements. These tests can be split into classes, such as functional tests, usability tests (including accessibility), non-functional tests. In Task 6.2 the cities did the functional tests on the prototype level in order to verify that the requirements written in the Design stage indeed help to overcome the barriers identified through the UX activity done in Task 6.1.

Therefore, in the beginning of Task 6.2 [M19], LULs were introduced to the three stages, related definitions and the exact requirements with examples on how to describe the process of each of the stages and how to fill in the requirements (for the design stage) and specifications (for the development stage). For this task, all LULs were also provided with the template and concrete guidelines on how each of the three stages should be described in the template (see Annex no. 3).

4. The Pilot Case Studies (Outcomes)

The following chapters will describe in detail the outcomes from each city involved in the project (i.e. full city partners Bologna, Cagliari, Lisbon and Zagreb; and associated city partners Brussels, Sofia and Stockholm). The expectations between the full city partners and the associated city partners were different. As mentioned before, the first group had to foresee all the stages of the pilot case study, in terms of design, development and testing of the solutions, while the second group just worked on the design and the testing ("on paper") of the solutions. Before focusing on the **pilot case study** stage for each city, a summary of what they promised before that stage, in the form of a **pilot case study brief.**

Once the pilot case study briefs were defined, the stage of the pilot case studies started, and in the following we will dedicate a chapter to each city. The outcomes are described for each stage as foreseen from the planning written in the pilot case study briefs, namely the **(1) design, (2) development** and **(3) testing** (as mentioned above full city partners completed all these stages while the associated city partners only completed the first and third one.). For the **(1) design stage,** the city partners were requested to fill in the specific

[8] 5 essential stages of mobility app development (2020). Available from: https://nix-united.com/blog/5-essential-stages-of-mobile-app-development/ Last accessed on 20/08/2022

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table (and optionally any further information) included in the template (Annex n. 3) provided to them.

The table (one for each type of impairment) includes the functional requirements of the identified solution/s, starting from the work done for the **pilot case study brief** in the UX research activity. The requirements specify how each solution helps to overcome the barriers identified (in the UX research activity) for the specific sub-phase of the journey. Therefore, the table required the following descriptive items:

- Phase of journey;
- Sub-phase of the journey;
- Barrier of the specific sub-phase;
- Requirement N.(ID);
- Title of the requirement;
- Description on how the requirement should work;
- Comments.

For the **(2) development stage**, the city partners were asked to write the **technical specifications of the solution** (e.g. in case of app, could it be installed on both iOS and Android systems? etc.) and any further information. However, it was decided to write a common list of technical specifications (Annex 2), including some customisations, since all the four full city partners (and also associated city partners) opted for a journey planner app as their main solution.

For the **(3) testing stage,** the city partners were requested **to test the functional requirements** of their solution. To do this, they started from the table already filled during the design stage, but a new column "check (OK, Not OK, Partial)" was included in order to verify if the solution actually helped to overcome the barriers, as expected from the design stage. The full city partners were able to test the solutions developed during the second stage, while associated partners tested the solutions designed during the first stage "on paper".

Finally, **in accordance with the principles for agile development approaches ,** the city partners **were asked to update any information (tables, etc) of each stage throughout the whole task**. However, for ease of reading only the last updated version of the activities of each stage will be included here.

4.1. Bologna Pilot Case Study

4.1.1. The Pilot Case Study Brief

The Bologna WG proposed **a set of solutions** to the local stakeholders (who approved)**,** with the aim **to develop recommendations** that together form **a set of guidelines leading to the improvement of the overall accessibility of public transport in Bologna**. The transport services affected by their change propositions are buses and car sharing, and focused mostly on visual and physical disabilities.

Bologna WG proposed the following solutions (and for each solution, a starting TRL and a target TRL were defined):

- Urban Buses:

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1. **Recommendations for the improvement on the official app (Roger app) of Bologna's bus transport operator**, in order to improve the accessibility for persons with visual disabilities and to provide useful information to persons with physical disabilities in order to create an accessible itinerary (e.g. the information on the actual presence of ramps on the buses, etc.). **The starting TRL is 1** (e.g. Basic principles observed) and the **target TRL is 5** (e.g. Technology validated in relevant environment);
2. **Recommendations for the improvement of bus stops**: in order to improve busstop identification for persons with visual disabilities and to improve the usability for wheelchair users. **The starting TRL is 1** (e.g. Basic principles observed) and **target TRL is 5** (e.g. Technology validated in relevant environment);
3. **Recommendations for boosting the accessibility of buses**, by improving the bus fleet, so that the presence of ramps for wheelchairs access is always guaranteed, as well comfort and safety on board, and the voice assistant always works. **The starting TRL is 1** (e.g. Basic principles observed) and the **target TRL is 5** (e.g. Technology validated in relevant environment);
4. **Recommendations for the training of the personnel of the transport provider**, so that they can guarantee the right assistance to travellers with disabilities (when necessary) and the full operation of the bus functionalities. **The starting TRL is 1** (e.g. Basic principles observed) and the **target TRL is 4** (e.g. Technology validated in lab).

- Car Sharing:
    5. **Recommendations for boosting the car sharing service accessibility**: by improving the fleet to guarantee the availability of a minimum number of cars on which wheelchair users can travel and full accessibility of app for people with visual disabilities. **The starting TRL is 1** (e.g. Basic principles observed) and the **target TRL is 5** (e.g. Technology validated in relevant environment);

By focussing on these solutions, the Bologna's WG identified and addressed **7 mobility challenges**:

1. **The journey planner *Roger App* is not fully accessible for travellers with visual and mobility disabilities**. This app does not contain complete information about the accessible buses. It is difficult to use for people with visual disabilities because it does not interact adequately with the voice over systems. The *Roger App* is not comfortable for persons with mobility disabilities as it does not provide reliable information regarding the actual presence of ramps on the buses to facilitate access to public transport for wheelchair users.
2. **Difficulties to identify the needed bus.** Bus stops are difficult to identify, especially for blind or persons with severe visual disabilities when they are not announced in a way accessible for persons with visual impairments. This leads to difficulties in understanding when it is time to get off the bus; difficulty of orientation, on the road, and in relation to the location of the stops at an intersection.
3. **The voice assistant on buses is not accessible for persons with visual disabilities.** The voice assistant often has the volume which is too low or does not

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work. It is not clear whether the volume of the voice assistant on board the buses is adjustable by the driver and whether he can activate / deactivate the service at will.

4. **Accessibility of buses and the use of on-board services (validating and purchasing tickets), lack of comfort and safety for wheelchair users.** For example, the scheduling of ramp buses needs to be improved as it is not reliable and buses accessible with ramps must be booked in advance; the passage of ramp buses should be established in time, at precise and predefined times, which allow for the planning of one's trip.
5. **Lack of communication between the decision makers and travellers with disabilities**. When it comes to design, decision makers mostly focus on persons in in wheelchairs and do not realise that there are other types of disabilities, it is necessary to ensure that they are all equally considered.
6. **Lack of knowledge of disability etiquette.** Accessibility on public buses can be problematic: the drivers (especially in suburban areas) expect those waiting at the shelter to signal with their arms that they have to board the bus, which is impossible for those who cannot read the line number or can be hard for some travellers with some disabilities.
7. **Lack of electric rental cars equipped for persons with disabilities.** In Bologna, there are no electric rental cars equipped for persons with disabilities (low floor and manual platform). It would be sufficient to have some cars with manual ramps and adaptations to driving for people with motor disabilities which could be activated / deactivated depending on the user of the vehicle and also be driven by able-bodied people.

Furthermore, through a specific survey, the **current MDI of the transport services involved** was measured at **5,42** and the target for the end of the pilot case study stage was defined, in order to measure the accessibility of the transport after the solution implementation. The Bologna WG identified the **Target MDI value 3,95** to validate the improvement of the transport accessibility thanks to the solutions. Also the work done on the UX research activities has been tracked in the pilot case study brief. A PEST analysis was implemented for each solution and in the Annex 1, details are available. Finally, the Bologna WG agreed a pilot case study planning with the local stakeholders, which is available in detail in the Annex 1.

4.1.2. The Pilot Case Study

During this stage, the Bologna WG confirmed their interest to carry on the activities on the solutions (due the feasibility checked within the project period) proposed in the pilot case study brief, namely:

- Urban Buses:
    - **Solution 1**: "*Recommendations improvements on the official app (Roger app) of Bologna's bus transport operator*";
    - **Solution 2**: "*Recommendations on the improvement of bus stops*";
    - **Solution 3**: "*Recommendations on boosting the accessibility of buses*";
    - **Solution 4**: "*Recommendations on the training of the personnel of the transport provider"*.
- Car Sharing:
    - **Solution 5**: "*Recommendations for boosting the car sharing service accessibility*".

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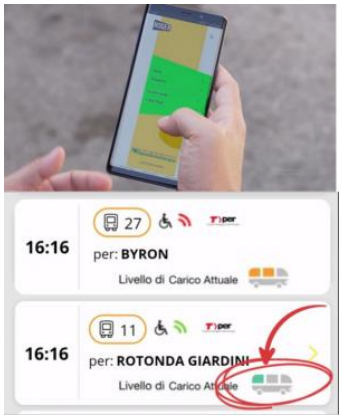
Stage 1: **Design**



Starting from the UX research performed in the previous stage of Task 6.1 (pilot case study brief), the WG analysed the phases and sub-phases of the journey on which they focused and where the current barriers, and possible improvements for overcoming them, were identified. In this activity, they kept the main breakdown between the solutions under the category “Urban buses” and the category “Car sharing”. Therefore, in this pilot case study, the identified phases (and related sub-phases) of the journey were four for the solutions “Urban buses” and two for the solution “Car sharing” (please refer to the tables below, one for each type of impairment).

The columns of the tables below, named, (1) “**Description on how the requirement should work**” and (2) “**Comments**” clarified how the requirements designed for the solutions, should help to overcome the current barriers identified for each sub-phase of the journey included. **Note that each solution doesn’t have an impact on all the sub-phases of the journey (according to an evaluation done during the UX research activity).** However each sub-phase is covered by one or more requirements, except the sub-phase “1A - Download and install the Roger App” of both “Urban buses” solutions and the “Car sharing” solution, because no barriers were found in the UX research. Furthermore, due to the high number of solutions identified and to ease the reading, the requirement ID column of the tables below (column named “Requirement N.”) applies the following terminology: “Number of the solution - Solution category”, namely e.g. “2-BUS” means a requirement referring to the solution 2 of the “Urban buses” category.

Finally, the “Car sharing” solution initially targeted impact just on persons with physical disabilities. However, during this stage, the local WG in Bologna also identified a requirement for persons with visual disabilities, because they may need to book a car sharing vehicle on behalf of a third person.

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URBAN BUSES (Solution 1,2,3 and 4)					
Phase	**Sub-phase**	**Barrier**	**Requirement N.**	**Description on how the requirement should work**	**Comments**
PHASE 1 - TRAVEL PREPARATION	1B- Consult the timetables of public transport via the Roger App	The Roger App is difficult to use by persons with visual disabilities because it does not interact adequately with the speech synthesis systems used by those with visual disabilities.	**1 - BUS**	It is proposed to improve the Roger App by making it totally accessible even to persons with visual disabilities, both for consulting bus timetables and for the eventual purchase of travel tickets.	Users want to be able to use the "Roger" in order to plan their trips, purchase tickets and be informed on the accessibility of public transportation; in particular, blind users want the app "Roger" to be accessible (total functionality of voice over in their smartphones).
	1C - Purchase travel tickets for buses via the Roger App	The Roger App is difficult to use by people with visual disabilities because it does not interact adequately with the speech synthesis systems used by those with visual disabilities.	**1 - BUS**	It is proposed to improve the Roger App by making it totally accessible even to people with visual disabilities, both for consulting bus timetables and for the eventual purchase of travel tickets.	Users want to be able to use the "Roger" in order to plan their trips, purchase tickets and be informed on the accessibility of public transportation; in particular, blind users want the app "Roger" to be accessible (total functionality of voice over in their smartphones).
PHASE 2 - THE BUS STOP	2A - Identify and locate the bus stop of your interest	Criticalities found: Several bus stops have the same name although they are on opposite sides of the road or an intersection, so those who cannot see cannot orient themselves well.	**2 – BUS**	Proposed solutions: Change the name of the stops by adding the unique alphanumeric code to the current name that allows you to distinguish the stops that currently have repeated names.	Persons with visual disabilities want to be able to find their way between bus stops more easily, thus being able to identify stops with certainty.

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	2B - Consult the bus timetables posted on the notice board at the stop	Criticalities found: The timetables are not readable by people who cannot see and information is not available in Braille or with voice assistant, however this criticality did not emerge in the discussion of the Core User Team*. *Persons with visual disabilities are aware that, at bus stops, there is not enough space to display bus timetables and other information in Braille, so they use other methods to find out about what is posted (e.g. by asking other people in waiting at the stop).	**1 - BUS**	Proposed solutions: No action needed. *	Users want to be able to use the “Roger” in order to plan their trips, purchase tickets and be informed on the accessibility of public transportation; in particular, blind users want the app “Roger” to be accessible (total functionality of voice over in their smartphones).
	2C - Identify the bus that has stopped	Criticalities found: The voice assistant who reads the name of the line to those waiting at the stop is not always functioning; when several buses stop in a row at the same time, you risk losing the ride.	**2 – BUS**	Proposed solutions: The voice assistant must always be working and the volume must be adjusted so that it can be heard by all those waiting at the stop. It is necessary to evaluate whether to deepen the training of drivers so that they always stop when they see a person with a white cane waiting and repeat the name of the bus that is passing through.	Persons with visual disabilities want to be able to find their way between bus stops more easily, thus being able to identify stops with certainty.

