



## **D2.3 – Universal Interface Language – Version 1**

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## Executive summary

The deliverable D2.3 Universal Interface language (UIL) – Version 1 introduces the principles of Universal Design (UD) to the world of icons and pictograms on digital interfaces. It aims to provide designers, developers, and transport or goods delivery service operators with a preliminary set of guidelines for the user-centred design of icons as part of the user interface, be it digital or physical.

This deliverable complements Deliverable 2.1 Universal Design Manual (UDM) – Version 1 (D2.1). They are both key tools for offering guidance to different types of professionals that work on planning, designing, deployment and operation of digital mobility and delivery services.

The UIL manual derives from the need to answer the following key questions:

- Are people aware of the emerging role of icons in mobile applications?
- How can icons help all people navigating smoothly within the contents and features of digital applications?
- Are the meanings of icons clear enough to all users?
- When clicking on or interacting with an icon, are users sure about the expected outcome?

For this purpose, a specific methodological path was set up to evaluate the accessibility and inclusiveness of icons in relation to service and application interfaces. It consisted of three main steps, as follows:

1. A preliminary review of 62 digital mobility and delivery service applications (DMS/DDS) from more than 20 different countries to explore interface accessibility and icon use. In addition, other 20 applications commonly used in Europe offering both transit and food delivery services were explored. From this review, a catalogue of 27 recurring icons, both general and mobility-related ones were identified.
2. The selection of icons collected in the previous phase was compared with those used in the pilot site applications. A UIL exercise was built to involve users in icon evaluation. Five similar interactive UIL exercises were performed, one for each pilot's Community of Practice (CoP);
3. To consolidate results about icon evaluation collected through the previous two steps, an UIL online survey was distributed to all stakeholders, to social media account followers and to the members of the Co-Creation Community.

The main results concerning the above-mentioned steps refer to:

- the creation of an *icons catalogue* that includes useful evaluation insights about recurring icons in digital mobility and delivery applications (section 7.1.2);
- an *interfaces analysis* providing useful tips about the importance of a well-structured application interface to ensure the highest comprehensibility and minimisation of errors (section 7.2);
- the identification of a *set of recommendations for the design of accessible and inclusive interfaces*. They have been organized in three main sections:

recommendations from the INDIMO project, inclusive design recommendations and general recommendations.

Recommendations from the INDIMO project (section 8.1) concern:

- The design of inclusive and accessible interfaces (section 8.1.1) with a specific focus on interfaces for the visually impaired and blind people;
- The design, selection and integration of pictographic icons for mobile applications (section 8.1.3).

Inclusive design recommendations (section 8.2) include:

- Inclusive user-testing recruitment (section 8.2.1);
- Plan the development of inclusive mobile interfaces (section 8.2.2);
- Design inclusive mobile interfaces (section 8.2.3);
- Recommendations from other communities (e.g., UXs designers, gamers) (section 8.2.4);

General recommendations (section 8.3) address the following target groups and topics:

- Digital mobility and goods delivery service providers (section 8.3.1);
- Policy Makers in the field of digital accessibility (section 8.3.2);
- Software developers and designers (section 8.3.3);
- Institutional decision makers (section 8.3.4).

The results collected in this deliverable, confirm findings from the interviews with stakeholders from Task 1.4 of the INDIMO project in (D1.4) and together with recommendations and solutions provided by the other tools included in the INDIMO Inclusive Digital Mobility Toolkit, will be applied to the Pilot phase 2 (T3.4) to assess and redesign pilots' digital mobility and delivery services. For this purpose, two re-design workshops will be carried out in each pilot site. Feedback and suggestions gathered during these activities will nourish and enrich the final version of the UIL manual, due at M34.

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## Acronyms

ACRONYM	
<b>AIGA</b>	American Institute of Graphic Arts
<b>CCC</b>	Co-Creation Community
<b>CEN</b>	Comité européen de normalisation
<b>CENELEC</b>	Comité européen de normalisation en électronique et en électrotechnique
<b>CONs</b>	Advantages
<b>CoP</b>	Community of Practice
<b>CSS</b>	Cascading Style Sheets
<b>DDS</b>	Digital Delivery Services
<b>DMS</b>	Digital Mobility Services
<b>DOT</b>	Department Of Transportation
<b>DOA</b>	Description of Actions
<b>EAA</b>	European Accessibility Act
<b>EEA</b>	European Economic Area
<b>ETM Forum</b>	European Transport and Mobility Forum
<b>ETSI</b>	European Telecommunications Standards Institute
<b>EU</b>	European Union
<b>FAQ</b>	Frequently Asked Question(s)
<b>GPS</b>	Global Positioning System
<b>HF</b>	Human Factors
<b>ICT</b>	Information and Communications Technology
<b>IEC</b>	International Electrotechnical Commission
<b>ISO</b>	International Organization for Standardization
<b>IT</b>	Information Technology
<b>MBE</b>	Mozgasserultek Budapesti Egyesulete
<b>NALA</b>	National Adult Literacy Agency
<b>NGOs</b>	Non-governmental Organizations
<b>PROs</b>	Disadvantages
<b>PRMs</b>	People with Reduced Mobility
<b>PT</b>	Public Transport





<b>PTS</b>	Public Transport Services
<b>SSI</b>	Semi Structured Interviews
<b>TTS</b>	Text-to-Speech
<b>UCD</b>	User-Centred Design
<b>UD</b>	Universal Design
<b>UDM</b>	Universal Design Manual
<b>UI</b>	User Interface
<b>UIL</b>	Universal Interface Language
<b>UNCRPD</b>	UN Convention on the Rights of Persons with Disabilities
<b>US</b>	United States
<b>UX</b>	User Experience
<b>WAI</b>	Web Accessibility Initiative
<b>WAI-ARIA</b>	Accessible Rich Internet Applications Suite
<b>WCAG</b>	Web Content Accessibility Guidelines
<b>W3C</b>	World Wide Web Consortium

**Table 1 - List of acronyms**

# 1. Introduction

## 1.1. About INDIMO

The INDIMO project aims to enable researchers, operators of digital mobility services and platforms, developers of digital mobility solutions and policy makers to include the user perspective and co-creation approaches in the entire development process of digital mobility solutions. This way, products and services delivered would be tailored to the actual needs of transport users. The project will identify the main characteristics of demands that digitally based mobility solutions place on users, focusing on all types of transport users and in particular on vulnerable-to-exclusion citizens (such as elderly people, children, people with disabilities, low income, low education level). The project will develop the INDIMO Inclusive Digital Mobility Toolbox consisting of the Universal Design Manual, Universal Interface Language for transport services, Guidelines for cyber-security and personal data protection and a Policy Evaluation Tool. These tools will support policy makers, developers and service operators to develop digital mobility solutions universally accessible to citizens focusing on accessibility and social and spatial inclusivity. The toolbox will be applied and tested on five pilot projects in Madrid (Spain), Antwerp (Belgium), Emilia-Romagna (Italy), Berlin (Germany) and Galilee (Israel). INDIMO has five project objectives, as follows:

- **Objective 1:** To improve the understanding of the needs of users towards the digital transport system.
- **Objective 2:** To improve the knowledge about the requirements of a personalised digital transport system towards users.
- **Objective 3:** To co-create tools that can help engineers, developers, operators and policy makers to develop an inclusive, universally accessible personalised digital transport system.
- **Objective 4:** To facilitate the concept of universal design throughout the planning design process of digital applications and services both for accessibility and inclusion.
- **Objective 5:** To navigate future policy by channelling project results into European, regional, and local policy making.

## 1.2. Vision for D2.3 – Universal Interface Language – Version 1

### 1.2.1. The INDIMO toolkit

INDIMO's main goal is to expand the use of existing and emerging digital mobility services to target users-groups that are currently excluded due to physical, cognitive, cultural, or socio-economic barriers. Fulfilling this goal requires a holistic approach that takes into consideration a variety of digital services and an extensive data collection from end-users, developers, operators, and policy makers in order to establish policies and guidelines towards more inclusive digital information systems and mobile applications related with transport and goods delivery services.

The outcome of the project will be a comprehensive digital mobility deployment toolkit, which will be comprised of:

- The Universal Design Manual (UDM) for digital transport services (D2.1);
- The Universal interface language (UIL) for digital transport services (D.2.3);
- The Cybersecurity and privacy assessment guidelines (D2.6);
- The Policy evaluation tool and recommendations for policy makers (D2.7).

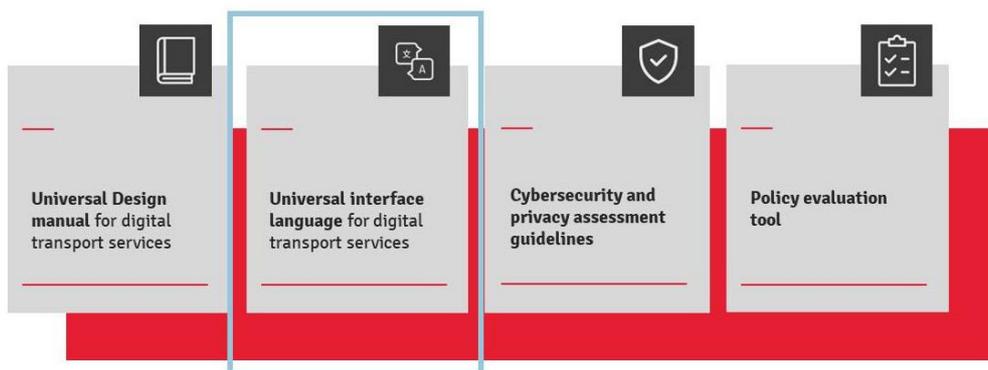


Figure 1 - The INDIMO Toolkit

The Universal Design Manual (D2.1) and Universal Interface Language (D2.3) are based on the assessment of user requirements and feedback from real-life applications contained in the pilots. The manuals are constructed following seven principles of Universal Design<sup>1</sup> (Fogli, Arengi, & Gentilin, 2020), while also considering cybersecurity and privacy. They expand the concept of equitable use to social, spatial and economic inclusivity in accessing digital on-demand mobility services. The focus is on the interaction between users and the digital transport system through user interfaces on multiple devices (e.g., mobile, desktop, interactive equipment or information display). Enablers and barriers for the use of mobility services in general are also identified. These manuals are complementary tools and both nourished by a number of research inputs on user’s experience collected in previous stages of the INDIMO Project (WP1) and in the literature review. Practitioners should combine provided recommendations to extract lessons that are of interest for their planning, design, deployment and operation. The UDM and UIL are

<sup>1</sup> General principles of Universal Design include the following:

- the design is useful and marketable to people with diverse abilities;
- the design accommodates for a wide range of individual preferences and abilities;
- the design communicates necessary information effectively to the user, regardless of contexts of use or the user’s sensory abilities;
- the design can be used efficiently and comfortably and with a minimum of fatigue;
- appropriate size and space are provided for approach, reach, manipulation, and use regardless of the user’s body size, posture, or mobility.

key tools for offering guidance to different types of professionals that work on planning, designing, deployment and operation of mobile mobility and delivery services. These professionals may be Graphic Designers, UX/UI Designers, Computer programmers, Computer Engineers, System Analysts, Information systems Managers, Computer Network Architects, transport operators, policymakers.

### 1.2.2. The Universal Interface Language

Visual icons (also called pictograms) are fundamental elements in design because they symbolize concepts and how people consciously or unconsciously interact daily with them. Icons are a powerful communication tool, yet not accessible to all. Thus, the purpose of the UIL is to improve the non-textual communication of digital applications to ensure that different types of people may intuitively access contents overcoming the language, cultural, physical and cognitive barriers.

This document introduces the principles of Universal Design applied to the world of icons and pictograms and it is addressed to designers, developers and transport or goods delivery service operators. It includes a preliminary set of guidelines and suggestions, enriched with direct links to contents addressing the usability and inclusivity of icons and interfaces used by mobile digital services. This UIL can be considered as a first step into user-centred digital applications' design.

The UIL offers guidelines for the user-centred creation of icons as part of the user interface, be it digital or physical (e.g., the image of a delivery box in a digital delivery service or the wayfinding pictograms in a transport hub). The UIL manual establishes a clear conceptual approach, to promote awareness about the close connections among icons, visual interface elements and multi-modal cues that lead to the full comprehension of digital application contents and features.

### 1.2.3. Structure of the deliverable

This first version of the D2.3 - Universal interface language icons is the third deliverable of Work Package 2 (WP2) and it is complementary to the other deliverables submitted in M18 and M19: D2.1 – Universal Design manual (D2.1); D2.5 Enhancing appropriation of digital mobility solutions (D2.5) and D2.6 Guidelines for cybersecurity and personal data protection (D2.6, 2021). More advanced versions of D2.1 and D2.3 will be delivered by the end of the project (D2.2, D2.4) together with the deliverable D2.7 - Recommendations for policy makers and operators for implementing an inclusive digital transport system (D2.7).

The UIL version 1 is a comprehensive document that, beside guidelines, best practices, templates and the icons catalogue, includes a detailed theoretical rationale, the explanation of the methodology applied to the data collection and several annexes. These consist of instructions and templates to perform exercises (e.g., interactive dashboards, online survey), the detail of the analysis carried out and raw data regarding the five INDIMO pilot sites (UIL exercises).

The UIL version 2 will be a more readable and navigable document designed for UX/UI designers, service operators and developers who need an operational approach to the information. A new information structure and graphical organization will be provided. The content will be shortened and it will be mainly focused on recommendations and methodological templates.

Coming back to the D2.3, in the opening section 2 an overview of the main challenges related with the design of inclusive mobile interfaces and icons are briefly described. The following section 3 summarises the current knowledge in literature about icons, symbols signs and pictograms plus a collection of relevant standards. Additionally, an overview of icons' inclusivity and accessible user interface best-practices, including insights from similar public and private research projects and linked results from WP1 in section 4.

The main contents of the UIL manual can be found from section 5 where the user interfaces' and icons' analysis is introduced and further detailed in section 6 about Methodology. The results are reported in section 7, from which we derived recommendations collected in section 8. Section 9 is dedicated to the lessons learnt and section 10 extrapolates conclusions from our research and next steps.

At the end of each section, we have summarised the key insights and findings of the respective section in order to provide a quick point of reference.

## 2. The Universal Interface Language Icons' problem statement

### 2.1. Why a Universal Interface Language manual?

We're all getting used to interacting daily with mobile applications' and online tools, helping us with most activities in the daily routine: alarms, calendars, route-planners, calories and step counters, online reservation systems, reminders, music players and sleep managers. In May 2021 56% of worldwide mobile traffic came from personal devices<sup>2</sup> such as smartphones, small sized notebooks and tablets and wearables (e.g., smart watches).

The main difference between the use we all make of fixed or desktop devices and mobile devices is the goal-directed intention. When using mobile devices, we need to find specific pieces of information relevant to our current context. Browsing or reading through lengthy pages and documents is typically avoided, textual input is difficult when compared with a desktop device equipped with a keyboard and excess information or pop-up contents prevent us navigating seamlessly on small screens.

Notwithstanding the limitations, mobile devices are extremely popular due to their portability, connectivity and multi-functional purposes. Additionally, they are highly adaptable, which makes their accessibility even more interesting and challenging.

To minimise written contents and increase intuitive use, designers rely more and more on pictograms, sounds and haptic feedback. Such elements are all referred to as "icons" (visual,

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<sup>2</sup> <https://gs.statcounter.com/platform-market-share/desktop-mobile-tablet/worldwide> - last access on 18<sup>th</sup> of June 2021

auditory, haptic) in the relevant literature Digital visual icons represent objects or computer system functions that users can manipulate and interact with (section 3).

The INDIMO project UIL manual derives from the need to answer to the following key questions:

- Are people aware of the emerging role of icons in mobile applications?
- How can icons help all people navigate smoothly within the contents and features of digital applications?
- Are icons' meanings clear enough to all users?
- When clicking or interacting with an icon, are users sure about the expected outcome?

Studies confirm that the comprehension of signs and symbols, be it in the real world and in the digital world, is not as obvious as it may seem (Bagagiolo, Vigoroso, Caffaro, Cremasco, & Cavallo). Icons' comprehension and the comprehension of the overall user interface are strictly related with each other and they are both influenced by factors such as the context-of-use, socioeconomic and cultural background of users (section 3.4.2). There are pictograms considered “universal”, either because their visual affordance is highly intuitive for most people globally either because they are already positioned as global standards and used worldwide, but it is not enough to declare them universal (Norman, 2019). We challenge the universality of the most common visual icons used by digital applications offering mobility and goods delivery services, applying Universal Design and Design for All principles to their analysis and evaluation, both as standalone elements and as parts of user interfaces.

## 2.2. Accessibility barriers in the era of smartphones and mobile devices

The context of use of digital applications is very diverse: mobile applications can be accessed via devices equipped with different screen sizes and operating systems; mobile applications have to ensure a high level of consistency and usually link to data or extended contents available on the desktop version. Together with the “miniaturisation” of screens, textual contents dropped to the minimum and developers had to fully review processes and strategies: responsiveness, triggers and roll-over contents, multi-sensorial haptic and auditory notifications, minimalist design only to mention a few innovations for mobile environments. In recent years usability and user experience became essential.

While the number of internet connections increased significantly globally<sup>34</sup> thanks to the broad success and affordability of personal mobile devices, accessibility issues struggled to gain the attention they deserved from service providers. Standardization bodies and regulations try to keep pace with society's push towards equity and accessibility, but their influence is limited, and recommendations often remain on paper since there is no real enforcement to encourage a change in mindset.

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<sup>3</sup> <https://ourworldindata.org/internet> - last access on 18<sup>th</sup> of June 2021

<sup>4</sup> <https://ourworldindata.org/grapher/share-of-individuals-using-the-internet> - last access on 18<sup>th</sup> of June 2021

The false myth of the “average user”<sup>5</sup> has been debunked by human factors studies (ETSI Technical Committee Human Factors, 2002) and Universal Design experts, whose instances concerning the digital accessibility and usability have been lately recognized by European Standards (section 3.3).

## 3. State of the art

### 3.1. Icons, symbol signs and pictograms in a complex society: cultural matters *versus* globalised information

The majority of icons are understood thanks to our familiarity with rhetorical images (Moles, 1989) such as metonymy, synecdoche, and metaphor<sup>6</sup>. Most software still use icons representing objects related with the 1980s office environment or other professional areas to transpose attributes from a familiar context/object to an unfamiliar one (Smitshuijzen, 2007). Nowadays, such precondition is no longer valid for two main interlinked reasons:

- Until the early 2000 only certain categories of people could or were asked to use software or digital applications, mainly people employed in offices, research entities or high-innovation companies. Today with the fast-spread of personal computers and mobile devices, the context of use and the familiar objects and symbols have completely changed. People born after year 2000, for example, have probably never seen a floppy disk or a landline phone in their whole life. This is only one example of how common visual icons can become outdated or refer to obsolete technology.
- The number of mobile connections globally already trespassed the number of living human beings. There is almost no place in the world where people cannot exchange daily messages and other types of information (e.g. photos, videos, vocal messages) with each other thanks to broadband network coverage. It is understandable that digital icons will undergo a fast process of change.

As for any language, we expect the continuous evolution of visual icons and their meaning, seeing it as a process of selection that will proceed in two apparently opposite directions:

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<sup>5</sup> “Another mistake that is often made in the design process is the incorrect use of anthropometric tables for the purpose of designing for the statistical mean of the population. However, it may be obvious to keep on repeating it, we have to remember that there is no such person as Mr. Average” ETSI IPR - ETSI Technical Committee Human Factors (HF), 2002.

<sup>6</sup> Metonymy: a word or expression that refers to something using the name of one of its qualities or features; Synecdoche: word or phrase in which a part of something is used to refer to the whole of it, for example “a pair of hands” for “a worker”, or the whole of something is used to refer to a part, for example “the law” for “a police officer”; Metaphor: an expression, often found in literature, that describes a person or object by referring to something that is considered to have similar characteristics to that person or object - Source: Cambridge Dictionary.

- The broader the creation and use of new icons (and their attached meaning) by different cultural groups, the larger their diversity becomes;
- The larger the transfer of new icons from the most competitive and powerful services to different cultural groups is, the faster their adoption.

If we assume the above simplification is true, icons related with homogeneous contexts of use (transport, travel, health, safety and security, ...) in different socio-cultural and socio-economical contexts will tend to a partial homogenization of appearance and meaning over time similarly as it happened with wayfinding signage used in worldwide transport hubs.

## 3.2. Signs comprehension

To better understand how socio-cultural aspects can impact the understanding of icons, the following sections discuss studies about signs and pictograms used in non-digital contexts, as well as design of pictograms for international audiences at international events and international transportation hubs. Also, the healthcare domain studies contributed with valuable insight to this topic.

### 3.2.1. A Universal pictographic language

The advantage of pictograms and symbols over text is that they were considered capable to overcome the barriers of individual languages or even literacy (Smitshuijzen, 2007). The first who embraced this approach was Otto Neurath who, in the beginning of the 20th century, created the *International System of Typographic Picture Education (Isotype)*<sup>7</sup>. By the late 1960s, the concept of a standardized design system was considered necessary when communicating in large organizations or international events involving multilingual users who needed to be guided and informed (Rosa, 2009). The first example of a wide pictographic system used in a universal context is related to the 1972 Olympic Games<sup>8</sup> designed by Otl Aichler (Aichler, 1996).

In 1974 the United States Department of Transportation commissioned the American Institute of Graphic Arts (AIGA)<sup>9</sup> to create a set of pictograms to be used throughout public transport networks and other transportation hubs and at large international events (Figure 2).

In the 1980s, a standard set of pictograms was defined in the international standard *ISO 7001:2007 Graphical symbols – Public information symbols* (ISO - International Standard Organisation, 2007) that specifies graphical symbols for the purposes of public information. (Figure 3).

It is worth to mention that the design of the first standardized and universally understandable systems of pictograms clarified the need for consistency of symbols used in international facilities or in any context involving multi-cultural audiences. The basic issue concerning

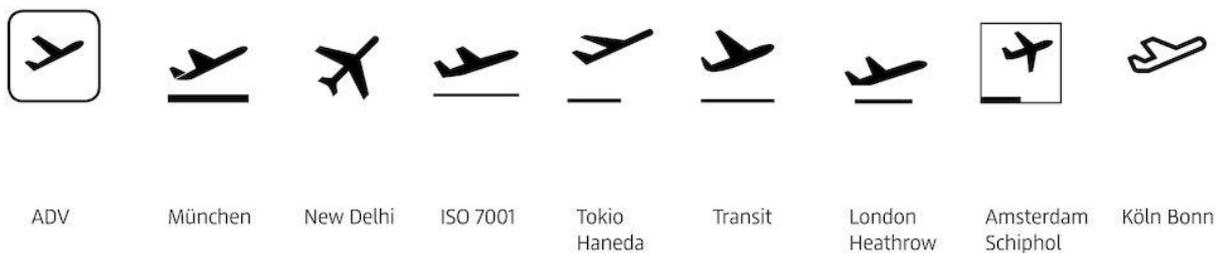
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<sup>7</sup> <http://isotyperevisited.org> - last access on 29<sup>th</sup> of June 2021

<sup>8</sup> <https://www.piktogramm.de/en/> - last access on 29<sup>th</sup> of June 2021

<sup>9</sup> <https://www.aiga.org/resources/symbol-signs> - last access on 29<sup>th</sup> of June 2021





**Figure 4 – A comparison of the departure pictogram among different international airports<sup>10</sup>**

Room for designers' creativity shall be ensured at all times, but it is necessary to take into consideration the ability of all people to read, decode and understand graphical forms: *“Like other written languages, pictograms require learning, a conscious methodology and pedagogic support”*(Rosa, 2009).