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			4 - BUS		Persons with disabilities want to access the buses knowing that they can interact with drivers who know how to behave in case of need and who reduce the occurrence of problems in accessing the service and during transport. Transport provider staff should always check if the buses function properly and all the services on board work (voice assistant, push button panel, ticket machines, ramps).
	2D - Communicate to the driver your intention to board	Criticalities encountered: Especially in the case of buses that go to the province, the drivers stop only if the person waiting raises his arm to "call" the stop of the vehicle in transit; this is not possible for those who do not see or have visual impairment.	**2 – BUS**	Proposed solutions: evaluate how to make bus stops “smart” through the Roger App, so that they can communicate to drivers the presence of users who need assistance or who are unable to communicate to drivers their intention to board. It is necessary to evaluate whether to deepen the training of drivers so that they always stop when they see a person with a white cane and repeat the name of the bus that is passing by.	Persons with visual disabilities want to be able to find their way between bus stops more easily, thus being able to identify stops with certainty.

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			4 - BUS		Persons with disabilities want to access the buses knowing that they can interact with drivers who know how to behave in case of need and who reduce the occurrence of problems in accessing the service and during transport. Transport provider staff should always check if the buses function properly and all the services on board work (voice assistant, push button panel, ticket machines, ramps).
PHASE 3 - BUS TRAVEL	3A - Obliterate or purchase the travel ticket	Criticalities found: The ticket machines and ticket machines on board the buses do not have a voice assistant, therefore they are difficult to use by users with visual disabilities.	**3 – BUS**	Proposed solutions: Evaluate how to improve the ticket machines on board by equipping them with a voice assistant.	Persons with visual impairments want to be able to wait at the bus stop with the certainty that all buses stop, communicate the line number aloud and therefore they can safely board; persons with visual disabilities wish to be able to purchase or validate their travel ticket on board without difficulty; they also want to be able to orient themselves properly during the journey so that they know when to get ready to go down.
	3D- Know the position of the bus in relation to the stop at which you want to get off	Problems encountered: The voice assistant who reads the name of the next stop (or the one at which the bus is parked) is not always working or the volume is too low to be heard when the bus is very crowded.	**3 – BUS**	Proposed solutions: The manager of the transport company must ensure that the voice assistant is always functioning and adjusted to the right volume when the public transport enters service.	Persons with visual disabilities want to be able to wait at the bus stop with the certainty that all buses stop, communicate the line number aloud and therefore they can safely board; persons with visual disabilities wish to be able to purchase or validate their travel ticket on board without difficulty; they also want to be able to orient themselves properly

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					during the journey so that they know when to get ready to go down.
			4 - BUS		Persons with disabilities want to access the buses knowing that they can interact with drivers who know how to behave in case of need and who reduce the occurrence of problems in accessing the service and during transport. Transport provider staff should always check if the buses function properly and all the services on board work (voice assistant, push button panel, ticket machines, ramps).
	3E - Book the stop	Problems encountered: The voice assistant who reads the name of the next stop (or the one at which the bus is parked) is not always working or the volume is too low to be heard when the bus is very crowded.	**3 – BUS**	Proposed solutions: The manager of the transport company must ensure that the voice assistant is always functioning and adjusted to the right volume when the public transport enters service. The introduction of the repetition of the stop name upon arrival could be considered, to facilitate users with visual disabilities (or those with other types of disabilities).	Persons with visual disabilities want to be able to wait at the bus stop with the certainty that all buses stop, communicate the line number aloud and therefore they can safely board; persons with visual disabilities wish to be able to purchase or validate their travel ticket on board without difficulty; they also want to be able to orient themselves properly during the journey so that they know when to get ready to go down.

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			4 - BUS		Persons with disabilities want to access the buses knowing that they can interact with drivers who know how to behave in case of need and who reduce the occurrence of problems in accessing the service and during transport. Transport provider staff should always check if the buses function properly and all the services on board work (voice assistant, push button panel, ticket machines, ramps).
PHASE 4 - DESCENT FROM THE VEHICLE AND INTERMODALITY	4B - Orient yourself at the stop to - possibly - reach another one	Criticalities found: Several bus stops have the same name although they are on opposite sides of the road or of an intersection, so those who have visual impairment or disabilities cannot orient themselves well.	**2 – BUS**	Proposed solutions: Change the name of the stops by adding an alphanumeric character to the current name that allows you to distinguish the stops that currently have repeated names.	Persons with visual disabilities want to be able to find their way between bus stops more easily, thus being able to identify stops with certainty.
			4 - BUS		Persons with disabilities want to access the buses knowing that they can interact with drivers who know how to behave in case of need and who reduce the occurrence of problems in accessing the service and during transport. Transport provider staff should always check if the buses function properly and all the services on board work (voice assistant, push button panel, ticket machines, ramps).

Table 1: Bologna WG list of requirements of "Urban buses" solutions for users with visual disabilities

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CAR SHARING (Solution 5)					
Phase	**Sub-phase**	**Barrier**	**Requirement N.**	**Description on how the requirement should work**	**Comments**
PHASE 1 - TRAVEL PREPARATION	1B - Book the car in car sharing	Criticalities found: Users with visual disabilities cannot own the car sharing contract for themselves, therefore they cannot currently use the dedicated app.	**5 - CAR SHARING**	Provide that the dedicated apps are still accessible even to persons with visual disabilities because they may need to book a car sharing vehicle on behalf of a third person.	1B - Book the car in car sharing

Table 2: Bologna WG list of requirements of "Car sharing" solution for users with visual disabilities

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URBAN BUSES (Solution 1,2,3 and 4)					
Phase	**Sub-phase**	**Barrier**	**Requirement N.**	**Description on how the requirement should work**	**Comments**
PHASE 1 - TRAVEL PREPARATION	1B - Consult the timetables of public transport via the Roger App	Criticalities found: The Roger App does not provide reliable information regarding the actual presence of ramps on board buses to facilitate access to public transport for persons using wheelchairs.	**1 - BUS**	Proposed solutions: It is proposed to improve the Roger App so that it can always provide adequate and reliable information for the planning of travel by persons using wheelchairs.	Users want to be able to use the "Roger" in order to plan their trips, purchase tickets and be informed on the accessibility of public transportation; in particular, blind users want the app "Roger" to be accessible (total functionality of voice over in their smartphones).
PHASE 2 - THE BUS STOP	2B - Consult the bus timetables posted on the notice board at the stop	Criticalities found: The timetables posted on the bus stop boards are written in small print and positioned high up behind the benches, so those who use wheelchairs cannot read them.	**1 - BUS**	It is proposed to use the Roger App as much as possible as it is not possible to enlarge the characters of the timetables: they are standardized and the notice boards of the stops where many lines stop would not have enough space to contain all the information if they were printed bigger.	Users want to be able to use the "Roger" in order to plan their trips, purchase tickets and be informed on the accessibility of public transportation; in particular, blind users want the app "Roger" to be accessible (total functionality of voice over in their smartphones).

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	2D - Communicate to the driver your intention to board	Criticalities encountered: To date, it is possible to signal one's presence only by gesturing with an arm to the driver. For some persons with mobility disabilities such movement is not possible. Furthermore, in the event that the stop is crowded, standing people can cover the person using wheelchair from the view of the driver.	**2 – BUS**	Introduce a technological solution that allows the driver to be informed about their intention to get on board.	All persons with disabilities want to be able to get on the bus without difficulty, relying on adequately trained drivers and stops that do not create problems in accessing the means of transport.
			4 - BUS		Persons with disabilities want to access the buses knowing that they can interact with drivers who know how to behave in case of need and who reduce the occurrence of problems in accessing the service and during transport. Transport provider staff should always check if the buses function properly and all the services on board work (voice assistant, push button panel, ticket machines, ramps).
	2E - Get on the bus	Criticalities found: Access to buses, due to the construction characteristics of the stops, often requires assistance from the driver; not all drivers are properly trained for this action.	**2 – BUS**	Improvement of the stops with greater criticalities. Evaluation of any further training of drivers so that they can provide the necessary assistance to those who need help to get on board a bus with their own wheelchair.	All persons with disabilities want to be able to get on the bus without difficulty, relying on adequately trained drivers and stops that do not create problems in accessing the means of transport.

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			4 - BUS		Persons with disabilities want to access the buses knowing that they can interact with drivers who know how to behave in case of need and who reduce the occurrence of problems in accessing the service and during transport. Transport provider staff should always check if the buses function properly and all the services on board work (voice assistant, push button panel, ticket machines, ramps).
PHASE 3 - BUS TRAVEL	3A - Obliterate or purchase the travel ticket	Criticalities found: The ticket machines and ticket machines on board the buses are not easy to reach for those who are using wheelchairs, especially if the bus is very crowded.	**3 – BUS**	Evaluate a better positioning of the ticket machines on board so that they can always be reached by those using wheelchairs.	Persons in wheelchairs want to be able to get on the bus easily, to be able to buy or validate the ticket on board and settle in adequate, comfortable and safe spaces.
	3B - Get on board the bus and interact with the other passengers	Criticalities found: The space reserved for travellers in wheelchairs often obliges them to anchor the wheelchair in the opposite direction to the direction of travel or to have to hold up with their arms; protection from other passengers (impacts, etc.) is not guaranteed.	**3 – BUS**	Improvement and standardisation of spaces reserved for wheelchair users on board buses so that comfort and safety during the journey are always guaranteed.	Persons in wheelchairs want to be able to get on the bus easily, to be able to buy or validate the ticket on board and settle in adequate, comfortable and safe spaces.

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	3C - Request assistance from the driver during the journey	Criticalities found: The push-button panel on board the buses positioned in the place reserved for persons in wheelchairs is not always working.	**3 – BUS**	The manager of the transport company must ensure that the button panel works when the public transport enters service.	Persons in wheelchairs want to be able to get on the bus easily, to be able to buy or validate the ticket on board and settle in adequate, comfortable and safe spaces.
	3D- Know the position of the bus in relation to the stop at which you want to get off	Criticalities found: Sitting at the bottom, in the event of a crowded bus it is difficult to see outside and find your way around by reading the names of the stops on the platforms.	**3 – BUS**	Solutions for the blind users are also useful for this type of user; moreover, screens can be provided with indication of the stop - also useful for persons with hearing disabilities and general users.	Persons in wheelchairs want to be able to get on the bus easily, to be able to buy or validate the ticket on board and settle in adequate, comfortable and safe spaces.
	3E - Book the stop	Criticalities found: The push-button panel on board the buses positioned in the place reserved for persons in wheelchairs is not always functional.	**3 – BUS**	The manager of the transport company must ensure that the push button panel is in operation when the bus comes into service.	Persons in wheelchairs want to be able to get on the bus easily, to be able to buy or validate the ticket on board and settle in adequate, comfortable and safe spaces.
PHASE 4 - DESCENT FROM THE VEHICLE AND INTERMODALITY	4A - Get off the vehicle	Criticalities encountered: Due to the construction characteristics of the stops, getting off the bus often requires assistance from the driver; not all drivers are properly trained.	**2 – BUS**	Improvement of the stops with greater criticalities; evaluation of any further training of drivers so that they can give due assistance to those who need help to get on board a bus with their own wheelchair.	All persons with disabilities want to be able to get on the bus without difficulty, relying on adequately trained drivers and stops that do not create problems in accessing the means of transport.

Table 3: Bologna WG list of requirements of "Urban buses" solutions for users with mobility disabilities

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CAR SHARING (Solution 5)					
Phase	**Sub-phase**	**Barrier**	**Requirement N.**	**Description on how the requirement should work**	**Comments**
PHASE 2 - TRAVEL BY CAR	2A - Get in the car	Criticalities found: In the currently available fleets, there are no cars on which persons in wheelchairs can use freely, therefore the service is inaccessible.	**5 - CAR SHARING**	Include larger cars in the fleet, which can also be used by persons in wheelchairs. These cars, larger than the current ones, could be used by having them driven by a companion of the person with disabilities, but also by those who, able-bodied, need a car with a larger load compartment.	Persons using wheelchairs desire to be able to book a shared car and use it without limitations.
	2B - Settle down and anchor on board	Criticalities found: In the currently available fleets, there are no cars on which persons wheelchairs can use freely, therefore the service is inaccessible.	**5 - CAR SHARING**	Include larger cars in the fleet, on which wheelchairs can be loaded using manual ramps. These cars, larger than the current ones, could be used by having them driven by a companion of the person with disabilities, but also by those who, able-bodied, need a car with a larger load compartment.	Persons in wheelchairs desire to be able to book a shared car and use it without limitations.