A study conducted on a sample of 100 participants to verify whether persons from different cultures, age, groups and literacy levels correctly interpret standard healthcare symbols (Hashim, 2014) demonstrated that:

- participants find it harder to understand healthcare symbols than general purpose signs;
- symbols referring to abstract concepts were the most misinterpreted;
- interpretation rates varied across cultural backgrounds and increased with higher education and younger age;
- pictograms with human figures and synthetic description of actions are better understood than abstract concepts.

Nevertheless, some symbols were highly misinterpreted by all participants and required further support information to be understood, since the average comprehension rate was as low as 68%. Researchers agree that internationally approved signs adoption is spreading worldwide, but some still need to be examined (Vilar, Rebelo, & Noriega, 2014).

### 3.2.2. The use of signage in transport terminals

The use of effective signage and maps in urban environments and transport terminals is critical to enable people to navigate around them efficiently and effectively. Fendley (Fendley, 2009) introduced six design principles for signage and maps arising from his work with the Legible London scheme, which aimed to improve the clarity of information provided to passengers and pedestrians using the London public transport system. The design principles mostly focused on overall comprehensibility of wayfinding information, yet it paid no specific attention to vulnerable people and inclusivity and left out emergency and safety issues related with signs

<sup>10</sup> <http://www.moniteurs.de/en/project/vision-plus-2014-transforming-information-airport-pictograms> - last access on 29<sup>th</sup> of June 2021

comprehension in crowded places such as transport hubs. Thanks to the research done by two past H2020 European Projects IMPACT and LET’S CROWD, such issues have been partly addressed by identifying socio-cultural aspects that can influence the communication with crowds and signs comprehension (e.g. cultural background, people’s social identities, socio-demographic factors). These projects suggested solutions to enhance the communication, e.g. the use of a multi-language approach to reduce language barriers in crowded places and the application of a multi-channel strategy that takes into consideration the characteristics of the different subgroups composing the crowd. The identification of the specific target audience is a key point to deliver effective messages (both verbal signals and signs placed in the physical/digital world). However, the strong relationship between the information provided in the physical world and on digital channels is hardly mentioned in the recent literature, offering an interesting opportunity for further researches. Throughout its whole duration the project INDIMO aims at improving all its target groups’ awareness about the additional benefits of such an inclusive and broad-minded design approach to all people with vulnerabilities. Thus, specific attention will be paid to the needs of vulnerable people related with the physical navigation in crowded places, also in emergency situations, and to the additional issues and opportunities that may emerge when adding-up the information provided by DMS and DDS.

#### Key Insights

Even though the need for standardized and universal set of pictograms and symbols are recognized, differences in culture, age, social identities and literacy levels may impact on the understanding of icons. People’s capability to read and decode graphical forms needs to be always taken into consideration. Designers and developers should be aware of this and follow a “conscious methodology” to evaluate and identify a proper set of icons to use when developing mobility and delivery applications. This document also describes the methodological process to evaluate icons according to the Universal Design Principles. It provides developers and designers with a quick and simple exercise to perform with users to assess the comprehensibility of icons in relation to the application interface, starting from the prototyping phase of the development process.

The design principles for designing signage and maps in transport terminals can be useful when designing digital mobility applications (Fendley, 2009). These guiding principles allows to consider the consistency between physical (i.e. in real contexts) and digital set of pictograms as an opportunity to implement to support people in recognizing icons.

### 3.3. Relevant Accessibility Standards and Directives at the European and the International level

*Accessibility should be achieved by the systematic removal and prevention of barriers, preferably through a universal design or ‘design for all’ approach, which contributes to ensuring access for persons with disabilities on an equal basis with others. According to the UN CRPD, that approach ‘means the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design’*



(The European Accessibility Act, 2019)

The European Commission has taken a decisive stand towards inclusion and instructed European standards organisations (CEN, CENELEC and ETSI) to develop and implement accessibility standards. Such standards are recognized worldwide and, together with the Web Content Accessibility Guidelines, they constitute the main reference for organisations and developers who are committed to provide more inclusive digital services. Thanks to the hundreds of people who were involved in their forging, today the digital world is a better place for all people who faced prohibitive barriers only few years ago. Yet, the hard work still needs to be done. The worst barriers are still hiding in our own minds: the comfortable “business as usual” prevents the necessary changes in how services and products are designed. In this section, we briefly summarise the following recent European standards and international guidelines are shortly summarised as they should be the starting point of the development of specific guidelines related to digital mobility and delivery applications.

1. **2006: UN Convention on the Rights of Persons with Disabilities (UNCRPD);**
2. **2015: ICT accessibility standard** resulting in European Standard, updated version including accessibility of websites and mobile applications **EN 301 549: 2019** (ETSI – CEN - CENELEC, 2018);
3. **2016: Web Accessibility Directive on the accessibility of the websites and mobile applications of public sector bodies** (European Parliament, 2016);
4. **2018: Web Content Accessibility Guidelines (WCAG) 2.1** and the Accessibility Evaluation Tools (W3.org, 2018);
5. **2019: European Accessibility Act on the accessibility requirements for products and services** (European Parliament, 2019);
6. **2019: Accessibility and usability of the built environment**, leading to European Standard **EN 17210:2021**; (CEN, 2021);
7. **2019: EN 17161:2019 Design for All** - Accessibility following a Design for All approach in products, goods and services - Extending the range of users (CEN, 2019);
8. **ISO 7010:2019** Graphical symbols – safety colours and safety signs – Registered safety signs (ISO - International Standard Organisation, 2019);
9. **2020: Reviewed and confirmed version of the ISO/IEC 11581-1:2000** - Information technology – User system interfaces and symbols – Icon symbols and functions (ISO/IEC, 2000).

The (1) **UN Convention on the Rights of Persons with Disabilities (UNCRPD)** is the first international, legally binding instrument setting minimum standards for rights of people with disabilities, and the first human rights convention to which the EU has become a party. In 2015 the first version of the (2) **ICT accessibility standard**<sup>11</sup> was published, almost in parallel with the (3) **Web Accessibility Directive** which came into force in 2016. The Directive strongly relates with the most recent (4) **Web Content Accessibility Guidelines** and stated that by October 2019 all new websites should comply with the Directive and that all public websites, including existing

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<sup>11</sup> Latest version **EN 301 549:2019**

ones, were required to be compliant by the end of 2020. These guidelines, the basis of most web accessibility laws in the world, are based on four requirements:

- **Perceivable:** Available to the senses (vision and hearing primarily) either through the browser or through assistive technologies.
- **Operable:** Users can interact with all controls and interactive elements using either the mouse, keyboard, or an assistive device.
- **Understandable:** Content is clear and limits confusion and ambiguity.
- **Robust:** A wide range of technologies (including old and new user agents and assistive technologies) can access the content.

**What about mobile applications?** According to the regulation, all mobile apps in the public sector will have to comply by June 2021 while private companies are not mentioned at all. But it is reasonably likely that in the future they will be required to comply with the same accessibility standards. Service providers and application developers who start building competencies to increase accessibility of their products and services today will be at the fore-front in the future digital market. In April 2019, the (5) **European Accessibility Act** was issued to mitigate the disparities between the Member States' laws, thus increasing the flow of products in the European single digital market. The European Accessibility Act acknowledges that in particular small and medium-sized enterprises are the most affected by accessibility barriers and that information and communications technologies and systems provided to the public need to promote inclusion at affordable prices. Already in the foreword it specifies that the accessibility of transport services concerns also the delivery of real-time travel information through websites, mobile device-based services, interactive screens and self-service terminals, and mobile applications. In line with the **Web Accessibility Directive (2016/2102)**, it states that products and services, including their user interfaces, shall contain features, elements and functions, that allow persons with disabilities to *access, perceive, operate, understand and control* the product or service itself.

(6) **The European standard on the Accessibility and Usability of the built environment** not only provides general obligations and recommendations for the accessibility of the built environment, but it also contain in-depth details on how wayfinding, signage and graphical symbols should be used to inform people about safety issues, with the purpose of preventing accidents and hazards. When designing digital services, it is important to be aware of such provisions to avoid overlapping, to ensure that the use of digital services takes into account the context of use (environmental, socio-cultural) and the communication analogies across the built and the digital world.

The (7) **Design for All standard, Universal Design and Human Factors** recently gained official recognition as disciplinary fields supporting usability of products and services and determining the effectiveness of human-centred design approaches.

Detailed information about the design of signs and symbols is included in the (8) **ISO 7010:2019** safety colours and safety signs and in the (9) **ISO/IEC 11581** provides a framework for the development and design of icons and their application on screens capable of displaying graphics as well as text. It contains general requirements and recommendations for icons and global variations to the graphical representations of icons.

**Other existing tools and guidelines:**

- [Customer Communications Toolkit for the Public Service](#);
- [NALA's plain English guidelines](#);
- [Usability website](#) developed by the U.S. General Services Administration Technology Transformation Services;
- [ICT Accessibility 508 Standards and 255 Guidelines](#) - especially Chapter 3;
- [WebAim checklists](#).

**Key Insights**

The previous prescriptive documents altogether have the potential to help providers obtain the highest level of inclusiveness of their mobility services, both in the physical and digital environment. If broadly adopted, existing requirements and guidelines would allow to design, develop and provide products, goods and services that can be understood and accessed by the widest range of users. It is therefore mandatory to have a certain degree of familiarity with their contents. Indeed, new challenges will emerge while technologies evolve and such provisions will eventually go through continuous updates. Since the fast pace of technological innovation does not allow standards and regulations to adapt timely, this UIL manual tries to bridge this gap integrating the existing official guidance with recommendations (from the INDIMO research, from other projects and relevant communities) that are useful to seize a personalised step-by-step user-centred process for the inclusive design of icons and related application interfaces. As a final remark to this section, we recommend to follow Alan Cooper's suggestion "*Obey to standards unless there is a truly superior alternative*" (Cooper, Reimann, & Cronin, 2014).

## 3.4. An overview of digital icons' accessibility

### 3.4.1. Digital visual icons: main characteristics

Digital visual icons (also called pictograms) represent data objects or computer system functions that users can manipulate and interact with. The ISO/IEC 11581 standard on *Information technology – User system interfaces and symbols - Icon symbols and functions*, distinguishes icons in five main groups:

- *Object icons* – they represent functions by association with an object and they can be moved and/or opened;
- *Pointer icons* – they represent a user interaction attached to a physical input device. The user manipulates it in interaction with other screen elements (e.g. the pointer is associated with selection, move and release of object icons);
- *Control icons* – they provide control of the display and create a sort of dialogue between the system and the user;
- *Tool icons* – they describe what user interaction is offered between the tool itself and the pointer icon;

- *Action icons* – they represent an action by association with objects that prompt the user to recall the intended action.

Digital visual icons have intrinsic characteristics that depend on how they appear as standalone elements, and characteristics that depend on their actual use in the specific user interface. The second set of characteristics are specified by developers in the content style sheets of the application code (.css files). The combination of both sets of icons' characteristics results in the visually perceivable element users will interact with.

The main characteristics of visual icons are:

#### **Intrinsic characteristics of icons**

- Colour
- Contrast
- Style (e.g. Wireframe/Abstract/Realistic)
- Flat design/Skeuomorphic design (2D/3D)
- Static/Animated
- Raster/Vectorial

#### **Additional characteristics of icons dependent on their use in the UI**

- Name
- Label
- Textual description
- Size or Scale
- Ratio
- Relative position on screen
- Linked multi-channel information (e.g. associated text or auditory signs)
- Movement or Animation triggers (e.g. rollover)
- Responsive behaviour (resizing, colour)
- Linked interactions

As already mentioned in section 3.3, the standard ISO/IEC 11581 offers basic recommendations about icons characteristics which influence their comprehensibility. Complying with such recommendations is an important step towards basic accessibility. The INDIMO project suggests that service providers and developers commit to a more case-specific design process, promoting a higher degree of iteration and user-testing of icons comprehensibility.