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	2C - Get out of the car	Criticalities found: In the currently available fleets, there are no cars on which a person in a wheelchair can be transported, therefore the service is inaccessible.	**5 - CAR SHARING**	Include larger cars in the fleet, on which wheelchairs can be loaded using manual ramps. These cars, larger than the current ones, could be used by having them driven by a companion of the person with disabilities, but also by those who, able-bodied, need a car with a larger load compartment.	Persons in wheelchairs desire to be able to book a shared car and use it without limitations.

Table 4: Bologna WG list of requirements of "Car sharing" solutions for users with mobility disabilities

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Stage 2: **Development**

As mentioned in Chapter 4, in reflection of the results from all full city partners at this stage, it was decided to write a common list of technical specifications (Annex 2), including some customisations, since all of them (including the associated city partners) opted for a journey planner app as the main solution. Indeed, in the case of Bologna, the first solution is *Recommendations for improvements on the official app (Roger app) of Bologna's bus transport operator*.

Stage 3: **Testing**

The Bologna WG, at this stage, **tested the requirements** about the:

- **Solution 1**: "*Recommendations improvements on the official app (Roger app) of Bologna's bus transport operator*";
- **Solution 2**: "*Recommendations on the improvement of bus stops*";
- **Solution 3**: "*Recommendations on boosting the accessibility of buses*";
- **Solution 4**: "*Recommendations on the training of the personnel of the transport provider*".
- **Solution 5**: "*Recommendations for boosting the car sharing service accessibility*".

The proposed solutions have been described in the previous Design stage (Table 1, 2, 3 and 4), to help to overcome the barriers identified through UX activity done in Task 6.1. They were not able to provide details on the testing results for each requirement, however the feedback by the WG was positive overall.

4.2. Cagliari Pilot Case Study

4.2.1. The Pilot Case Study Brief

The **Cagliari WG proposed a set of solutions to the local stakeholders** (who approved)**, with the aim to develop and test new features specifically designed for persons with disabilities, to be uploaded in the CTM's (the official full city partner of Cagliari) App BusFinder (a journey planner).**

The transport service, affected by their proposed changes, is the bus, and persons with physical, visual and hearing disabilities should benefit from them.

The Cagliari WG proposed the following solutions (and for each solution, a starting TRL and a target TRL were defined):

1. **Accessibility improvement of the journey planner app** through:
   - **Bus stops mapping**: mapping of the accessibility (for persons with mobility disabilities) routes from between selected bus stops and final destinations in the city centre of Cagliari. This feature to be integrated into the app (existing BusFinder app). **Starting TRL equals 2** (e.g. Technology concept formulated) and **target TRL equals 6** (e.g. technology demonstrated in relevant environment);
   - **Vocal synthesis capabilities**: to enable the existing BusFinder app to make the accessibility routes mapped, accessible to persons with visual disabilities. **Starting TRL equals 2** (e.g. Technology concept formulated) and **target TRL equals 6** (e.g. technology demonstrated in relevant environment).

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2. **Booking a journey on bus**: integration of a new feature to the existing BusFinder app which allows a person with disability to (a) inform bus control room about the bus stop where the person with disabilities is waiting to board, (b) the bus route she/he would like to board on, as well as (c) about his/her specific disability. In this view, the control room could alert the bus driver and provide timely information for them to manage bus occupancy and ensure appropriate assistance during on boarding. **Starting TRL equals 7** (e.g. System prototype demonstration in operational environment) and target **TRL equals 8** (e.g. System complete and qualified).

Cagliari WG prioritised the solutions in terms of development in the pilot case study and identified the first solution as mandatory while the second one as optional, according to the feasibility investigated during the pilot case study stage.

By focussing on these solutions, the Cagliari WG identified and addressed **2 mobility challenges**:

1. **Architectural barriers and final destination.** Despite the presence of fully accessible bus stops (and those accessible for accompanied users) a user with disabilities often finds it impossible/very difficult to reach a final destination because of the architectural barriers between the bus stop area and the final destination.
2. **Bus stop booking issues for users with disabilities.** Currently there are no chances for persons with visual or mobility disabilities to book a bus stop and seat in advance. Often people with visual disabilities face troubles to recognize if the right bus is coming at the bus stop and furthermore, the driver might not recognise the disability of the user waiting at the bus stop. On the other hand, a person in a wheelchair cannot know in advance if her/his dedicated area on the bus is already occupied by someone else.

Furthermore, through a specific survey, the **current MDI (Mobility Divide Index) of the transport service (i.e. the bus) involved** measured at **5,7** and the target for the end of the pilot case study stage was defined, in order to measure the accessibility of the transport after the solution implementation. The Cagliari WG identified as **Target MDI value 4,7** to validate the improvement of the transport accessibility thanks to the solutions. The work done on the UX research activities has been tracked in the pilot case study brief. A PEST analysis was implemented for each solution and in the Annex 1, details are available. Finally, the Cagliari WG agreed on a pilot case study planning with the local stakeholders, available in detail in the Annex 1.

4.2.2. The Pilot Case Study

During this stage, the Cagliari WG confirmed their interest to carry on the activities on the first proposed solution (due the feasibility checked within the project period) proposed, namely the **CTM's journey planner app (BusFinder) improved in the bus stops mapping and vocal synthesis capabilities** in order to make the app more accessible and to provide transport accessibility info to persons with disabilities. Below the activities for each stage is described in detail.

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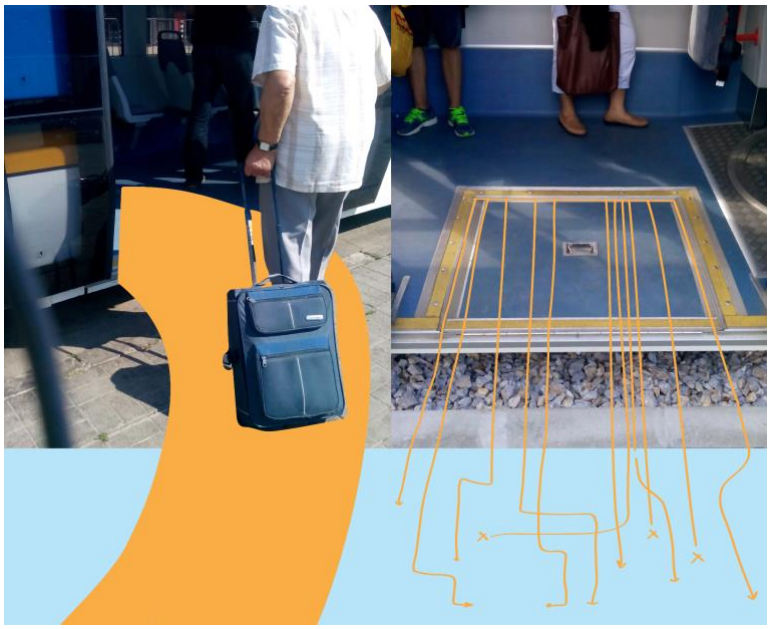
Stage 1: **Design**

Starting from the UX research performed in the previous stage of Task 6.1 (pilot case study brief), the WG analysed the phases and sub-phases of the journey on which they focused and where the current barriers and possible improvements for overcoming them, were identified. Therefore, in this pilot case study, the identified phases of the journey were two and for each one, one sub-phase was identified (please refer to the tables below, one for each type of disability/impaiirment).

The columns of the tables below, named (1) "**Title of the requirements**", (2) "**Description on how the requirement should work**" and (3) "**Comments**" clarified how the requirements designed for the journey planner BusFinder, should help to overcome the current barriers identified for each sub-phase of the journey.



Actually, the requirements were expected to be written also for people with hearing disabilities, but the only member of CUT, who was deaf, was replaced by someone with Usher's syndrome, which affects more visual abilities compared to hearing abilities. Accordingly, his contribution to the Pilot falls into the visual impairment section. In general, it has been agreed that it is very complicated to represent the needs of users with hearing disabilities, even within the realm of disability associations. From technical issues when participating in online meetings to contacting him as part of the Project activities, the LUL was faced with unexpected and, in the end, impossible to overcome difficulties that determined his exit from the project.

Furthermore, the number of bus stops interested by the mapping and vocal synthesis development has been higher than originally expected, sometimes including other types of vulnerable to exclusion people, such as those living in remote, and often infrastructure-wise poorly served, areas, at least by urban standards

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The maps produced were shown to 3 institutional stakeholders during 3 separate online meetings. This added activity was carried out to verify possible infrastructural interventions on their behalf on the most critical situations discovered during the mapping activity. Videos detailing the criticalities were shown during the meetings. Difficulties to actively include other transport operators in the pilot case have meant that the pilot itself revolves solely around CTM bus stop infrastructures.

CTM went through a massive reorganisation one year into the project. This meant that the former responsible had to be replaced with obvious consequences and added difficulties.

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Phase	Sub-phase	Barrier	Requirement N.	Title of the requirements	Description on how the requirement should work	Comments
1) Collecting information for the journey	a. Verifying the accessibility of the route toward a destination	The App BusFinder does not currently contain a section that can provide users with visual disabilities with information on the accessibility features of a route linking a fully or partially accessible bus stop to a destination	1	Download BusFinder	(If you haven't already done it) Download the App BusFinder on your mobile	Some features might change if the app is installed in iOS or Android smartphone
			2	Open BusFinder	Open the App with the mobile phone set on accessible mode	Partially sighted users can access the able-bodied version too if they want
			3	Select the route/s of interest	Select by tapping on the route/s of interest	Vocal command currently not available on BusFinder
			4	Select the boarding bus stop of interest	Select by tapping on your boarding bus stop to verify whether it is accessible or not (both unaccompanied and accompanied)	Currently the App BusFinder does not tell apart the different kinds of disabilities
			5	Select the alighting bus stop of interest	Select by tapping on your alighting bus stop to verify whether it is accessible or not (both unaccompanied and accompanied)	Vocal command currently not available for BusFinder Currently the App BusFinder does not tell apart the different kinds of disabilities

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			6	(Providing that you can alight the bus at that bus stop) Select the corresponding vocal synthesis	Tap on the vocal synthesis icon to start it and listen to the suggested itinerary (from the alighting bus stop to the chosen destination)	Vocal synthesis currently provided only in Italian At prototyping stage, we can't isolate the different segments of the route and therefore the user will have to listen to an uninterrupted vocal message
			7	Go back to the main menu	Tap on the App to go back to the main menu or exit the App once you have gotten all the information you need to plan your trip	
2) Alighting the bus and reaching a chosen destination	a. Walk the route from the bus stop to the journey destination	Same as Barrier 1	1	(Upon alighting the bus) Open BusFinder	Open the App with the mobile phone set on accessible mode	Partially sighted users can access the able-bodied version too if they want
			2	Select the bus stop you are in	Select the bus stop you are in by tapping on the available icon	Vocal command currently not available for BusFinder
			3	Start the corresponding vocal synthesis	Tap on the vocal synthesis icon to start it and listen to the suggested itinerary (from the alighting bus stop to the chosen destination)	Vocal synthesis currently provided only in Italian At prototyping stage, we can't isolate the different segments of the route and therefore the user will have to listen to an uninterrupted vocal message

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			4	Follow the vocal synthesis	Listen to the vocal synthesis coordinates as you walk toward your chosen destination	
			5	Go back to the main menu	Tap on the App to go back to the main menu or exit the App once you have reached your destination	

Table 5: Cagliari WG list of requirements for users with visual disabilities

Phase	Sub-phase	Barrier	Requirement N.	Title of the requirements	Description on how the requirement should work	Comments
1) Collecting information for the journey	a. Verifying the accessibility of the route toward a destination	The App BusFinder does not currently contain a section that can provide users with mobility disabilities with information on the accessibility features of a route linking a fully or partially accessible bus stop to a point of destination	1	Download BusFinder	(If you haven't already done it) Download the App BusFinder on your mobile	Some features might change if the app is installed in iOS or Android smartphone
			2	Open BusFinder	Open the App in the version available to the able-bodied users by tapping on it	

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			3	Select the route of interest	Select by tapping on the route/s of interest	
			4	Select the boarding bus stop of interest	Select by tapping on your boarding bus stop to verify whether it is accessible or not (both unaccompanied and accompanied)	Currently the App BusFinder does not tell apart the different kinds of disability
			5	Select the alighting bus stop of interest	Select by tapping on your alighting bus stop to verify whether it is accessible or not (both unaccompanied and accompanied)	Currently the App BusFinder does not tell apart the different kinds of disability
			6	(Providing that you can alight the bus at that bus stop) Select the available map	Tap on the map icon to open it and check the accessibility features of the route that you must cover to reach your destination	Text content currently provided only in Italian
			7	Go back to the main menu	Tap on the App to go back to the main menu or exit the App once you have gotten all the information you need to plan your trip	
2) Alighting the bus and	a. Travel the route from the bus stop	Same as Barrier 1	1	(Upon alighting the bus) Open BusFinder	Open the App in the able-bodied version	

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reaching a chosen destination	to the journey destination		2	Select the bus stop you are in	Select the bus stop you are in by tapping on the available icon	
			3	Open the map	Tap on the map icon to open it and orientate yourself	Text content currently provided only in Italian
			4	Follow the map	Follow the suggested itinerary to your chosen destination	The vocal synthesis can be used too (but the map should be sufficient)
			5	Go back to the main menu	Tap on the App to close the map, go back to the main menu, exit the App once you have reached your destination	

Table 6: Cagliari WG list of requirements for users with mobility disabilities

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Stage 2: **Development**

As mentioned, in Chapter 4, it was decided to write a common list of technical specifications (Annex 2), including some customizations, since all of them opted for a journey planner app as the main solution. In the case of Cagliari, the solution is about the *CTM's journey planner app (BusFinder) improved in the bus stops mapping and vocal synthesis capabilities*. However, some specific technical comments were discussed within the WG and they wrote down explicitly some specific technical specifications of their solution. To do this, they mapped these remarks to some requirements described in the Design stage (Table 5 and 6). Please below, the details of the technical specification-requirement mapping.

Concerning the requirements written for persons with visual disabilities (Table 5):

- **Phase 1** "Collecting information for the journey " and **sub-phase a)** "Verifying the accessibility of the route toward a destination" of journey identified in UX research, requirement n. including a specific technical specification:
    a. Requirement n. 1, the following technical specification is mapped: IoS or Android operating systems are both fine as the App is available on Apple Store (for iOS), Google Play (for Android) and App Gallery (for Huawei);
    b. Requirement n. 2, the following technical specification is mapped: VoiceOver (for iOS) or Talkback (for Android and Huawei) are available for the sightless;
    c. Requirement n. 6, the following technical specification is mapped: Vocal synthesis software provided within the mobile phone (thus different providers might install a different software).
- **Phase 2** "Alighting the bus and reaching a chosen destination" and **sub-phase a)** "Walk the route from the bus stop to the journey destination" of journey identified in UX research, requirement n.:
    a. Requirement n. 1, the following technical specification is mapped: VoiceOver (for iOS) or Talkback (for Android and Huawei) are available for the sightless;
    b. Requirement n.3, the following technical specification is mapped: Vocal synthesis software provided within the mobile phone (thus different providers might install a different software).

Concerning the requirements written for people with physical impairments (Table 6):

- **Phase 1** "Collecting information for the journey " and **sub-phase a)** "Verifying the accessibility of the route toward a destination" of journey identified in UX research, requirement n.:
    a. Requirement n. 1, the following technical specification is mapped: iOS or Android operating systems are both fine as the App is available on Apple Store (for iOS), Google Play (for Android) and App Gallery (for Huawei);
    b. Requirement n. 6, the following technical specification is mapped: Orthophoto maps created resembling those created with Google Earth;
- **Phase 2** "Alighting the bus and reaching a chosen destination" and **sub-phase a)** "Walk the route from the bus stop to the journey destination" of journey identified in UX research, requirement n.:
    a. Requirement n. 3, the following technical specification is mapped: Orthophoto maps created resembling those created with Google Earth.

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Stage 3: **Testing**

The Cagliari WG, at this stage, tested the requirements **about the** CTM's journey planner app (BusFinder) **written in the previous Design stage (Table 5 and 6), to help to overcome the barriers identified through UX activity done in Task 6.1.**

They were able to provide details on the testing results for each requirement, and they are summed up below. Basically, as general comment on the results, the main criticalities faced during this stage, are related to (1) the vocal synthesis features integration for people with visual impairments, and (2) the zooming features integration for persons with mobility disabilities. Indeed, at the first development stage, these features didn't provide the correct details needed for persons with these disabilities to feel comfortable with their journey.

Concerning the requirements written for persons with visual disabilities (Table 5):

- **Phase 1** "Collecting information for the journey " and **sub-phase a)** "Verifying the accessibility of the route toward a destination" of journey identified in UX research, requirement n.:
    1. The **testing result was partially ok**: currently the beta version of Bus finder, with the new features, is available only for iOS not yet for Android or Huawei;
    2. The **testing result was partially ok**: the beta version of Bus finder available is not suitable for Talkback (Android and Huawei system) but only for iOS.
    3. The **testing result was partially ok**: routes are not as easy to read as they should be. The characters are not zoomable so people with low vision are forced to use vocal synthesis.
    4. The **testing result was partially ok**: bus stops names at bus stop and in the App are sometimes different. This can be misleading.
    5. The **testing result was partially ok**: bus stops names at bus stop and in the App are sometimes different. This can be misleading.
    6. The **testing result was partially ok**: **(1)** not all the vocal synthesis work with the beta version of Bus finder. **(2)** The vocal synthesis is a long, uninterrupted, message from point of departure to destination. This decreases its usefulness as it is difficult for the user who has a disability to remember such a large amount of information. Descriptions of the steps needed to complete the trip are too detailed and filled with information of little use for the user. Language should be improved too. **(3)** After selecting the route. The button "Additional functions" to open the vocal text is not intuitive.
    7. The **testing result was ok**.
- **Phase 2** "Alighting the bus and reaching a chosen destination" and **sub-phase a)** "Walk the route from the bus stop to the journey destination" of journey identified in UX research, requirement n.:
    1. The **testing result was partially ok**: please refer to requirement n. 1 of Phase 1;
    2. The **testing result was ok**;
    3. The **testing result was not ok**: as the vocal synthesis does not isolate the single segments from the origin to destination route, this makes it very difficult for the visually impaired user to use it as a navigation tool;
    4. The **testing result was not ok**: the vocal synthesis is an uninterrupted one. It is of little use during the trip as it conveys too much information at the same

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time. The text content is way too detailed and should be simplified significantly. Language used should be improved too. A geo-local position system is missing
5. The **testing result was ok**.

Concerning <u>the requirements written for persons with mobility disabilities (Table 6)</u>:

- **Phase 1** "Collecting information for the journey " and **sub-phase a)** "Verifying the accessibility of the route toward a destination" of journey identified in UX research, requirement n.:
    1. The **testing result was partially ok**: currently the beta version of Bus finder, with the new features, is available only for iOS not yet for Android or Huawei;
    2. The **testing result was ok**;
    3. The **testing result was ok**;
    4. The **testing result was ok**;
    5. The **testing result was ok**;
    6. The **testing result was partially ok**: accessibility evaluation should adopt a more conservative approach. The route should be considered inaccessible from the first significant obstacle till the end. A zoom option should be available for those who open the map from a smartphone. Length in metres of the different segments of the route would improve the maps usability. Distance between origin and destination would help too. The trip destination should be better highlighted. The red lines of the map don't specify the type of barrier. Linking photos could help to identify them;
    7. The **testing result was ok**;
- **Phase 2** "Alighting the bus and reaching a chosen destination" and **sub-phase a)** "Walk the route from the bus stop to the journey destination" of journey identified in UX research, requirement n.:
    1. The **testing result was ok**;
    2. The **testing result was ok**;
    3. The **testing result: N.A.;**
    4. The **testing result was partially ok**: please refer to the same comments of Phase 1 – requirement 6. Pinpoint the user's position once he/she leaves the bus, could be useful. A geo-local position system could be useful too.
    5. The **testing result was ok**.

After the testing some development refinements were performed, and in particular:

- For *persons with visual disabilities*, the *requirements n. 6 of phase 1 and requirement n. 3 of phase 2*, were subjected to an amendment, namely: partition of the vocal synthesis, with each segment representing a section of the "bus stop to destination" route (as represented in the map). This amendment was made possible with the implementation of a swipe system that can be fully controlled by the user;
- For *persons with mobility disabilities*, the *requirements n. 6 of phase 1 and requirement n. 3 of phase 2*, were subjected to an amendment, namely: a zooming function was added to the "pre-test" version. This allows to enlarge the map and get a better view of its content.

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4.3. Lisbon Pilot Case Study

4.3.1. The Pilot Case Study Brief

The **Lisbon WG proposed solutions, to the local stakeholders** (and they approved them)**, whose aim is (1) to develop and test new accessibility features specifically designed for persons with disabilities, to be integrated in the Carris's (the official full city partner of Lisbon) app (a journey planner) and (2) to develop recommendations to make the ticketing system inclusive and accessible for everyone.**

The transport services, affected by their proposed changes are the bus, railway, metro and ferry boat, and persons with physical, visual, hearing and intellectual disabilities, also persons with mental health issues should benefit from them.

By focusing on the solutions, the Lisbon WG proposed (and for each solution, the starting TRL, namely before the pilot case study stage and the target TRL, namely at the end of pilot case study stage, were defined):

1. **Incremental improvements of Carris' App introducing information regarding accessibility**: information about ramps availability, bus occupation, bus stops accessibility, next bus arriving and also next stop where to exit. **Starting TRL equals 1** (e.g. Basic principles observed) and **target TRL equals 4** (e.g. Technology validated in lab);
2. **Recommendations to make the ticketing system truly inclusive and accessible for everyone.** The system should provide information regarding credit cards funds, monthly subscriptions, and the on-site machines should be accessible for blind persons and wheelchair users**. Starting TRL equals 1** (e.g. Basic principles observed) and **target TRL equals 3** (e.g. Experimental proof of concept);

Lisbon WG, by focusing on these solutions, addressed **2 mobility challenges** that they identified during their meetings, and they are:

1. **No information regarding the accessibility.** There are problems regarding access to buses and transport infrastructures which are out of order or have maintenance problems and challenges. Current version of the Carris App doesn't provide information regarding Carris' fleet accessibility nor provides information in real time.
2. **Ticketing system accessibility issues.** Lisbon had a major change on the ticketing system in 2019, since then, the system became much more easy to use for everyone. Besides these improvements, there are several persons who can't have access to information regarding monthly subscriptions, tap-to-go cards, etc. There are few devices where it is possible to check this information and these are not fully accessible for everyone.

Furthermore, through a specific survey, the **current MDI (Mobility Divide Index) of the transport services involved** was measured at **(1) 7 for the railway, (2) 7,20 for the bus, (3) 6,07 for the metro, (4) N.A. for the Ferry Boat** and the target for the end of the pilot case study stage was defined, in order to measure the accessibility of the transport after the solution implementation. The Lisbon WG identified as **Target MDI value (1) 6 for the railway, (2) 6 for the bus (3) 5 for the metro, (4) 6 for the ferry boat** that should validate

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the improvement of the transport accessibility thanks to the solutions. **The work done on the UX research activities has been tracked in the pilot case study brief.** Then, a PEST analysis was implemented for each solution and in the Annex 1, details are available. Finally, the Lisbon WG agreed a pilot case study planning with the local stakeholders, available in detail in the Annex 1.

4.3.2. The Pilot Case Study

During this stage, the Lisbon WG confirmed their interest to carry on the activities on the solutions (due the feasibility checked within the project period) proposed in the pilot case study brief, namely:

1. **Incremental improvements of Carris' App (journey planner) introducing information regarding accessibility;**
2. **Recommendations to make the ticketing system truly inclusive and accessible for everyone.**

Below the activities for each stage will be described in detail.

Stage 1: **Design**

The local WG worked with the IT technical team of Carris'app in order to come out with the requirements needed to improve the solution (journey planner) providing accessibility information.

They didn't use the template provided, but they started from the journey phases identified in the UX research and worked on designing the interface of the app useful for the user in terms of accessibility information.

As foreseen in the pilot case study brief, the solution should be useful for persons with all disabilities mentioned (i.e. visual, physical, hearing, mental and intellectual).

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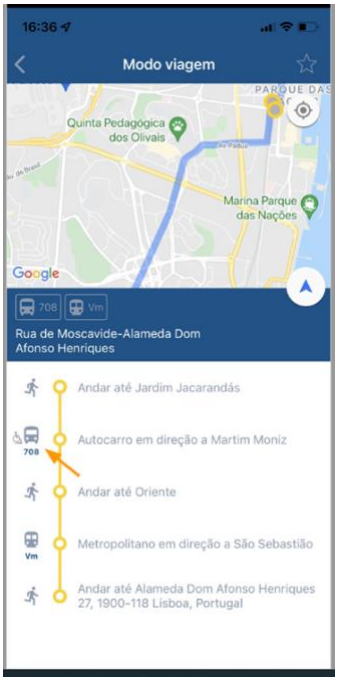
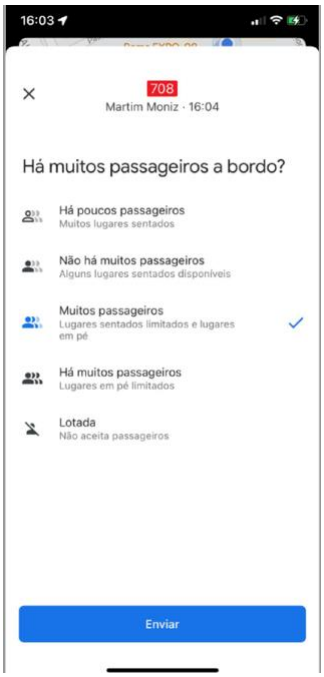
UX research phases	The Designed Solution	Comments
1) Will the next vehicle have the ramp?	 	Zoom on these symbols:  
2) Level of occupation expected of vehicle	 	Zoom on these symbols:   “Many passengers: limited seating and standing”