### **3.4.2. Usability of Icons on mobile devices**

Human Factors and human-centred design specialists, as cognitive psychologists, define icons' usability as the ability of a person to understand its meaning based on previous experience. Since icons are a visual representation of an object, action or idea, their intended meaning may not be immediately clear to all people<sup>12</sup>.

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<sup>12</sup> <https://www.nngroup.com/articles/icon-usability/> - last access on 29<sup>th</sup> of June 2021

Recent studies confirm that the identification task is harder than previously thought and the main factors influencing comprehension are related with familiarity and semantic distance (Isherwood, Mcdougall, & Curry, 2007). Additionally, contextual factors also contribute to the accuracy of the identification task (Mcdougall, Tyrer, & Folkard, 2006). In 2015 Hannah Alvarez<sup>13</sup> and her team of user-testing experts studied remote usability exploring the user experience with icons on mobile devices. Their work consisted in watching 35 users interact with 190 icons in a series of Android apps. Despite being an independent non-academic study, it allows gaining knowledge about most recent usability issues, especially about the level of ambiguity of well-known visual icons.

The main takeaways can be summarised as follows:

- **Only few icons are universally recognized by users** (i.e. home, print and shopping cart). As stated by Babich (2016)<sup>14</sup>, *“most icons continue to be ambiguous to users due to their association with different meanings across various interfaces”*;
- **Some icons are confusing, conflicting and frequently misunderstood** by users. (e.g. heart and star). Often the functionality associated to visual icons varies from site to site and changes over time. Many icons can be found in multiple contexts. Usually they perform slightly different functions from one product to the next (Figure 5).



**Figure 5 - Conflicting and confusing icons**

- The use of **labels increases the usability** of icons and clarifies what is the action related to the specific icon before the user clicks or taps on it. The Alvarez’s study has shown that users were able to correctly predict what would happen when they tapped icons with labels in 88% of the attempts. On the contrary, this number

<sup>13</sup> <https://www.usertesting.com/blog/user-friendly-ui-icons> - last access on 29<sup>th</sup> of June 2021

<sup>14</sup> <http://babich.biz/icons-as-part-of-an-awesome-user-experience/> - last access on 29<sup>th</sup> of June 2021

dropped to-60% for icons without labels. For unlabelled icons that are unique to the application and represent a unique function beyond the standard actions (e.g. sharing, rating, ...), users correctly predicted what would happen when they tapped the icon-only 34% of the time.

- **Testing new icons for recognisability and memorability** is important to avoid miscomprehension. As a rule of thumb, if more than 5 seconds are needed to choose the right pictogram to convey a meaning, it is unlikely that other people will recall it when they see it. This is even more important when addressing barriers to inclusivity and accessibility of digital applications.

### 3.4.3. Mobility specific icons

When people or objects travel, they move across the four dimensions of space and time. The laws of space and time are amongst the most studied and tricky ones physicists and philosophers ever explored. It is no surprise that everyone, including graphic designers and developers, get lost easily.

How can icons representing objects or actions related with time and movement be designed in such a way that they are clear enough and unambiguous for all people over time and across countries? The challenge remains open<sup>15</sup> and the main lesson is that no universal icon can be defined once and for all, but every icon’s usability can be increased by properly applying Universal Design principles and UIL recommendations properly when developing user interfaces (section 8). Key insights collected here come from the literature research about the digital icons reviewed in this section, namely the standard ISO/IEC 11581 (ISO/IEC, 2000).

Key Insights
Icons should always be combined with a textual label, especially at first use
Icons should be sized large enough to be easily touched in a finger-operated user interface
Icons should be compact enough to allow toolbars, palettes etc. to display in a relatively small space
Icons should be fast to recognize at a glance (particularly true for standard icons that people have n and used before)
There should be no need to translate icons for international users, provided that the icons are mindful of cultural differences
Icons should be visually pleasing and enhance the aesthetic appeal of a design
Internal icon consistency should support the notion of a product family or suite

<sup>15</sup> <https://99percentinvisible.org/article/biohazard-symbol-designed-to-be-memorable-but-meaningless> - last access on 29<sup>th</sup> of June 2021

### 3.5. Accessible user-interfaces in transport and food delivery digital services: best practices

This section summarises best practices concerning the design of accessible user-interfaces at European and international level. To identify them, INDIMO partner Mozgasserultek Budapesti Egyesulete (MBE) staff tested 62 applications from more than 20 different countries across the globe. The analysis focused not specifically on general applicability, but for searching for good examples to follow (and some bad examples to avoid).

The testing included three main groups of applications:

- Global routing and vehicle/ride sharing applications;
- Digital delivery applications (including smart boxes);
- Local public transport (or other transport) service applications.

The third group is also further divided into regions as transport habits and regulations in different countries can vary, which may lead to different interface designs of such applications. The extensive version of this interfaces’ accessibility analysis is included in (Annex 1).

Testing personnel included software engineers instead of people from potential vulnerable groups in order to keep the analysis timeline. However, software engineers used the knowledge of previous conversations and interviews with many target groups, especially mobility impaired, visually impaired, and caretakers. The distribution of different tested applications can be found in Table 2<sup>16</sup>.

Application group/region	Number of tested applications
Global routing and vehicle/ride sharing applications	5
Digital delivery applications (including smart boxes)	5
Public transport applications – Europe Mediterranean Region	9
Public transport applications – Northern European Region	6
Public transport applications – Eastern European Region	6
Public transport applications – USA, Canada, Oceania	4
Public transport applications – Arabic countries and Israel	8
Public transport applications – Asia	10
Public transport applications – Central and South America	5
Public transport applications – Africa	4

Table 2 - Distribution of tested applications

Testing took in consideration several applications using English language. In few cases, non-availability of an English version of the application or parts of it, were considered as issues. Tests

<sup>16</sup> Some of the tested applications without any interesting findings will not be mentioned in the following chapters.

were considered as fails also when the application posed constraints that did not allow access to people from other countries (e.g., one application asked for a phone number when initializing, but not allowed to enter a Hungarian phone number).

The analysis mapped the existence of inclusive interface and service solutions (e.g., public transport routes planning for wheelchair users) accessibility settings (personalization accommodating specific needs), notifications (personalized info about real-time accessibility issues), voice-based options (search, route planning, navigation), tracking for as much personalisation options for vulnerable to exclusion groups as possible. Specific details were also checked in the user interface design and underlying structure, in line with the issues reported in former conversations with target groups. For example, if on one hand dashboard-like interfaces are usually welcomed by users because they allow to use the application their own way, ambiguous icons can cause issues in selecting the needed services and missing or badly placed labels can mislead assistive technologies (e.g. text-to-speech software).

The analysis of the tested applications also included the study of screenshots of the applications interfaces where both general icons and specific mobility icons were clearly identifiable. The recurring icons and their variations have been evaluated through the UIL exercises and the UIL survey, as explained in sections 6.1, 6.2, 6.3.

The analysed features of DDS and DMS that can be considered as best practices are:

- Route planning with accessibility options (barrier free boarding and lighting, elevators at stations, etc.) – *many applications, most of the European PT apps*;
- Step-by-step pedestrian navigation (including stations, platforms, hop on/off and transfer alerts) – *e.g., BVG, Transit*;
- Detailed facility and layout information on specific stations (or station exits) – *e.g., Go! Taipei Metro, KakaoMetro*;
- Accessible ticketing options – *e.g., ZVV, HVV, SL-Journey planner and tickets*;
- Editable and/or dashboard-like home screen – *e.g., BVG, S'hail*;
- Contact support information for specific stations – *e.g., KakaoMetro, Delhi-NCR Metro*;
- Real-time status/condition of accessibility equipment – *e.g., TCL*;
- Built-in audio functions (alerts or reading) – *e.g., ZVV, BVG, KakaoMetro, Transantiago Bus Checker*;
- Pictures, street-view or augmented reality of the main points of interest for better recognition – *e.g., Sofbus24, Alza, Google Maps*.

These features are essential for increasing the inclusiveness of a DMS/DDS application. However, the implementation of all the above features in a single application can lead to usability issues on its day-to-day use. Therefore, applications should support advanced personalization since the highest level of inclusivity can be reached if users can access these services in the way they find more comfortable. When vulnerable-to-exclusion people use several applications, familiarity can be a key factor – the first step in this direction is creating similar user interfaces using a common visual language and style.

**Key Insights**

Global digital mobility applications present very different degrees of accessibility. Google maps services performs better than others, with built-in audio functions and real-time navigation. Nevertheless, as it focuses on the most profitable market, remote regions are poor in details and services cannot be accessed. Additionally, rarely the digital transport services analysed provide seamless ticketing (users can buy tickets with third party applications) due to limitations that can be addressed to the internal policies of the specific transport provider and to local regulations. Other digital mobility systems provide interesting personalisation options but not addressing the needs of vulnerable-to-exclusion users.

Global digital delivery services do not provide any specific solutions for people with special needs. The only mentionable feature is the information given about smart box accessibility.

In the context of local public transport applications (PTS), there are broad differences across EU27 countries and locally across geographical areas (even within European borders). Such differences range from the total lack of accessibility features (e.g. Keolis TBM, New York Subway) to detailed accessibility information of stations, departure areas and route planning options, and built-in functions (e.g., BKK Futár, ZVV). Interestingly, there are functions worth noticing in applications not focusing on accessibility at all (e.g., Street View pictures of bus stops in Sofbus24 app).

Several applications do not support multiple languages, some city navigation applications do not contain the city name in the application name or description, which makes them hard to find or identify in app download listings (e.g. Santiago de Chile ‘Red’ application neither has the city name in app description nor in publisher info). Unfortunately, several applications have compatibility issues, even on relatively new devices.

### 3.6. Can digital applications be more inclusive? Inputs from other similar projects

The Table 3 - Inputs from previous EU projects and existing applications offers an overview of previous European projects and already existing applications that are relevant for the Universal Interface Language guidelines. Key insights are included for each one.

Project/App	Web address	Project description and main inputs
Be My Eyes	<a href="http://www.bemyeyes.com/">www.bemyeyes.com/</a>	Be My Eyes is a free app that connects blind and low-vision people with sighted volunteers and company representatives for visual assistance. It helps low-vision people in performing tasks and activities in their lives using a digital app with an intuitive interface for interaction between low-vision users and volunteers.
<b>Key Insight</b>	<b>Collaborative support</b>	Inclusiveness is also a community effort. Creating and maintaining a community of users helping blind and low-vision people performing tasks improve also their ability to move and travel.
AI-Trawell	<a href="https://www.ai-trawell.eu">https://www.ai-trawell.eu</a>	AI-TraWell project wants to use AI to help people programming their mobility considering their needs, preferences, and wellbeing. Implementing such a solution would help also vulnerable user groups in having a better experience of mobility, and an easy way to interact with different system and data for programming a travel.
<b>Key Insight</b>	<b>Inclusive automation</b>	Designing of automated AI solutions can benefit vulnerable user groups, creating a more inclusive mobility.
INCLUSION	<a href="http://h2020-inclusion.eu/">http://h2020-inclusion.eu/</a>	The inclusion project worked on understanding how to increase accessibility and inclusiveness.