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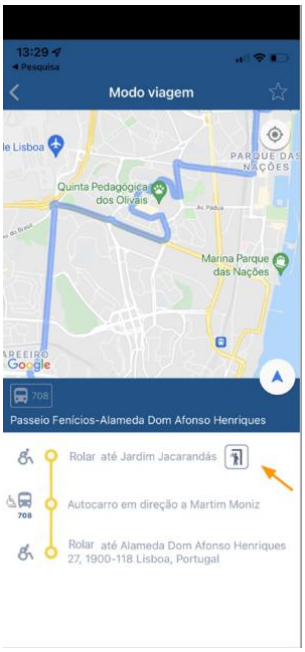
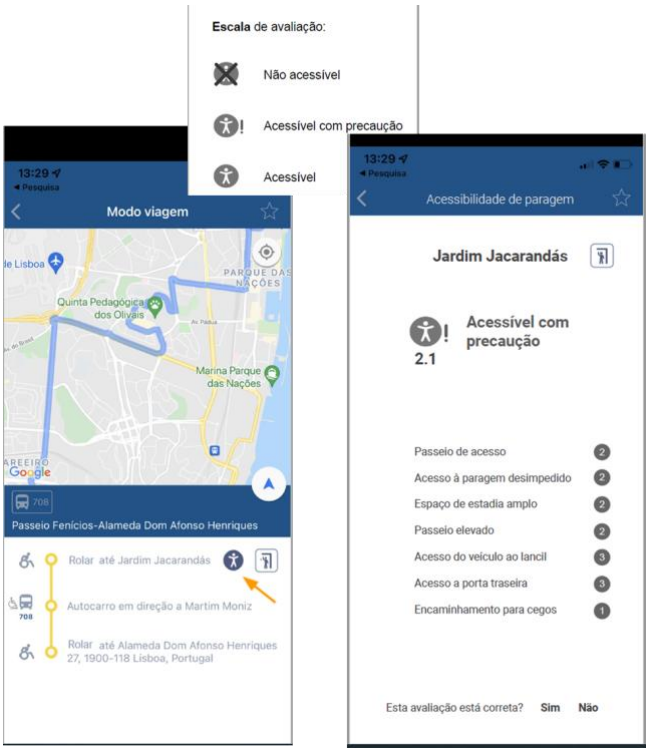
3) To find shelter at the stop		Zoom on this symbol: 
4) Accessibility of the stop and the entrance		Zoom on these symbols:  Não acessível “Not accessible”  Acessível com precaução “Accessible with caution”  Acessível “Accessible”

Table 7: The designed solution interfaces of Lisbon WG

Regarding the second solution (i.e. recommendation on ticketing system), the local WG identified the following UX recommendations (the requirements table was not applicable in this case) for improvements on Lisbon’s ticketing system, which are divided by the following categories:

Information

Information about what type of ticket people can/should buy must be available, accessible and clear.

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More information regarding where and how to buy tickets and monthly passes must be available, specifying which are the accessible options available and where are located the accessible automatic selling machines, ticket offices and customer support centres.

Information about procedures regarding buying and using the tickets and monthly passes must be available.

Ticket and monthly passes

Simple ways to buy tickets and monthly passes must be available for everyone. This needs to be simple and easy to understand.

Considering that on-board tickets are not considered the best option to buy tickets on buses, easy options must be available, such as contactless payments (pay as you go), and mobile based payment options.

Online payments and monthly passes subscriptions should be available through websites and/or apps. These must be accessible and simple to use.
A monthly pass for the door-to-door service, which is now based on on-board tickets, which end up being more expensive for passengers, must be studied and implemented.

On-board features

Pay-as-you-go is considered a must-have feature, so users can pay with their contactless cards, their phones or other similar and future technologies.

Validation machines must be placed in a way that everyone can reach them, especially passengers using wheelchairs, which often can't reach the front of the buses to validate the tickets.

Validation machines must have audio announcements targeted for persons with visual disabilities. These audio announcements must inform if the ticket is validated or not (which already occurs in some equipment).

Providing information about card credit balance must be studied and implemented as soon as possible.

After travelling

Feedback is considered very important by the local CUT, and therefore we must provide easy and simple ways to collect feedback from passengers.

Suggestions were made about an automatic system that sends emails with forms to passengers within a specific timeframe. This must not disturb passengers but must be frequent enough to collect information while it is still in people's minds.

Chats must be available for all travel stages, so people can contact directly with someone who can help clarify information and deal with problems on the go. Phone numbers should be available as well.

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Stage 2: **Development**

As mentioned, in Chapter 4, it was decided to write a common list of technical specifications (Annex 2), including some customizations, since all of them opted for a journey planner app as the main solution. In the case of Lisbon, the first solution is about the *Incremental improvements of Carris' App (journey planner) introducing information regarding accessibility.*

Stage 3: **Testing**

The Lisbon WG, at this stage, **tested the requirements** about the:

- **Solution 1**: "*Incremental improvements of Carris' App (journey planner) introducing information regarding accessibility"*;
- **Solution 2**: "*Recommendations to make the ticketing system truly inclusive and accessible for everyone*".

written in the previous Design stage, to help to overcome the barriers identified through UX activity done in Task 6.1.
They were not able to provide details on the testing results for each requirement, however, the feedback by the WG was quite positive, overall.

4.4. Zagreb Pilot Case Study

4.4.1. The Pilot Case Study Brief

The **Zagreb WG proposed a set of solutions to the local stakeholders** (who approved)**, with the aim to develop and test a personalised and accessible digital journey planner that should provide real time information on accessibility of transport services, personalised for the user's location, destination, preferences and type of disability.**

The transport services, affected by their proposed changes, are the bus, railway and tram, and persons with physical, visual, hearing disabilities, also persons with mental health issues should benefit from them.

The Zagreb WG proposed the following solutions (and for each solution, a starting TRL and a target TRL were defined):

1. **Personalised and accessible digital journey planner:** it should provide real time information (according to the user's location, destination, preferences and type of disability) on (1) timetables of trams, buses and trains in Zagreb, (2) traffic information, including changes in routes, (3) integration of multimodal transport, (4) accessibility of public transport vehicles, (5) accessibility of public transport facilities. **Starting TRL equals 3** (e.g. Experimental proof of concept) and **target TRL equals 7** (e.g. System prototype demonstration in operational environment);

Zagreb WG focusing on this solution, and identified and addressed **2 mobility challenges**:

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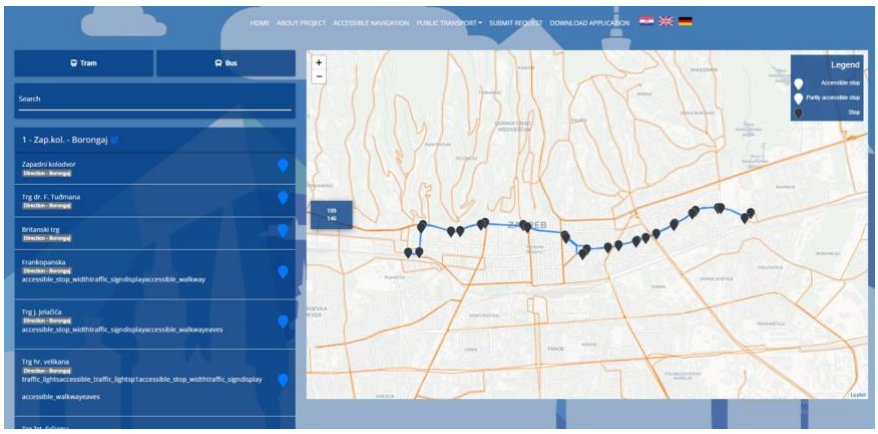
1. **General lack of accessible travel planning information.** Railway, bus and tram services do not provide online real time traffic information and this makes travel planning difficult in case of changes of the schedules. The services have separate information systems for the static itineraries, and this makes multi-modal transport planning really difficult. There is no dedicated, accessible travel planning service.
2. **Not all facilities, buses, trams and stops are accessible.** Different models of vehicles are used in railway, bus and tram transport and they all have different accessibility features. The same is applicable for various stops / stations and related facilities. There is no information on the accessibility of individual vehicles, stations, and facilities, by adding a level to uncertainty in the travel planning.

Furthermore, through a specific survey, the **current MDI (Mobility Divide Index) of the transport services involved** was measured at **(1) N.A. for the railway, (2) 4,2 for the bus, (3) 5 for the tram** and the target for the end of the pilot case study stage was defined, in order to measure the accessibility of the transport after the solution implementation. The Zagreb WG identified as **Target MDI value (1) N.A. for the railway, (2) 2 for the bus (3) 2 for the tram** to validate the improvement of the transport accessibility thanks to the solutions. The work done on the UX research activities has been tracked in the pilot case study brief. A PEST analysis was implemented for each solution, details are available in Annex 1. Finally, the Zagreb WG agreed a pilot case study planning with the local stakeholders, also available in detail in Annex 1.

4.4.2. The Pilot Case Study

During this stage, the Zagreb WG confirmed their interest to carry on the activities on the solution (due the feasibility checked within the project period) proposed in the pilot case study brief, namely **a personalised and accessible journey planner application.**
Below the activities for each stage will be described in detail.



Stage 1: **Design**

Starting from the UX research performed in the previous stage of Task 6.1 (pilot case study brief), the WG analysed the phases and sub-phases of the journey on which they focused and where the current barriers and possible improvements for overcoming them were identified. Therefore, in this pilot case study, the identified phase of the journey was one and one sub-phase was defined (please refer to the table below, one for all types of disabilities, including mobility, visual, hearing and intellectual disabilities and mental health issues).

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The columns of the tables below, named (1) "**Title of the requirements**", (2) "**Description on how the requirement should work**" and (3) "**Comments**" clarified how the requirements designed for the journey planner app, should help to overcome the current barriers identified for each sub-phase of the journey included.

Furthermore, the local WG arranged the following activities in order to achieve the design objective:

- Consultations with developers on application development;
- Establishment of field practice with the school for road traffic - data harvest;
- Development of data entry tool for mapping of accessibility of tram and bus stops;
- Organisation of data collection.

Finally, *the proposed solution was expected to be built upon the already existent Accessible Zagreb service, accessible as a website or a mobile app*, both of which are being built in line with Web Content Accessibility Guidelines[9] (WCAG), allowing unhindered access to users with mobility, visual, hearing and intellectual disabilities, speech difficulties and mental health issues. The Accessible Zagreb service relies on Google Maps service to display objects and routes. The step-by-step guidelines within Google Maps provide information for users with visual disabilities. However, the Accessible Zagreb interface is expected to be further tested by users with different disabilities using different devices with different assistive technologies.

[9] Web Content Accessibility Guidelines (WCAG) 2.0 – W3C Recommendation 11 December 2008

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Phase	Sub-phase	Barrier	Requirement N.	Title of the requirements	Description on how the requirement should work	Comments
1- Travel Preparation	1B- Consult the app on accessible routes and destinations	1- The accessible Zagreb app lacks the information on accessible bus and tram stops and routes	1	Open the app and select “start” option	The users opens the app and navigates to the “start” option to be able to plan a journey	Some features may change if the app is installed in iOS or android smartphone
			2	Open «Public transport» category	The solution shows tram and bus stations of the City of Zagreb with basic information and information on accessibility	
			3	Choose a type of transport.	The user will have the option to choose the type of public transport (bus or tram)	
			4	Consult the interactive map .	After selection, all existing routes are printed in the list.	
			5	Route selection.	By selecting a route on the map, it is drawn, and all stations on that route are displayed. Stations, i.e. their accessibility, will be displayed with different pins.	

Table 8: Zagreb WG list of requirements for users with all types of disability

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Stage 2: **Development**

As mentioned, in Chapter 4, it was decided to write a common list of technical specifications (Annex 2), including some customizations, since all of them opted for a journey planner app as the main solution. In the case of Zagreb, the solution is about the *personalised and accessible journey planner application*.
However, below some specific insights raised from the work done by the WG, are reported.

For example, the solution can be installed on iOS and Android operating systems. The app was written in React Native program language, the TRIPS plugin in Django framework. Given the existing solution where the google navigation is used, this application will allow in the future to move the navigation function from google maps solution to a custom solution. Backend is in postgresql. Both are being built in line with Web Content Accessibility Guidelines (WCAG), allowing unhindered access to users with mobility, visual, hearing and intellectual disabilities, speech difficulties and mental health issues. The service relies on Google Maps service to display objects and routes. The step-by-step guidelines within Google Maps provide information for users with visual disabilities.

Stage 3: **Testing**

The Zagreb WG, at this stage, tested the requirements about **the personalised and accessible journey planner application** described in the previous Design stage (Table 8), to help to overcome the barriers identified through UX activity done in Task 6.1**.**

Basically, the activities done on the testing followed the following steps: (1) debugging with the sw developers, (2) integration of the app features (plug-in) with the existing accessible service app, finally (3) testing of the app functionalities by the core user team.

In the initial plan Croatian Railways were planned to be added to the routes, but it was not possible during the development of the TRIPS plugin and it remains to be incorporated in future updates. The service relies on third party apps like Google Maps to provide timetables and accessibility of vehicles (crowdsourcing), since at the moment Zagreb electric tram doesn't have live data on locations of the vehicles and about accessibility of the vehicles since there are frequent changes of vehicles on the lines, it is technically not possible to organise such data.

They were able to provide details on the testing results for each requirement, and they are summed up below:

- **Phase 1** "Travel Preparation " and **sub-phase 1B)** "Consult the app on accessible routes and destinations" of journey identified in UX research, requirement n.:
    1. The **testing result was ok**: some features may change if the app is installed in iOS or android smartphone;
    2. The **testing result was ok**: no comments were inserted;
    3. The **testing result was ok**: no comments were inserted;
    4. The **testing result was ok**: no comments were inserted;
    5. The **testing result was ok**: no comments were inserted.