<p><b>Key Insight</b></p>	<p><b>Inclusive ICT solutions</b></p>	<p>ICT and digital solutions help mitigating disadvantages, and they are able of considering inclusive needs. It is important to consider how users could understand and use new technologies and the interfaces they have in order to reach a goal, that is especially true for vulnerable user groups.</p>
<p>Dignity</p>	<p><a href="https://www.dignity-project.eu/">https://www.dignity-project.eu/</a></p>	<p>Dignity project wants to support mobility providers in creating digital products or services accessible and usable by as many people as possible. To do so they prepared specific guidelines for inclusive design processes for digital products. The project specifically focuses on the design for digital interface inclusivity, since it is considered a major issue for the adoption of digital solutions, and for inclusion of vulnerable user groups.</p>
<p><b>Key Insight</b></p>	<p><b>Inclusive design processes</b></p>	<p>There is the need to establish an inclusive design process to create solutions usable by different user groups with different needs. Usable and inclusive services contribute to reducing social exclusion.</p>
<p>Feelspace</p>	<p><a href="https://www.feelspace.de/?lang=en">https://www.feelspace.de/?lang=en</a></p>	<p>naviBelt is a new hardware device for helping visual impaired people navigating in urban context. It provides a new haptic interface for getting directions and indications, together with an application where to set the location. This interface helps visual impaired people being more aware with other senses like hearing otherwise used to getting direction from apps, and thus being more aware of risks around them.</p>
<p><b>Key Insight</b></p>	<p><b>Mobile multi-modal assistive devices</b></p>	<p>Innovative interfaces like naviBelt allow for a more inclusive mobility experience, and at the same time open new challenges for usable interaction.</p>

TRIPS	<a href="https://trips-project.eu/">https://trips-project.eu/</a>	TRIPS project wants to design and demonstrate how to design inclusive digital mobility solutions by making people with mobility challenges central in the design process, thus making public transport more accessible for everyone.
<b>Key Insight</b>	<b>Inclusive co-creation</b>	Innovative technologies addressing mobility barriers are well accepted by people with disabilities. They welcomed innovative technologies that would address mobility barriers and mitigate and reduce their impact in the future. Their participation in the design of technologies has potential to have an impact.

Table 3 - Inputs from previous EU projects and existing applications

## 4. Inputs from WP1

The research work carried out in Work Package 1 (WP1) through the thematic analysis of user and non-users semi structured interviews conducted in the five pilot sites (D1.3), provided useful insights to build the first version of the INDIMO Inclusive Digital Mobility Toolkit. However, the results collected in WP1 partially addressed the UIL topic. The main inputs come from the Pilot 4 (Madrid). They generally concern the user interface, while only few suggestions directly address the interface icons’ issue. That is why a specific data collection was performed in task T2.2 to create the UIL content, as described in the following section (section 6). General barriers to the use of digital mobility services emerged from the thematic analysis of the Pilot 4 interviews. In particular users with reduced vision reported poor graphical interface as the main barrier to online purchases.

The relevant inputs for the UIL manual are included in Table 4. Some of them are specific for digital delivery services (general DDS or food DDS). They mostly highlight the need for “visual aids” to support user experience. According to the data collected, visual aids mainly refer to:

1. the prevailing use of pictures, images and visual icons in the application interfaces avoiding too many textual descriptions,
2. a uniform, stable and consistent use of icons not affected by periodic updates;
3. a higher transparency of process status (e.g. the progress bar confirming the expected waiting time for processing an action).
4. A user-friendly and accessible interface supporting step-by-step navigation and avoiding information overload (i.e. solve a single problem at each step).

Inputs for UIL manual (from Deliverable D1.3)
<b>Graphic interface and features</b>
A good number of images;
A consistent colour coding;
A proper contrast level;
Customizable font sizes and types;
An intuitive spatial organization of the interface elements facilitating reading and identifying priority information;
The presence of specific accessibility features allowing people with different characteristics using the service (e.g. a voice-assisted menus and of sounds to confirm actions).
<b>Accessibility</b>
Involve target groups throughout the process;
Uniformed icons and spatial organization, for instance, breakfast food on top, lunch in the middle, dinner on the bottom (for people with reduced vision) (ONLY FOR FOOD DDS);
Avoid automatic updating of the version and provide information about changes across versions (people with reduced vision may find labels or buttons missing or in different position);
Easy interface (step-by-step interface accompanied by helpful images).
<b>Inclusiveness</b>
Provide a help button;
Avoid foreign words and attempt to provide all terms in the local language used by the app.
<b>Workflow</b>
Priority information should appear on top with higher visibility (e.g. the working hours of the service and the contact phone should be immediately and intuitively identified, possibility in the welcome screen);
Every product, store or shop on a list should be accompanied by its image or picture (ONLY FOOD DDS);
Match textual information with visual aids (e.g every payment method should come with an icon);
Include the possibility of viewing user’s ratings;
Provide status of ongoing process to reduce users’ uncertainty (e.g. progress);

Provide dynamic information about the current/total price of purchase (e.g. each item added to cart results in the update of the total amount and it's visible at all times on screen).
<b>Security</b>
Include emergency button in case of physical/sexual assault.
<b>Communications</b>
Ensure a positive user experience through an open and inclusive communication style;
Develop graphic interfaces that are comprehensible and attractive for everyone, not only young and/or digitally skilled people.

Table 4 - Inputs for the UIL manual (WP1 results)

## 5. An overview of icons and interfaces of digital mobility and delivery solutions from the INDIMO pilot sites

After the preliminary overview about icons and their use worldwide, both in real life and in global digital mobility applications, the analysis of icons' usability and accessibility in the five pilot sites (P1 Emilia-Romagna, P2 Antwerp, P3 Galilee, P4 Madrid, P5 Berlin) could proceed.

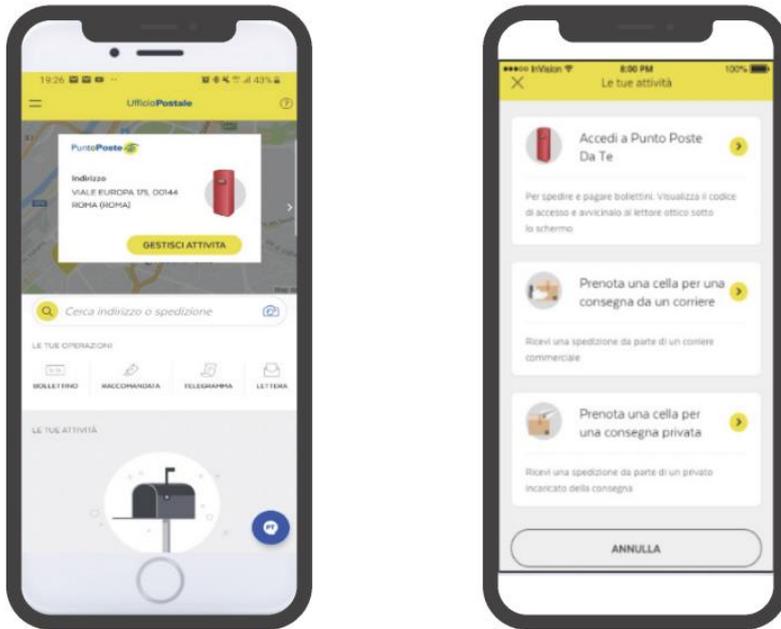
In Table 6 Table 7 Table 8 and Table 9 the specific objectives and approaches of the five applications are summarised, including welcome screens. In INDIMO each application and its visual icons have been analysed involving vulnerable-to-exclusion people and/or their representatives during dedicated COP meetings and through an online survey. The pilot sites are an integral part of the co-creation process envisaged in INDIMO. They represent living laboratories where key actors (developers, service operators, policy makers, citizens) are involved in the co-creation of new or upgraded, inclusive and accessible digital mobility and logistics solutions from the very beginning of the design process. More details about the adopted methodology are included in section 6 of this document.

**P1 Emilia - Romagna**

**Pilot topic: Introducing digital technology to enable e-commerce in rural areas (smart boxes).**

**Name of the application: Punto poste da Te (Poste Italiane).**

Description: digital locker installed in Monghidoro (Metropolitan Area of Bologna) offering services such as shipment and collection of parcels, collection of correspondence requiring a signature or payment (e.g. registered mail, postal bills) phone credit and prepaid debit cards recharge. Access to the digital locker interface is provided through an app installed on personal mobile devices (e.g. smartphone or tablet).



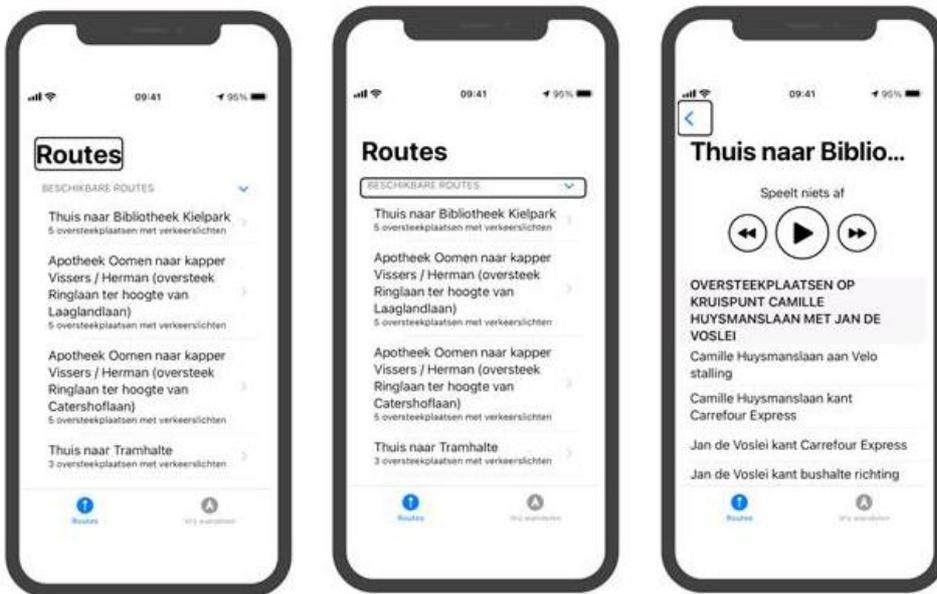
**Table 5 - P1 Emilia-Romagna application details**

**P2 Antwerp**

**Pilot topic: Inclusive smart traffic light.**

**Name of the application: Mobilidata.**

Description: in the city of Antwerp, Mobilidata is one of the target actions towards a more efficient mobility and it is related with the collection of mobility related data for future C-ITS solutions and applications. One of these solutions is an intelligent traffic light system. The pilot will work on prioritising traffic streams by adapting the length of timings of green lights for pedestrians, in particular for people with reduced mobility or reduced vision.



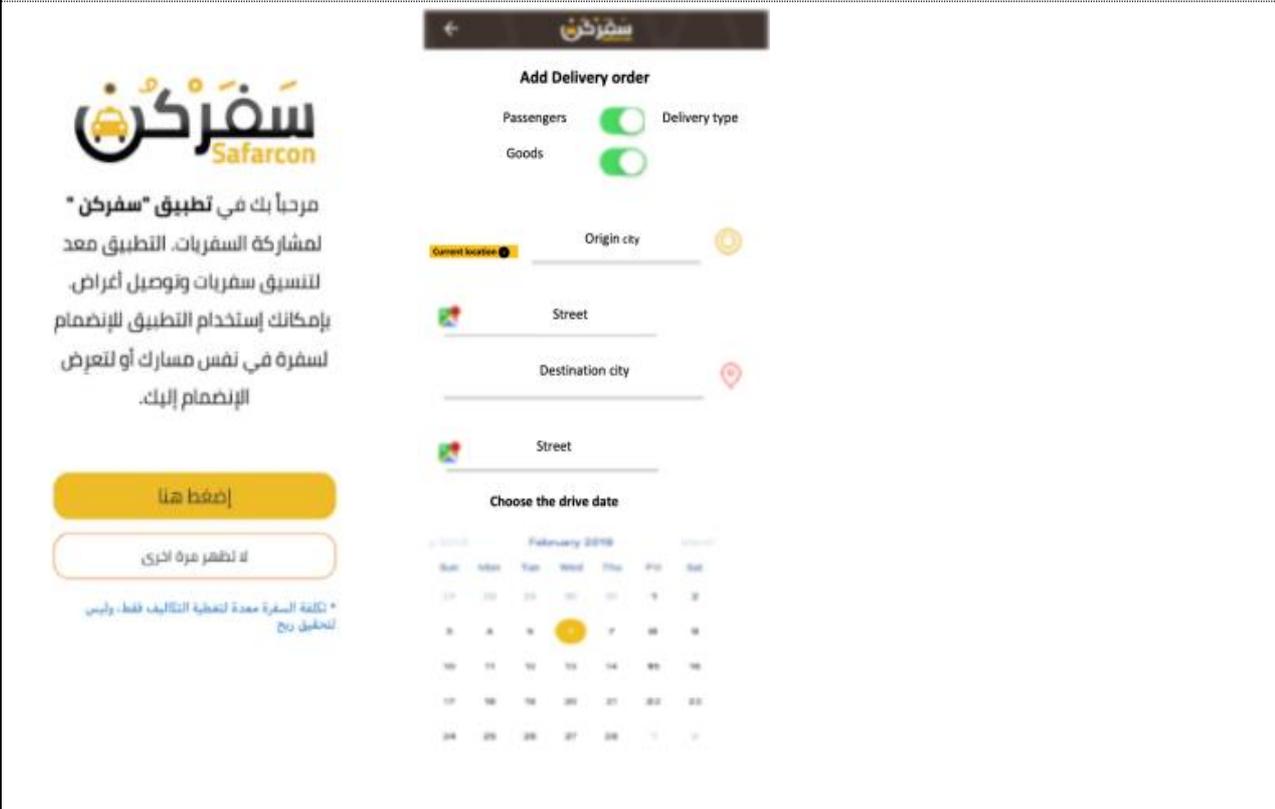
**Table 6 - P2 Antwerp application details**

**P3 Galilee**

**Pilot topic: Informal ridesharing in ethnic towns.**

**Name of the application: Safarcon.**

Description: rural areas in Israel, and Arab villages among them, experience insufficient level-of-service with regards to public transport services. Low frequency of public transport services as well as long distances from residential locations to the nearest bus stop represent barriers to the use of public transport and result in a higher use of private cars. Ride-sharing could offer a feasible solution to many different kinds of users and digital channels, particularly smartphone apps, could promote direct interaction among residents of small towns and villages.



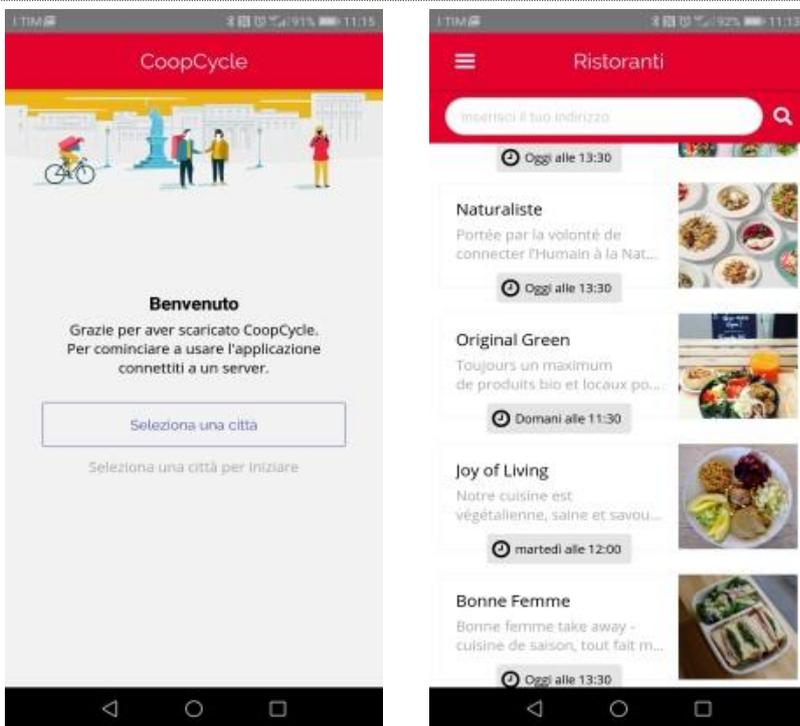
**Table 7 - P3 Galilee application details**

**P4 Madrid**

**Pilot topic: Cycle logistics platform for deliveries.**

**Name of the application: La Pajara.**

Description: the Madrid pilot will test users’ experience and needs related to the use of an existing goods delivery digital platform, in order to design a more inclusive and accessible version ensuring accessibility for vulnerable users. People with lower digital skills need, now more than ever, to gain access to healthy food while in lockdown and anytime they are confined at home for any other reason. Particular attention will be paid to the needs of lower-income people, older people and functionally diverse people, especially those at risk of being socially isolated during the COVID-19 pandemic or living in unwanted isolation.



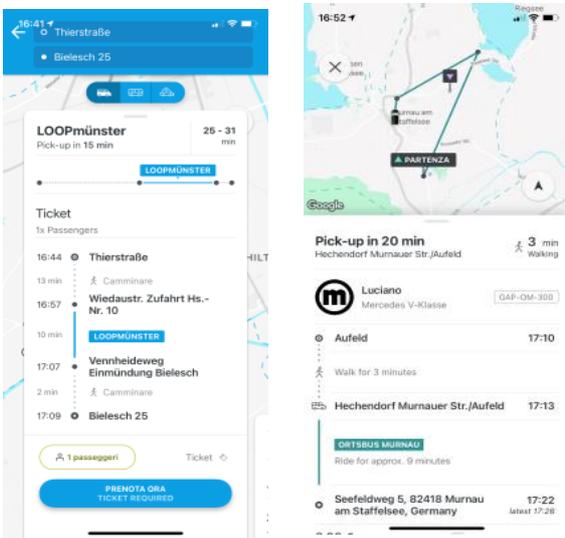
**Table 8 - P4 Madrid application details**

**P5 Berlin**

**Pilot topic: On-demand ridesharing integrated into multimodal route planning.**

**Name of the applications: Loop Munster.**

Description: Urban mobility can be challenging, even in areas with good public transport coverage. In recent years many new mobility services have been introduced, primarily in urban areas, promising smarter and shared mobility solutions. Indeed, many of these new mobility services are technology-based, thus it is important to acknowledge to what extent technology can represent a barrier for certain user groups. Door2door will contribute to the collection of specific requirements in order to increase access and provide individual mobility for all in the Berlin pilot, focusing on user testing, to analyse the whole user experience of multimodal ride-sharing services of each user group.



**Table 9 - P5 Berlin application details**

## 6. Methodology

This section describes the process followed to evaluate the accessibility of icons and inclusiveness in relation to services and applications' interfaces. The objective is to propose a methodological path that can provide developers and service providers with useful insights to plan, build and perform quick and intuitive exercises with users. This can be done already in the prototype phase of the service/application development and replicated several times, according to the user-centred design principle “test early and often”.

To identify a proper set of accessible and inclusive icons, we suggest following three main steps, i.e.:

1. Carry out a preliminary review of similar services to explore icons use and the accessibility of interfaces;
2. Build a user-centered exercise as described in this UIL to involve users in the evaluation of icons;
3. Consolidate the review and the results of exercises that have been carried out with a more systematic survey, using the UIL survey as an example.

### 6.1. Review of services and applications

In the first step, we identified a preliminary set of icons to be evaluated in steps 2 and 3, through the analysis of digital mobility and delivery service applications conducted by MBE (section 3.5). The analysis included relevant screenshots of applications' interfaces where both general icons and specific mobility icons were clearly identifiable. In addition, we explored 20 applications<sup>17</sup> commonly used in Europe offering both transit (DMS) and food delivery services (DDS), plus few applications dedicated to people with visual impairments. On this quite extensive list of digital applications, we built a catalogue of 27 recurring icons (section 7.1.2) and classified them following Norman Nielsen's heuristics<sup>18,19,20</sup> and Universal Design principles (see Annex 5 - Icons' and application interfaces usability questions template). The evaluation focused on the use of visual icons in mobile applications (Figure 6), leaving out the in-depth analysis of mobile operating systems.

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<sup>17</sup> The 20 common applications explored are: DTS | blablacar, Cabify, Citymapper, Flixbus, FreeNow, Lyft, Moovit, Omio, Safr, Transit, Uber, Waze DDS | Deliveroo, JustEat, Glovo, UberEats. Apps for the visually impaired | BeMyEyes, Emit, Kimap, Wheelmate

<sup>18</sup> <https://www.usertesting.com/blog/user-friendly-ui-icons> - last access on 29<sup>th</sup> of June 2021

<sup>19</sup> <https://www.nngroup.com/articles/icon-usability/> - last access on 29<sup>th</sup> of June 2021

<sup>20</sup> <https://www.nngroup.com/articles/icon-testing/> - last access on 29<sup>th</sup> of June 2021

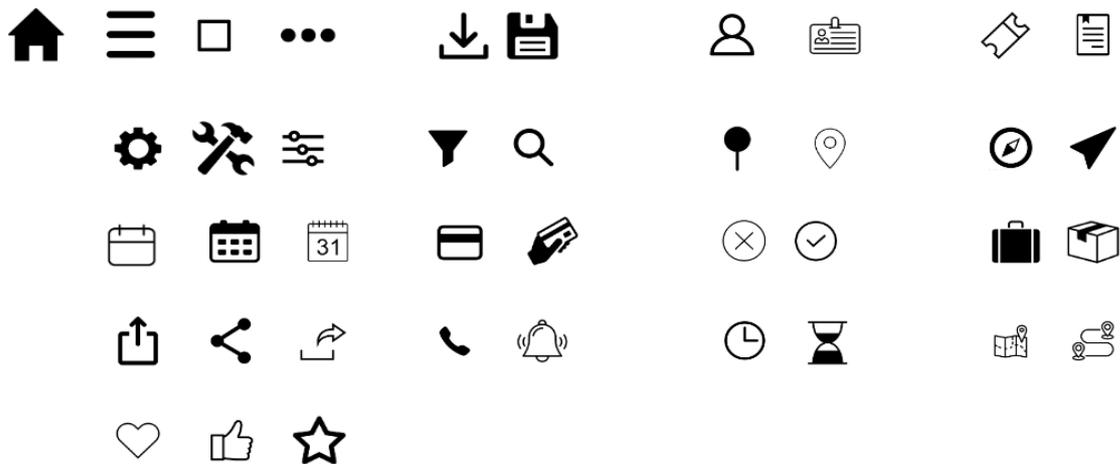


Figure 6 – Recurring icons in digital mobility and delivery applications

## 6.2. UIL exercises

The selection of icons collected in the preliminary phase was compared with those used in the pilot sites’ applications. Thereafter, five similar interactive UIL exercises were built (one for each pilot site) starting from existing Human Factors design and UX testing examples (ETSI - Technical Committee on Human Factors (HF), 1993) (Bagagiolo, Vigoroso, & Caffaro, 2019), and questionnaires (Blees & Mak, 2012) (Zender & Cassedy, 2014). The UIL exercises took place during pilot sites’ COPs between March and April 2021 and in total 46 participants attended as described in the following Table 10. The full debriefing templates about UIL exercises are collected in the Annex 3 – UIL exercise: debriefings

#	Pilot Site	Date	N. of participants	Targer groups involved
P1	Emilia – Romagna	29/04/2021	14	Town major; Citizens; Researchers;
P2	Antwerp	30/04/2021	10	Users’ representatives; Local Public Transport Accessibility Council Antwerp; Agency of Accessibility Flanders; Blind persons organization representatives; Developers; Designers; Researchers;
P3	Galilee	05/04/2021	7	Users’ representatives; Developers; Researchers;
P4	Madrid	13/04/2021	10	Riders representative; Users’ representatives; Public officer; Developers; WEB designers; Food store owner; Researchers;
P5	Berlin	26/03/2021	5	Users’ representatives; Developers; Researchers;

Table 10 - UIL exercise information

The exercises focused on gathering qualitative feedback about the User Experience from a vulnerable-to-exclusion person's point of view. The term User Experience refers to how a person interacts and experiences a product, a system or a service. It includes all perceptions and responses that results from the use of such product, system or service (emotions, beliefs, preferences, perceptions, behaviours and accomplishments that occur before, during or after use) (Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009). Despite the hype around the term User Experience, its role is often misinterpreted by non-experts as a way to make applications look nicer and increase customers and revenues. The truth is, as users we only realise what is UX design when something doesn't work as we expect it to. Our assumption is that digital mobility and goods delivery services shall be considered as public services, since they support and facilitate autonomy through access to public and private transport services and the purchase of essential goods. Thus, we believe user-testing should not only explore the expectations and needs of the main group of target users, but involve vulnerable-to-exclusion users since early phases.