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4.5. Brussels Pilot Case Study

4.5.1. The Pilot Case Study Brief

The **Brussels WG proposed a set of solutions to the local stakeholders** (who approved)**, with the aim to design and validate on the paper, an accessible journey planner application (actually by adding new features to the already existing STIB TRIP Planner),** based on the experience of persons with disabilities within the WG but also on discussions with diverse mobility actors in Brussels and organisations supporting persons with disabilities in the city.

The transport services, affected by their proposed changes, are the bus, railway, metro, taxi, taxi bus, and are focused mostly on persons with physical, visual, hearing and intellectual disabilities, also persons with mental health issues.

The Brussels WG proposed the following solutions (and for each solution, a starting TRL and a target TRL were defined):

1. **Personalised Accessible Journey Planner application**: the solution, by adding new features to the already existing STIB TRIP Planner, aims to provide personalised information to each user in a format accessible to them according to their type of impairment. The solution hasto be designed on paper and the goal is to bring the prototype as a detailed guideline to the local transport stakeholder STIB. **Starting TRL equals 0** (e.g. not even basic principles observed) and **target TRL equals 3** (e.g. experimental proof of concept).

Brussels WG focused on this solution, and identified and addressed **1 mobility challenge**:

1. **General lack of accessible travel planning information.** Transport services do not provide online real time traffic information and this makes travel planning difficult in case of changes of the schedules. The services have separate information systems for the static itineraries, and this makes multi-modal transport planning really difficult. There is no dedicated, accessible travel planning service.

Furthermore, through a specific survey, the **current MDI (Mobility Divide Index) of the transport services involved is measured** at **(1) N.A. for the railway, (2) 5,3 for the bus, (3) 6 for the metro, (4) 8,1 for the taxi, and (5) 7,7 for the taxi bus.**

No Target MDI values were needed since **Brussels as an associated city partner should not develop and test the solution. Therefore this doesn't make the accessibility level measurement of the transport services feasible after the pilot case study stage.** The work done on the UX research activities has been tracked in the pilot case study brief. A PEST analysis was implemented for each solution and in Annex 1, details are available. Finally, the Brussels WG agreed a pilot case study planning with the local stakeholders, also available in detail in Annex 1.

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4.5.2. The Pilot Case Study

During this stage, the Brussels WG confirmed their interest to carry on the activities on the solution (due the feasibility checked within the project period) proposed in the pilot case study brief, namely **a personalised and accessible journey planner application (by adding new features to the already existing STIB TRIP Planner).** Below the activities for each stage is described in detail.

Stage 1: **Design**

Starting from the UX research performed in the previous stage of Task 6.1 (pilot case study brief), the WG analysed the phases and sub-phases of the journey on which they focused and where the current barriers and possible improvements for overcoming them, were identified. Therefore, in this pilot case study, the identified phases of the journey were two but just one will be used for each table (please refer to the tables below, three in total, one for all types of disabilities, one for visual and mobility disabilities and finally one dedicated just to visual disabilities). The columns of the tables below, named (1) "**Title of the requirements**" and (2) "**Description on how the requirement should work**" clarified how the requirements designed for the journey planner app, should help to overcome the current barriers identified for each sub-phase of the journey included. Besides the requirements activity, the local WG worked with the STIB technical team, in order to come out with solution mock-up[10] (please see the pictures below).

[10] What is a mock-up?: https://keenethics.com/blog/1521631041972-the-importance-of-mockups

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Mapping of stations

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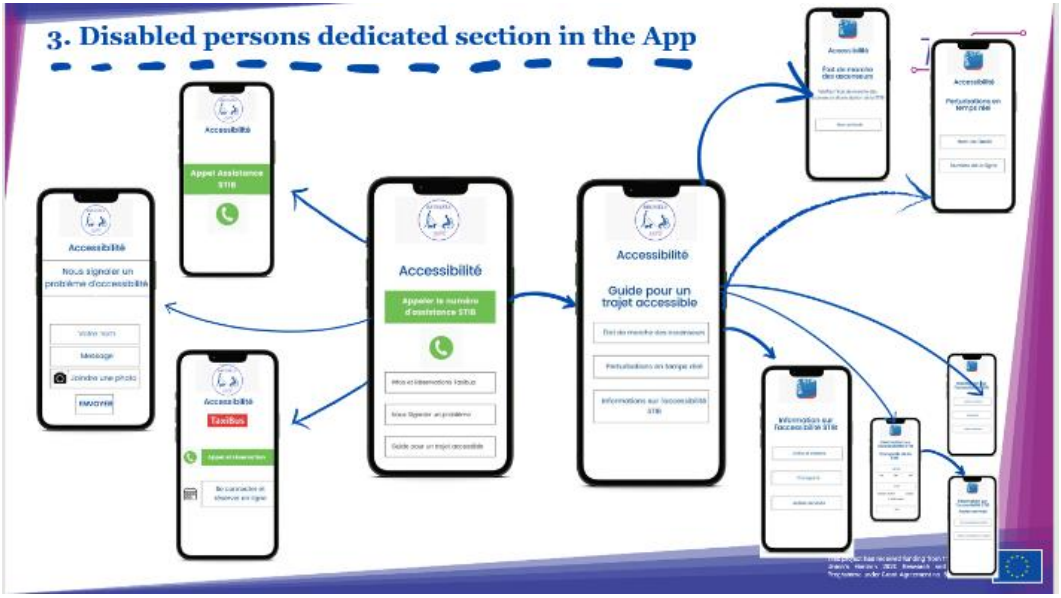
Highlight the most accessible route	
Persons with disabilities dedicated section in the app	

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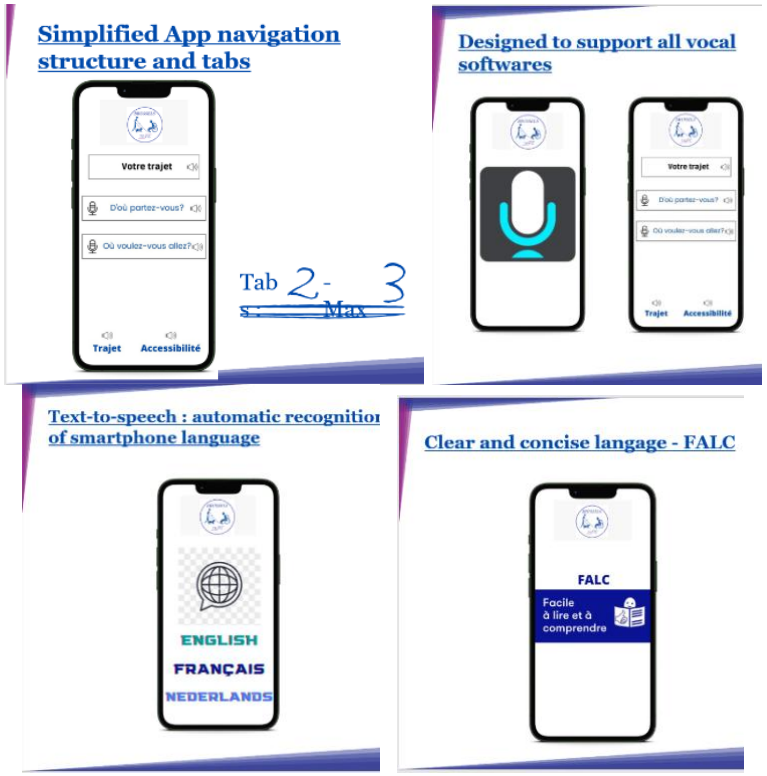
Interface features	

Table 9: Brussels WG solution mock-up

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Phase	Sub-phase	Barrier	N.	Title of the requirements	Description on how the requirement should work
Travel Planning	Consult the timetables and itineraries of STIB public transport	Lack of accessibility information available on the STIB app/website: ● for human assistance available in stations and how to contact ● about displacements within the stations and the precise location of platforms or stops ● working state of elevators and escalators in ● Live disturbances	1	Highlight the most accessible travel	In the travel propositions list after encoding the destination, the most accessible route is highlighted at the start and in special colour on basis of: ● the colour of STIB's accessibility pictograms for boarding/ disembarking stops ● elevators/escalators ● live disturbances ● most accessible transport
			2	Dedicated and designed Accessibility page (one tab in app) for STIB Assistance Contact and all accessibility informations	One dedicated tab and page in the app for STIB Assistance Contact and all accessibility dedicated informations: ● Central hyperlink to automatically call the STIB assistance call in stations ● Taxibus (STIB adapted transport) reservation informations ● New display of live disturbance informations

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			3	Interior mapping for big stations	Simplified mapping of the interior of a station for the movements and important points of accessibility: ● platforms ● working elevators ● escalators ● accessible toilets ● ticket offices ● possibly shops A station map will be sketched in the model as an example

Table 10: Brussels WG list of requirements for users with all types of disabilities

Phase	Sub-phase	Barrier	N.	Title of the requirements	Description on how the requirement should work
Navigation on the app before and during the journey		Current Ergonomy defaults of the STIB app/website itself	4	Contrast requirements and color between text and background in the app	● Contrast and color improvement between text and background in the app ● Contrast and good highlighting of hyperlinks
Navigation on the app before and during the journey		Current Ergonomy defaults of the STIB app/website itself	5	Clear and Simplified App structure and language	● Improvements in regards of STIB app structure: ◦ Simplified and intuitive tab system (5 tabs → 2 or 3) ◦ 'FALC' accessible standards: 'Easy to read and understand' ◦ Clear title on each page ◦ No panels, modal dialogs pop-ups or link to html page ◦ Clear and meaningful hyperlinks

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		Current Ergonomy defaults of the STIB app/website itself (No Screen Zoom in STIB app)	6	Integrate Screen Zooming function in the model	Possibility to Zoom the screen easiliy by double-tapping or pinching

Table 11: Brussels WG list of requirements for users with visual and mobility disabilities

Phase	Sub-phase	Barrier	N.	Title of the requirements	Description on how the requirement should work
1- Travel Planning	Integrate smartphone synthesis and vocal recognition system	STIB Current Trip Planner App does not take in charge smartphones vocal system (Voice Over, Google Voice)	7	Vocal system recognition and synthesis	The application supports the system of synthesis and voice recognition of the smartphone/android (Voice Over, Google Voice, Siri). On basis of the prototype mockup, show how the voice support systems should be integrated in the app • Mainly for the encoding of the destination and the list of the different routes available
			8	Content language indicated in the home page code ("lang" attribute so the detection system of the vocalisation software adapts to the required	"Lang" attribute so the detection system of the vocalisation software adapts to the required

Table 12: Brussels WG list of requirements for users with visual disabilities

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Stage 3: **Testing**

The Brussels WG, at this stage, **tested "on the paper" the requirements of the personalised and accessible journey planner application,** written in the previous Design stage (Table 10, 11 and 12), to help to overcome the barriers identified through UX activity done in Task 6.1.

They were not able to provide details on the testing results for each requirement, however, **they provided a detailed overview of feedback and recommendations raised from the work done during their meetings.** Indeed, the recommendations come from group discussions made according to the mockup in the paper version, and they can be summed up under the following main topics:

- Mapping of stations:
  - The most important point is that (1) the interior and exterior maps should be interactive in order to be able to find one's bearings within stations in real time and, (2) the map should indicate the route and can give precise directions (GPS);
  - How could we match the two maps? By a floor selection system? This is essential to the actual effectiveness of the mapping system;
  - Important to indicate the Contact terminal (STIB contact points in stations) and the meeting point with the station's STIB agents:
    - Access to the toilets in stations often requires opening by a STIB agent;
    - Differentiate between elevators to platforms and elevators to exits.
  - Maps must be up to date and indicate when there are work in progress, changes, etc.
- Choice of the most accessible route:
  - Too much info in the list: page of results for the most accessible road seems overloaded;
  - Page comparing different journeys and their accessibility must be clearer: one should quickly see and understand the differences due the chosen criteria among the different roads proposed in the list;
  - There should be more information concerning orientations between the transports integrated in the results system.
- PRM (Persons with Reduced Mobility) section in the App**:**
  - Important point is: information needed concerning STIB agents availability in the station: Available? How many? Where? STIB contact point?
  - On the STIB Assistance Call tab: possibility to book a STIB guide in advance without calling? Link to Station Contact terminals?
  - Info: PRM places available in transport? How can we integrate STIB traffic information (see STIB App).
- Other feedback on the App prototype for an open discussion:
  - Ideas on further possible insight on a more manipulable version of the app to control navigation and ergonomy, as:
    - Clarity of information;
    - Tactile manipulation;
    - Voice assistance;
  - Question about the App access:

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- Either completely dedicated PRM App? 2 applications, one of which is simplified and specially designed for passengers with reduced mobility?Or a dedicated tab in the main STIB App?

4.6. Sofia Pilot Case Study

4.6.1. The Pilot Case Study Brief

The **Sofia WG proposed a set of solutions to the local stakeholders** (who approved)**,** with the aim to design and validate on the paper, **(1) an accessible journey planner application, and a (2) smart bus/tram stop to improve the accessibility of the transport service,** based on the experience of persons with disabilities within the WG but also on discussions with diverse mobility actors in Sofia and organisations supporting persons with disabilities in the city.