We decided to test up to 6 icons in use by the pilot' applications and discuss with participants during COPs online meetings how they were used in the application user interface. The exercises sessions were attended by users and non-users, civil society organizations representing vulnerable-to-exclusion groups, operators, policymakers, researchers, and other relevant stakeholders. The level of ambiguity of icons was qualitatively evaluated both as stand-alone elements and as parts of the related interface context.

The main objectives of the UIL exercises were:

1. Raising participants' awareness (both users and developers) of the ambiguity of icons';
2. Identifying the most common issues in the usability of icons;
3. Identifying how the application interface and internal structure influences the comprehension of icons;
4. Finding potential solutions or mitigations to accessibility barriers of digital applications.

We tried to ensure the highest degree of inclusivity during 1-hour online meetings, taking into consideration the fact that the INDIMO CoPs (Communities of Practice) were composed of people who could present one or more characteristics of vulnerability, or by vulnerable users' representatives (NGOs, associations). To this aim, interactive exercises were led by a guiding moderator who presented the slides on screen and facilitated an open discussion verbally. Moderators were invited to leave the questions as open as possible and to give the minimum input to participants, in order to avoid biased answers.

The moderator received specific instructions in advance to collect participants' feedback without influencing their answers with broad explanations. An open and non-judgmental setting was an important feature of UIL exercises..

The exercise consisted in two parts: one introducing the theme of the ambiguity of icons and the other exploring their use in the digital context of the application itself.

The first part consisted of the "icons' pitch". All the participants were shown a first set of icons that are typically part of the graphic language of most of the mobile apps and a second set of matching icons with similar meanings (Figure 7).

In the second part, participants were invited to observe the same icons as they appeared in the different “application screens”. For this purpose, they were invited to comment on screenshots taken from the actual interface of the pilots’ applications (Figure 8).

To summarize, during the UIL exercises participants were asked feedback about: i) the meaning of the icons; ii) the potential matching with other icons that could be used to convey the same meaning; iii) elements that were unclear or produced confusion in the visual outlook; iv) elements that could be added for clarification or a more accurate communication; v) other elements that should be kept in consideration when designing a graphic interface.

The exercises provided a clear understanding of the common interpretations that people give to visual icons, the variety of meanings attached to them, the interaction between their intrinsic characteristics and the relationship with the other user interface components.

Finally, each pilot was asked to fill in a debriefing template to collect participants’ comments and feedback during the UIL exercises. A synthesis of the most relevant results is reported in sections 7.1 and 7.2 .

Annex 2 includes the UIL exercises performed in the five pilot sites and the instruction for moderators. Annex 3 reports the full transcription of UIL debriefings for each pilot.

1) Icons pitch



10 MINUTES - Please, name and describe the meaning of each presented pictogram in your words. According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?

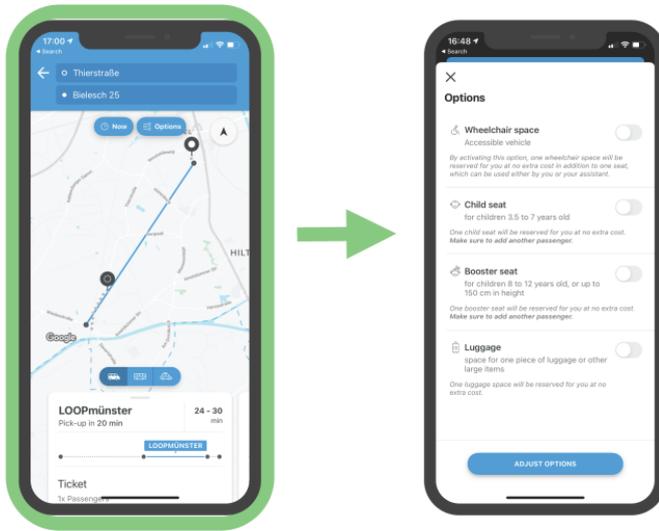
5 MINUTES - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?

5 MINUTES - Here some examples, who would like to comment? Do you think they are equivalent?

Figure 7 - an example of UIL exercise - icons' pitch

5) Options

INDIMO WP2 - UIL exercise for P5 | Berlin



This is the related screenshot.

- 5 MINUTES: What other information would you like to be included here?

Figure 8 - An example of the UIL exercise - Berlin app screens

### 6.3. The UIL online survey

To complement results about icon’s evaluation collected through the review of DMS and DDS applications, and the UIL exercises performed in the local COPs, an online UIL survey was distributed to all project partners and stakeholders, social media followers and to the members of the INDIMO Co-Creation Community (Annex 4 – UIL online survey).

The survey included five sections as follows:

1. Survey introduction;
2. Consent form;
3. The use of pictograms in the digital mobility and good delivery services;
4. General questions on accessibility of digital services;
5. Background information.

*Section 3 - The use of pictograms* explored icons’ ambiguity. First questions (Q1-Q2) were about common general icons, supposedly the least ambiguous among the non-mobility specific ones. Q1 asked respondents how certain they felt about the outcome when clicking on some icons (i.e. Home, Phone handset/Contacts, Lens, Info circle, User profile, Funnel/ Filter). Q2 included open fields to shortly describe the meaning of such icons according to the respondents’ experience, to let discrepancies emerge.

Core questions (Q3-Q13) focused on the level of comprehension of recurring icons on DMS and DDS applications. Participants were asked to rank on a four-steps Likert scale all proposed icons, from the one most related with a specific function to the least (i.e. open menu; go to settings; rate a content/app; share content; save or download; visualize travel documents/tickets; locate point of interest on a map; contact support; go to payment; visualize map; plan trip). The aim was to identify which icon best represented the function with the lowest rate of ambiguity. Question

Q14 asked participants to match a set of pictograms (i.e. clock, alarm clock, hourglass, calendar, timetable) with the functions they better represented, based on their personal experience.

Results concerning *Section 3* of the UIL survey are included in the icons catalogue in section 7.1.2.

*Section 4 – General questions on accessibility of digital services* focused on the respondents' perspectives and experience with digital mobility applications. The set of questions Q15-Q21 collected responses about common barriers experienced by respondents due to the poor accessibility of the digital mobility or delivery services, or specific situations concerning the use of digital application at general level (e.g. contacting the support center, error occurrence, ...). Four-steps Likert scales were used.

The last set of questions (Q22-Q28) included in *Section 5 - Background information*. focused on respondents' socio-economical background information such as age, gender, education, state of employment, caregiving activities, income.

The online survey collection of responses lasted for three weeks in the month of May 2021 and it was promoted on all social media accounts and website of the project and through a dedicated newsletter item circulated internally and through co-creation community members. In total, 89 responses were collected. A frequency analysis was performed.

Results concerning *Section 4* and *Section 5* of the UIL survey are analysed in section 7.3. The Annex 4 – UIL online survey reports the full UIL survey questionnaire.

## 7. Main results

### 7.1. Icons analysis results

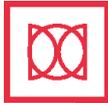
#### 7.1.1. Icons mapping

As a result of the extensive desk research across the digital mobility and goods delivery applications, a total of twenty-seven (27) common icons were identified. We divided the catalogue into mobility specific icons and general icons<sup>21</sup>. The following Table 11 reports the mapping of users involved in each pilot site, to allow a direct matching with visual icons analysed through the UIL exercises. Table 12 – Icons mapping includes the list of all visual icons analysed. The Table 13 reports a summary of the main feedback from participants collected through the UIL exercises run during dedicated CoPs in pilots (in both icon catalogue tables in the evaluation column we kept track of what icons have been analysed in which pilot site and which ones didn't). In Table 14 we collected examples and participants evaluations of icons used in pilot sites applications. In Table 15 we reported results from the UIL survey concerning icons' comprehensibility, except for a few icons that were only used as terms of comparisons and were considered not meaningful in the UIL exercises (alarm clock; timetables; lens; info-point circle). Finally, a summary of the analysis of each visual icon as used in the pilots applications' user interfaces is reported in Tables Table 16, Table 17, Table 19 and Table 20.

P1 – Emilia-Romagna	P2 – Antwerp	P3 – Galilee	P4 – Madrid	P5 - Berlin	UIL Survey
<ul style="list-style-type: none"> <li>• People living in peri-urban or rural areas</li> <li>• Foreign people</li> <li>• Older people</li> <li>• Lower educated people</li> <li>• Lower income people</li> <li>• Non-connected people</li> </ul>	<ul style="list-style-type: none"> <li>• Older people</li> <li>• People with reduced mobility</li> <li>• People with reduced vision (totally blind and low-vision)</li> </ul>	<ul style="list-style-type: none"> <li>• Ethnic minorities</li> <li>• Lower educated people</li> <li>• Non-connected people</li> <li>• People lacking digital skills</li> <li>• Women</li> </ul>	<ul style="list-style-type: none"> <li>• Lower income people</li> <li>• Non connected people</li> <li>• Older people</li> <li>• People with reduced mobility</li> <li>• People lacking digital skills</li> <li>• People with mental health impairments</li> <li>• Women</li> <li>• Covid-19 confined people</li> <li>• Socially isolated people</li> </ul>	<ul style="list-style-type: none"> <li>• Women</li> <li>• Caregivers</li> <li>• People living in peri-urban or rural areas</li> <li>• People lacking digital skills</li> </ul>	all

Table 11 - Vulnerable users' involved in pilot sites

<sup>21</sup> Icons credits go to artists collaborating with [www.thenounproject.com](http://www.thenounproject.com) – last visit 29<sup>th</sup> of June 2021



#	Icon name and function	P1Emilia Romagna	P2 - Antwerp	P3 - Galilee	P4 - Madrid	P5 - Berlin	UIL Survey
	<b>MOBILITY ICONS</b>						
1.	Clock		✓	✓	✓		✓
2.	Calendar					✓	✓
3.	Alarm clock						✓
4.	Hourglass			✓			✓
5.	Checkmark	✓		✓			✓
6.	Payment card				✓		✓
7.	Ticket	✓				✓	✓
8.	Map				✓		✓
9.	Pin Point 1					✓	✓
10.	Pin point 2		✓	✓	✓	✓	✓
11.	Compass locator				✓		✓
	<b>GENERAL ICONS</b>						
12.	Home	✓					✓
13.	Hamburger menu	✓					✓
14.	Lens/Search						✓
15.	Equalizer/Options	✓					✓
16.	Wrench/Settings					✓	✓
17.	Tools/ Settings	✓					✓
18.	User profile	✓					✓
19.	Info circle						✓
20.	Inbound arrow /Save	✓					✓
21.	Linked dots/ Share	✓					✓
22.	Outbound arrow					✓	✓
23.	Phone handset/Contacts		✓	✓			✓
24.	Heart rating	✓				✓	✓
25.	Star rating	✓					✓
26.	Word bubble			✓			✓
27.	Funnel/ Filter				✓	✓	✓

Table 12 – Icons mapping



### 7.1.2. Icons catalogue

Based on the experience gained through the literature research, the WP1 main results and the UIL exercises (for data collection Methodology see 6.2 and 6.3), the INDIMO icons catalogue (Table 13) was created to set the basis for the creation of individual icons cards. The icon card template (Annex 6 - Preview of an icon ) represents a practical tool for developers and policy-makers who wish to design, analyse or evaluate a set of icons in terms of accessibility and inclusivity following the INDIMO approach.