The transport services, affected by their proposed changes, are the railway, bus and metro, and persons with physical, visual and hearing disabilities should benefit from them.

The Sofia WG proposed the following solutions (and for each solution, a starting TRL and a target TRL were defined):

1. **Accessible journey planner application:** new mobile application for planning a trip by a person with a disability, including travel tracking, communication with drivers of public transport vehicles, communication with the system of the Urban Mobility Center (UMC)**. Starting TRL equals 1** (e.g. basic principles observed) and **target TRL equals 3** (e.g. experimental proof of concept);
2. **Smart bus/tram stop:** including accessibility communications between passengers and the UMC. **Starting TRL equals 1** (e.g. basic principles observed) and **target TRL equals 3** (e.g. experimental proof of concept).

Sofia WG focused on this solution, and identified and addressed **1 mobility challenge**:

1. **General lack of accessibility of the transport services.** Transport services do not provide correct accessibility (including the bus stops) for the users with disabilities. Moreover, there is a lack of communication between passengers with disabilities and the system of the UMC.

Furthermore, about the foreseen MDI survey, Sofia partner tackled critical issues and was not able to achieve a value on the current MDI. No Target MDI values were needed since **Sofia, as an associated city partner, should not develop and test the solution on site. Therefore this doesn't make the accessibility level measurement of the transport services feasible after the pilot case study stage. T**he work done on the UX research activities has been tracked in the pilot case study brief.
Then, also about the PEST analysis the partner was not able to discuss it with the enlarged WG. Finally, the Sofia WG agreed a pilot case study planning with the local stakeholders, available in detail in Annex 1.

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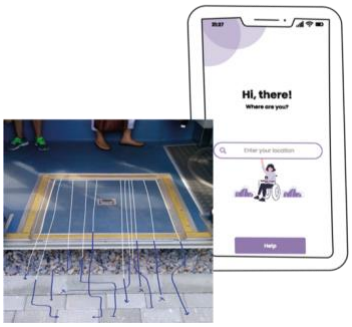
4.6.2. The Pilot Case Study

During this stage, the Sofia WG confirmed their interest to carry on the activities on the solutions (due the feasibility checked within the project period) proposed in the pilot case study brief, namely:

1. **An accessible journey planner application;**
2. **A smart bus/tram stop.**



Below the activities for each stage will be described in detail.

Stage 1: **Design**

The local WG didn't use the template provided, but they started from the journey phases identified in the UX research and worked on designing the interface of both solutions. As foreseen in the pilot case study brief, the solution should be useful for persons with all disabilities mentioned (i.e. visual, physical and hearing). Please refer to the tables below, which make the solutions mockup available (some screenshots).

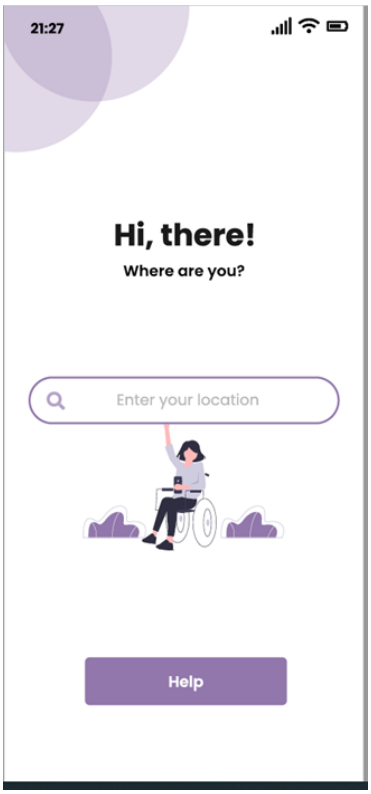
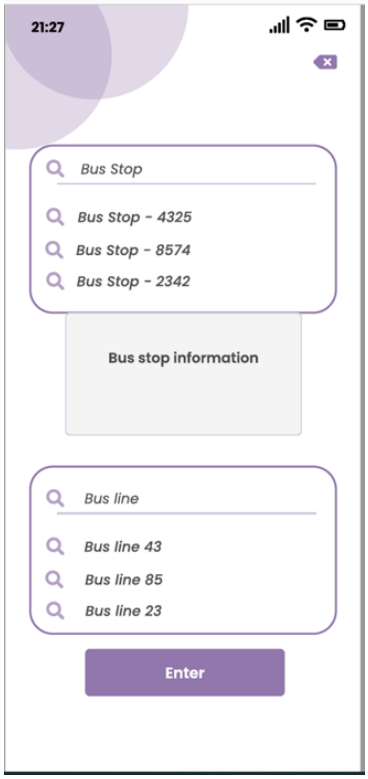
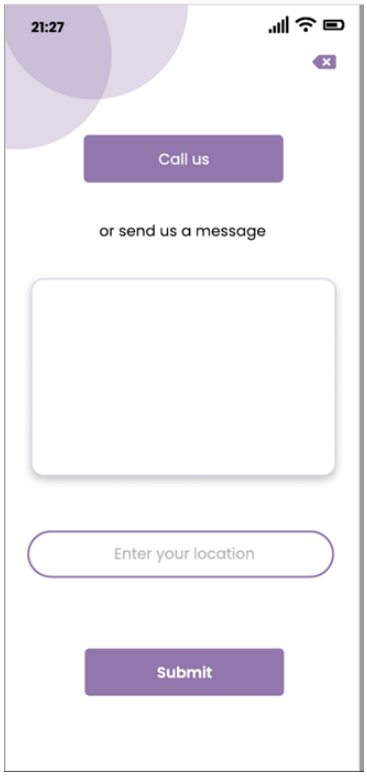
1) Enter the location to be reached	2) Bus information on the accessibility	3) Communication with the Transport Operator Centre
		

Table 13: The journey planner solution mock-up of Sofia WG

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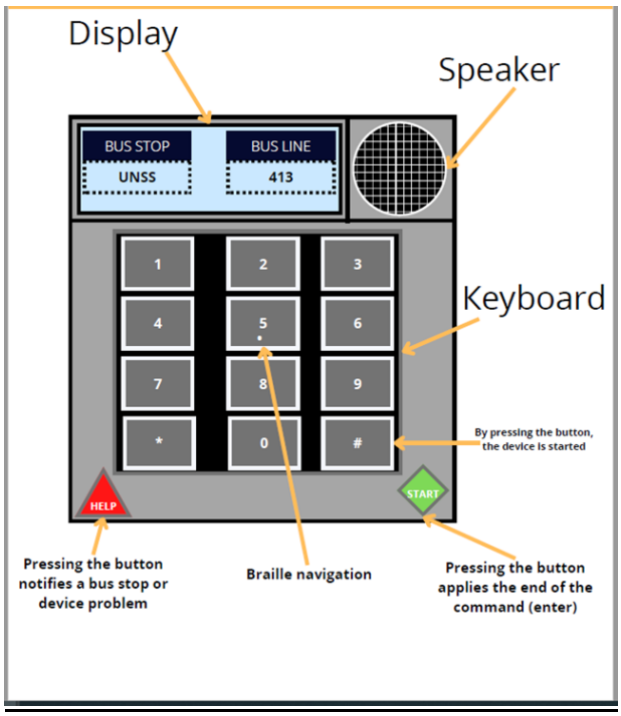
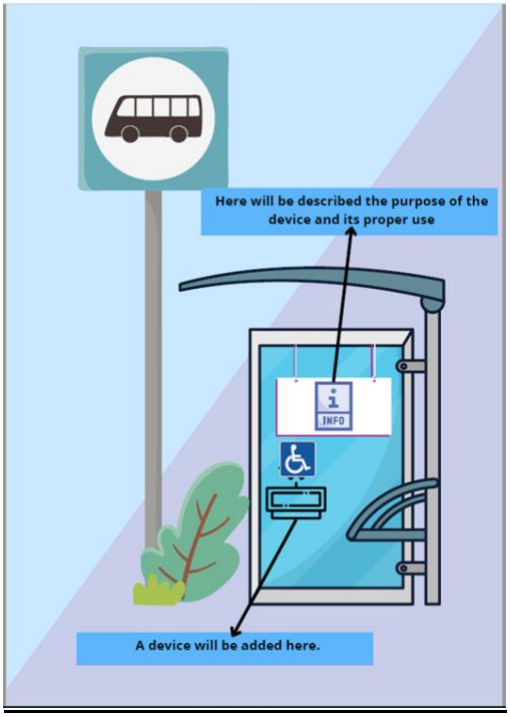
1) Set up the bus stop according to the needs	2) To be aware of the smart stop purpose and device location
	
The user can set up through a device available at the bus stop, the bus stop infrastructure itself according to her/his needs. The following features would be available: (1) a speaker, (2) a keyboard including braille navigation, (3) a button to finalise the command, (4) a button to notify some problem.	The use can have, at the bus stop, information available on the smart bus stop purpose and can be aware of the device location

Table 14: The smart bus stop solution mock-up of Sofia WG

Stage 3: **Testing**

The Sofia WG, at this stage, **tested "on paper" the requirements** about:

- **Solution 1:** *"An accessible journey planner application";*
- **Solution 2: "***A smart bus/tram stop***".**

written in the previous Design stage, to help to overcome the barriers identified through UX activity done in Task 6.1.

They were not able to provide details on the testing results for each requirement, however, the feedback by the WG was quite positive, overall.

4.7. Stockholm Pilot Case Study

4.7.1. The Pilot Case Study Brief

The **Stockholm WG proposed a set of solutions to the local stakeholders** (who approved)**, with the aim to design and validate on the paper, a Travel ID Planner (i.e. accessible journey planner application),** based on the experience of persons with disabilities within the WG but also on discussions with diverse mobility actors in Stockholm and organisations supporting disabled persons in the city.

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The transport services, affected by their proposed changes, are the bus, metro and ferry boat and persons with physical, visual and hearing disabilities should benefit from them.

The Stockholm WG proposed the following solutions (and for each solution, a starting TRL and a target TRL were defined):

1. **Travel ID Planner:** namely an accessible journey planner application that according to the user's information (the concept of ID as IDentity), enable the user to manage her/his journey planning, like to change the itinerary, to find new stops and stations, to collect update on travel routes, and etc. **Starting TRL equals 2** (e.g. technology concept formulated) and **target TRL equals 5** (e.g. technology validated in relevant environment).

The Stockholm WG focussed on this solution, and identified and addressed **2 mobility challenges**:

1. **Flex area limitation.** In the transport involved, often on board (1) the dedicated flex area is limited and not flexible, (2) usually there is no place enough, (3) there is no knowledge when space is occupied, and finally (4) the user cannot book tickets.
2. **General lack of accessibility of the transport services.** Transport services do not provide a correct accessibility to users with disabilities.

Furthermore, through a specific survey, the **current MDI (Mobility Divide Index) of the transport services involved** was measured at **(1) 7,92 for the bus, (2) 6,6 for the metro, and (3) 7,5 for the ferry boat.** No Target MDI values were needed since **Stockholm, as an associated city partner, should not develop and test the solution on site. Therefore this doesn't make the accessibility level measurement of the transport services feasible after the pilot case study stage.** Also the work done on the UX research activities has been tracked in the pilot case study brief. A PEST analysis was implemented for each solution and in Annex 1, details are available. Finally, the Stockholm WG agreed a pilot case study planning with the local stakeholders, available in detail in Annex 1.

4.7.2. The Pilot Case Study

During this stage, the Stockholm WG confirmed their interest to carry on the activities on the solution (due the feasibility checked within the project period) proposed in the pilot case study brief, namely a **Travel ID Planner (i.e. accessible journey planner application).** Below the activities for each stage will be described in detail.

Stage 1: **Design**

Starting from the UX research performed in the previous stage of Task 6.1 (pilot case study brief), the WG analysed the phases and sub-phases of the journey on which they focused and where the current barriers and possible improvements for overcoming them, were identified. Therefore, in this pilot case study, the identified phases of the journey were three and one sub-phase for the first two phases was defined (please refer to the table below, one for all disabilities, visual, physical, hearing, mental and intellectual).
The columns of the tables below, named (1) "**Title of the requirements**", (2) "**Description on how the requirement should work**" and (3) "**Comments**" clarified how the requirements designed for the journey planner app, should help to overcome the current barriers identified for each sub-phase of the journey included. Furthermore, the local WG

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worked on the design by assuming that the application will meet EU accessibility requirements and be easy to use for persons with visual disabilities.

The application called “EDS” (Emil does Stockholm), is expected to allow users to input information about their particular impairment/disability and mobility devices and then when they check the timetable for public transport the results are “enhanced” with information that is relevant to their particular needs. This includes realtime information about congestion and the availability of wheelchair space on the bus that they are planning to take. The WG *worked on a mock-up and please below, refer to an example of a possible app screenshot designed by the group.*

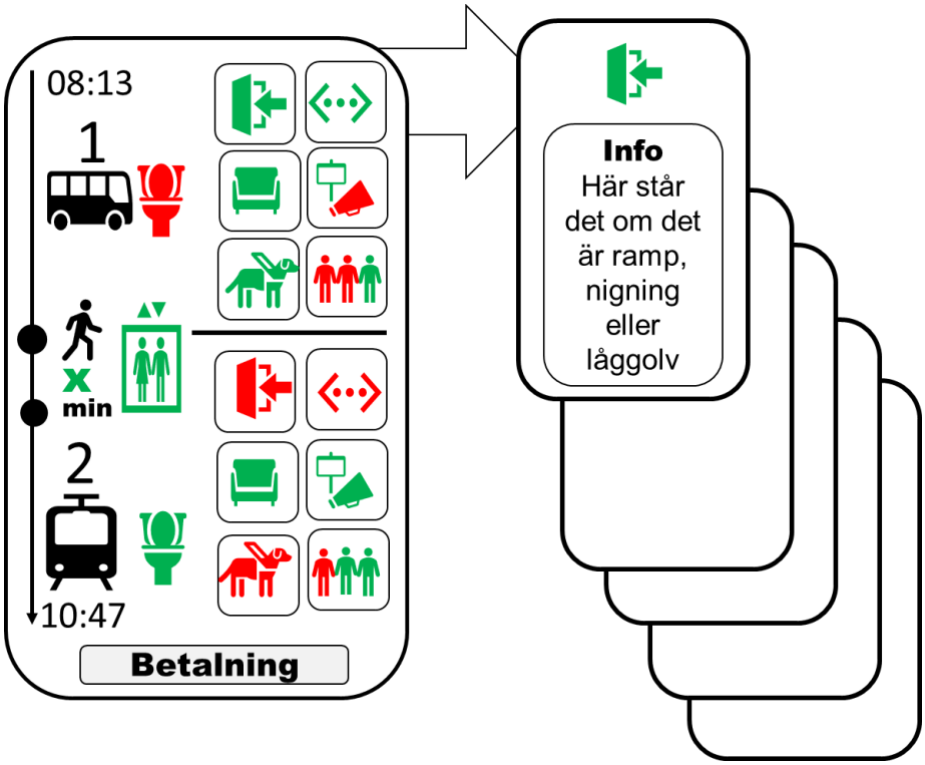

Figure 4: EDS App of Stockholm WG

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Phase	Sub-phase	Barrier	Requirement N.	Title of the requirements	Description on how the requirement should work	Comments
1 - Setup User enters information about impairments and assistive devices.	a) Setup the EDS app	In order for the app to calculate a route it needs to know both the timetable info and the users requirements.	1	Setup individual options form. Input user information and store it in the app.	Options to enter each impairment and list of wheelchair models and sizes. Can a user board a bus or train without assistance?	Users may be unwilling to supply personal info. Users may be disappointed if they enter their info and no travel is found due to lack of data.
2 - Travel Preparation	a) Consult the timetables of public transport via the EDS App. A week before travel. Or a day before travel Or An hour or less before travel (IRL)	The user needs to know in advance if the user can actually use public transport or arrange alternative transport.	1	Open the app and search «Planning» section with option to include users personal requirements in the search.	Form for searching with option to include individual requirements.	May cause confusion if requirements have not been entered.

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			2	Display result	The app displays if the route is possible for a person without accessibility requirements and then adds information for the user based on the user requirements. If the route is possible at another time or not at all. If the route will involve buses and trains where the accessibility data is not available then this is shown.	
			3	Options to zoom in on each stage of the travel.	Display known and unknown accessibility info.	
3 Transport provider must provide raw data.	● Which buses and trains and stations have or lack which features ● Timetables ● Which bus will be travelling which route known in advance ● Guides at major stations - where are they? ● Realtime congestion/ load - are all the wheelchair places on the bus taken					

Table 15: Stockholm WG list of requirements for users with all types of disabilities

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Stage 3: **Testing**

The Stockholm WG, at this stage, **tested "on the paper" the requirements of the Travel ID Planner,** written in the previous Design stage (Table 15), to help to overcome the barriers identified through UX activity done in Task 6.1. They were able to provide details on **the testing results for each requirement**, and they are summed up below (*regarding requirements for all kinds of impairments*), by referring to the table 15:

- **Phase 1** "Set-up " and **sub-phase a)** "setup the EDS app" of journey identified in UX research, requirement n.:
    1. The **testing result was partially ok**: no clear information on details of specific needs about to leave the vehicle and where to find facilities service (e.g. toilet, etc.).
- **Phase 2** "Travel Preparation" and **sub-phase a)** "Consult the timetables of public transport via the EDS App" of journey identified in UX research, requirement n.:
    1. The **testing result was partially ok**: misinterpretation on the symbols to be used and read (not very intuitive) on the app;
    2. The **testing result was ok;**
    3. The **testing result: N.A.**

The phase 3 "Transport provider must provide raw data for this to work" actually provided some insights but no requirements were developed in detail, so no testing was performed.

5. Lesson Learnt and recommendations

Throughout Task 6.2 which lasted for 14 months [M19-M31] seven city partners have worked on designing and developing inclusive digital mobility solutions by implementing the co-design methodology.

In many cases, working in the co-design way is a long process which requires effort and commitment from all parties. The method itself is a great learning opportunity. There are some of the learning points the cities have mentioned throughout these months:

- Working in the Co-Design-for-All methodology provides cities the opportunity to find common solutions to the problems faced by the different groups of persons with disabilities. As an example, the team of Bologna were very happy to work directly with the users - "*We are very good in focusing on the real needs of people with disabilities who wish to use public transportation in Bologna*";
- Some teams commented that working directly with the persons with disabilities helped them to identify the exact barriers and opportunities that persons with access needs are facing while using the public transportation: *"We thought about concrete things and did not focus on not achievable goals";*
- In addition, the Co-Design-for-All also enforces a proactive attitude vis a vis transport operators and political parties involved in the project. It helps to build up the efficient dialogue and connections between the users with disabilities and transport providers and other institutions, such as city municipalities and researchers. The project itself allowed the cities to take advantage of the connections established during these months of the Task 6.2 to ensure the sustainability of the collaboration and plan the follow-up actions.

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There are some things that still need improvement, such as:

- Limited collaboration among the several associations operating in the city (e.g in Cagliari);
- Some cities also have mentioned the lack of a long-lasting commitment to the TRIPS project on behalf of some CUT members. Of course, three years is quite a long time and during that time many things can happen;
- Lack of (other) communication between the parties present at meetings led to some dispersion (e.g. in Lisbon)
- Troubles to involve persons with some specific disabilities like sensory disabilities (e.g. deaf people) and intellectual disabilities (e.g. in Bologna)
- Lack of public awareness and troubles to find new investors for future developments (e.g. in Zagreb and Stockholm).

6. Conclusions

The result and outcomes from task 6.2 were very good overall, despite the contextual differences of each city partner. The Co–Design-for-All methodology was a win-win approach to manage these differences and even emphasise them to enable the city partners to achieve the maximum results. Indeed, this approach helped to bring out the real needs of local WGs and to allow them to bring these on the table with the local transport stakeholders.

On the other hand, each city partner tackled different (and just in some cases common) troubles to achieve the goal, with accordingly, different outcome levels.

For example the full city partners, who had also to develop the solution/s, achieved indeed different outcomes. Bologna WG decided to focus more on recommendations than on digital mobility solutions because it was a need raised from the local WG, then WGs in Cagliari and Zagreb developed digital solutions including an advanced TRL target (respectively 6 “Technology demonstrated in relevant environment” and 7 “System prototype demonstration in operational environment”), and finally Lisbon WG was more conservative (i.e. of the two solutions, the maximum identified TRL was 4 “Technology validated in lab”). **However, all the full city partners achieved the outcome levels that they promised in the pilot case study briefs (task 6.1).**

In contrast, the expectations of the associated city partners were different, because as mentioned, they didn’t have to develop the solutions. WGs in Brussels and Sofia focused on a TRL 3 “Experimental proof of concept”, suitable for a designed and not developed solutions, while Stockholm’s WG was more optimistic at the pilot case study brief stage, and they aimed for TRL 5 “Technology validated in relevant environment”. The reason was the potential opportunity to find funding through a joint venture with another research project but this was not possible within the TRIPS project timings. **Therefore, all the 7 city partners accomplished the activities and outcomes expected from task 6.2.**

The main important experience coming from these activities is that the Co-Design-for-All methodology works well. Indeed, the main opportunity after the TRIPS project, is that local WGs created during the project, keep working and the connections

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established with the local transport stakeholders keep helping to carry on the local projects.

For sure, the results coming from this task, will be useful to complete the work ongoing, of task 6.3 ("Business Case Development for Full-scale Deployment"). Indeed, this task is dedicated to the development of the business cases for the further development and funding of resulting solutions. To this end, once technically validated through in-situ testing and/or UX tested by local users, the inclusive digital mobility solutions will be evaluated under different perspectives in order to:

- Estimate how the implementation of new mobility service(s) will contribute to improving inclusivity of the local transport system;
- Measure the impact that the designed solution deployment will have in terms of increased accessibility of the local transport system;
- Understand the actual conditions and constraints for their viable implementation.

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Annex 1 (Pilot case Study Briefs)

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Annex 2 (Specifications of Accessible Journey Planner)

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Scope of the document

This document aims to list the initial IT requirements identified for the "TRIPS accessible journey planner" platform/application.

Mobile application for end-users

- Mobile app that allows to plan and execute all stages of the journey, carried out through the public transportation services geolocate a user, to consider individual disabilities through specific settings.
- For each trip or journey, all the stages that should be interconnected and can be flexibly changed by the user.
- There are two modes: with and without individual user profiling.
- For each phase of the journey, it is possible to choose and change the suggested options depending on current traffic situation and individual user preferences. It is also possible to give basic user feedback in form of comments, notes, photos and of the timestamp-position report with geographical coordinates (GPS).
- The app must include multilingual support (even for non-Latin characters: Cyrillic, Greek).
- App available for download on Google Play Store and Apple Store.

Web administration application

- Creation of a web app that allows the visualisation and evaluation of statistical information on user journeys and trips.
- The server summarises the data received into journey indicators and reports so that they can be consulted from the web portal.
- The portal provides several summary dashboards based on different data visualisation criteria.
- Ability to consult a dashboard via parameterized queries (e.g. place, disability, service/means of transport).

Initial IT requirements

The initial IT requirements presented as prerequisites for the functioning and purpose of the system in its context are presented below.

Category	**IT requirement (recommendation) description**
Functional	**Must have "Required":** 1. Dynamic journey steps planning at every time 2. Current geolocation 3. To show current time and date

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	Should have "Preferable": 1. To show a current weather 2. To show a current journey step
	Nice to have "Optional": 1. To show the remaining time until the journey end 2. To show a weather forecast
User Interface / User Experience / Accessibility (Human Centred Universal Design Principles)	**Must have "Required":** 1. Multimedia (visual-sound-haptic-odor) 2. Multilingual support 3. Option for accessible UI customization
	Should have "Preferable": 1. Option for user profiling 2. Opportunity to give basic user feedback
	Nice to have "Optional": N.A.
Non functional: Required platforms & libraries	**Must have "Required":** 1. iOS, Android
	Should have "Preferable": Download from Google Play Store and Apple Store
	Nice to have "Optional": Download from own website
Non functional: Technical interfaces	**Must have "Required":** 1. Bluetooth 2. REST API
	Should have "Preferable": 1. Cross-platform interoperability
	Nice to have "Optional": N.A.
Non functional: System performance	**Must have "Required":** 1. Maximum delay of 1 second at every step 2. Ability to serve at least 100 users at the same time at the first stage 3. 95% of on-time during the peak usage hours
	Should have "Preferable": 1. Ability to serve at least 1000 users at the same time at the first stage 2. 99% of on-time during the peak usage hours

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	Nice to have "Optional": 1. Ability to serve at least 10000 users at the same time at the first stage 2. 99.9% of on-time during the peak usage hours
Non functional: System attributes & properties	**Must have "Required":** 1. Remote configuration and installation 2. Security by design 3. Updates
	Should have "Preferable": 1. Automatic updates
	Nice to have "Optional": N.A.

User Stories

The following user stories describe the hypothesised situations that a user with disabilities would like to accomplish through interaction with the digital service.

JOURNEY			
Personas	**Needs**	**Functions**	**User stories**
Citizen with disabilities	Plan and execute all stages of a journey, using public transport.	Select and change the travel options at each trip stage with a means of public transport.	As a citizen with disabilities, I would like to be able to use a mobile app to plan and execute all the journey stages related to the use of public transport services (architectural barriers, ...).

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Citizen with disabilities	Give basic feedback for each stage of the journey.	Send feedback for a specific phase of the journey, through form of comments, notes, photos and of the timestamp-position report with geographical coordinates (GPS).	As a citizen with disabilities, I would like to be able to use a mobile app to communicate the basic feedback in a specific moment of my journey by public transport in form of comments, notes, photos and of the timestamp-position report with geographical coordinates (GPS).
Citizen with disabilities	Use the service in the mother tongue.	Ability to select the language based on the user's choice.	As a citizen, I would like to be able to use the app in a language that I understand.
Citizen with disabilities	Use the service in an easy way with respect to disability.	Ability to select the app configuration based on various criteria attributable to one or more disabilities.	As a citizen, I would like to be able to use the app easily and comfortably based on my disability.

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Annex 3 (Pilot case Study Template)

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