#	Icons' group, name and function	Evaluation (UIL exercises)
	<b>MOBILITY SPECIFIC</b>	
<b>1.</b>	<b>Clock</b> 	<b>P3 Galilee, P4 Madrid, P5 Berlin</b> <p>In transport apps it may represent schedules or calendars, maybe also availability of service/opening hours, expected time of arrival of the ride-sharing vehicle. In delivery apps it could be waiting time before preparation, time of delivery or opening hours of the restaurant/food provider.</p> <ul style="list-style-type: none"> <li>It's not clear if the clock is associated with the departure or arrival time. The fact that it is used in multiple ways creates confusion. Unfortunately, there is no text label in most screens where it is used. It would be clearer with hour numbers.</li> </ul>
<b>2.</b>	<b>Calendar</b> 	<b>P5 Berlin</b> <p>The calendar is not considered as a valid alternative to the clock icon when associated with arrival/departure, but it can be confusing when used for timetables. Consistency in use and textual labelling is paramount in this case.</p>
<b>3.</b>	<b>Timetable</b> 	N/A - Only analysed through the UIL survey
<b>4.</b>	<b>Alarm clock</b> 	N/A - Only analysed through the UIL survey
<b>5.</b>	<b>Hourglass</b> 	<b>P3 Galilee, P4 Madrid</b> <ul style="list-style-type: none"> <li>It is more a timer than a clock, they should not be used interchangeably. The hourglass could replace the clock icon only when the meaning is related to the passing of time (expected or remaining time for pickup or drop/delivery). It could also be used for opening hours.</li> </ul>
<b>6.</b>	<b>Checkmark</b> 	<b>P1 Emilia-Romagna, P3 Galilee</b> <p>The green checkmark associated with the delivery box icon is very clear, participants recognised it as a confirmation of a successful process finalisation. Similarly, the same box icon associated with the red cross undoubtedly informed them that there was a problem and they had to try</p>



		<p>again or contact support.</p> <p>With no contextual information it is very hard to identify its meaning, participants think it can be related with a confirmation/completion or acceptance of a task/order.</p> <p>In ride-sharing services it can be seen as a sign associated with drivers' compliance with car insurance, driving licence and vehicle licence. The fact that the icon is yellow may be interpreted as "pending validation". If the colour green was used it would be much clearer that validation is successful. Participants also thought that the check sign next to the driver's profile picture could be interpreted as a confirmed ride between rider and driver, this use of the icon can be misleading.</p>
<b>7.</b>	<b>Payment card</b> 	<b>P4 Madrid</b> <p>The icon is considered very clear by most participants. It could be replaced or enriched with coins or symbols of main/local currencies. For people with impairments all icons, especially those related with payment and sensitive data, should appear very large, not shaded and with a good contrast to ensure comprehension and avoid unwanted outcomes.</p>
<b>8.</b>	<b>Ticket</b> 	<b>P5 Berlin</b> <p>It is quite clear and it is used for a limited range of related functions: show ticket or buy ticket. It is unclear whether the ticket can be bought in-app or outside the app, the average time for purchase.</p>
<b>9.</b>	<b>Map</b> 	<b>P4 Madrid</b> <p>Participants interpreted as an itinerary map, would be considered clearer if associated with a pin on a rounded globe.</p>
<b>10.</b>	<b>Pin Point – drop pin and lollipop pin</b>  	<b>P3 Galilee, P4 Madrid, P5 Berlin</b> <p>The drop pin relates with location, but older people and people lacking digital skills may not understand it. Maybe it would be clearer if combined with a globe. In all cases, the pin icon should always appear on top of a map.</p> <p>In delivery apps the icon may represent where is the user location or to where location the order must be delivered, or also where the rider will start, where the rider is now, or where the rider is headed to. In route planning apps it can define an itinerary (how to reach a place), suggestions where to go.</p> <p>In some apps the pinpoint appears in two different versions, one for the origin location and one for the destination location of trip/delivery. The use of colour is misleading. Where the pin-point drop appears jointly with the "address field   Edit" text, it is easier to understand what is its specific role.</p> <p>Without context it is impossible to guess and the two shapes look quite interchangeable.</p> <p>The lollipop pin is also quite ambiguous, be it on a map or in a separate screen: participants think it provides GPS real-time location of a requested vehicle, or it may just mean that the vehicle will stop at a specific place. In some cases, it represents where the user is standing ("you-are-here" pin). It is highly dependent on the use case and situation but it is actually non-self-</p>



		<p>evident.</p> <p>Be it a lollipop pin or a drop-pin, when located on a map it is important to differentiate colour and shape, depending on its relation with objects or persons (e.g. departure and arrival, current or expected, static or dynamic).</p> <p>Participants felt uneasy having no hints about which one was the departure and which the arrival point. In any case, they should have consistent appearance in the search bar and on the map.</p>
<b>11.</b>	<p><b>Compass arrow</b></p> 	<p><b>P4 Madrid</b></p> <p>It represents user’s current location when moving along a given route on a map. This is based on previous experiences but it is not straightforward from the icon alone.</p>
	<b>GENERAL</b>	
<b>12.</b>	<p><b>Home</b></p> 	<p><b>P1 Emilia-Romagna</b></p> <p>All participants agreed that the icon is representing a home and it is associated with the main page of the application, expecting that from there exploration of contents begins.</p>
<b>13.</b>	<p><b>Hamburger menu</b></p> 	<p><b>P1 Emilia-Romagna, P4 Madrid, P5 Berlin</b></p> <p>Participants think this icon is there to offer further options and information (i.e. options of the app, context menu, other actions available), but could also go to where you can search for other contents, to log-out or to edit user profile data, possible route selections or adding intermediate stops. Such meanings could be interpreted as “desired” functions users would like to have as shortcuts on screen.</p> <p>Participants were disappointed when it only offered a list of secondary information, instead of offering actual support in specifying trip details and preferences. To non-digital users this icon resembles the fog. Only few knew from past experience with social media websites that it is related with a menu. The icon itself does not help them recall the function associated. They all claim a text would help.</p>
<b>14.</b>	<p><b>Lens</b></p> 	<p>N/A - Only analysed through the UIL survey</p>
<b>15.</b>	<p><b>Equalizer</b></p> 	<p><b>P5 Berlin</b></p> <p>According to participants, in a mobility app this icon could allow editing preferences, but also offer information about “other transport connections”.</p> <p>In the ride-sharing app it is clear that it is about options thanks to the label, but participants expected more options to appear beyond wheelchair, child seat, booster seat and luggage (e.g. baby seat, approaching or entrance side of the vehicle, require assistance with loading/unloading passengers/objects, size of the vehicle).</p>
<b>16.</b>	<p><b>Gear</b></p>	<p><b>P1 Emilia-Romagna</b></p>



		To non-digital users the gear has no meaning and it's not perceived as related with settings. They would understand better the two tools crossed. Also, it is not so straightforward to them what is the difference between what you can find in a general menu and the more specific contents of the settings menu.
<b>17.</b>	<b>Tools</b> 	<b>P1 Emilia-Romagna</b> This icon is clear, but it's not clear who is going to fix the problem with those tools. To low-digital skilled users it is ambiguous since it does not tell them if it's there to offer external assistance or if she/he should operate with (digital) tools and try to solve problems.
<b>18.</b>	<b>User profile</b> 	<b>P3 Galilee, P4 Madrid, P5 Berlin</b> The icon can represent oneself (user-profile) or also other profiles or users. It can suggest the profile is not complete, since there is no picture but an "empty/indefinite" profile outline. It could also be the icon related with the contact person.  In delivery apps participants would expect to also see the account/order history and personal address (for pick-up or delivery of people/goods). In ride-sharing apps the icon does not make it clear if the service has been correctly reserved, if the child-seat place is included/confirmed, or how many passengers are counted.
<b>19.</b>	<b>Info circle</b> 	N/A - Only analysed through the UIL survey
<b>20.</b>	<b>Inbound arrow</b> 	<b>P1 Emilia-Romagna</b> Participants declare they know it is used to download contents, but no one mentioned it as saving option. Only when told that download can be a synonym of saving, they mentioned the floppy disk icon as an alternative.
<b>21.</b>	<b>Linked dots/ Share</b> 	<b>P1 Emilia-Romagna</b> Participants declared they could intuitively understand it as something connecting to other things. Some declare from past experience in WhatsApp they know it is used to share contents.
<b>22.</b>	<b>Outbound arrow/Share</b> 	<b>P5 Berlin</b> With no context around it, participants see it as something related with abandoning/leaving a place/area of the app. They not have connection with the action it might support. They know from past experience it is related with sharing contents, but it is unclear.  Providing a text or label would be important to understand what you are going to share and with whom.
<b>23.</b>	<b>Phone handset/Contacts</b> 	<b>P3 Galilee</b> It should give users the option to make a phone call or it just contains contact information (most likely at least a phone number). Depending on the context of use, it can either mean "make a call", "save or contact



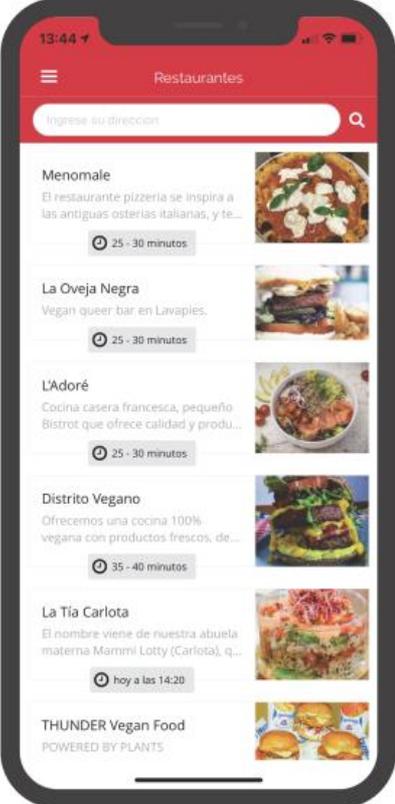
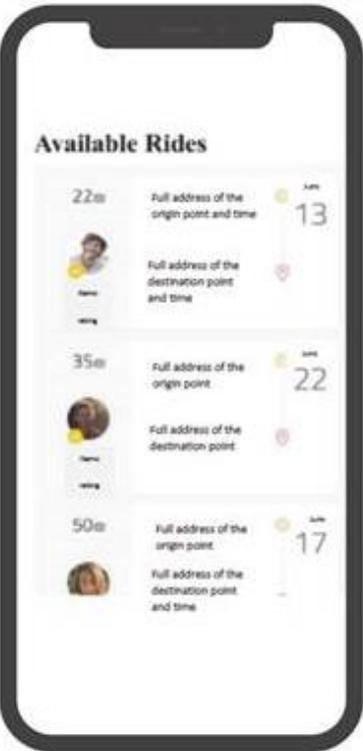
		<p>details”, “contact assistance”. Such nuances may determine errors if other cues are not helping comprehension or absent.</p> <p>In some apps it is used in an unexpected way, since it is associated with the user phone number field (add your number here...). If it is not an actual dialling option, it can be misleading.</p>
<b>24.</b>	<b>Heart/Rating</b> 	<b>P5 Berlin</b> <p>Participants are unsure whether it is a rating function (thumbs-up) for the app or for a specific feature. It could also mean save something as favourite.</p>
<b>25.</b>	<b>Star/Rating</b> 	<b>P1 Emilia-Romagna</b> <p>Participants agree that a star is related with adding an item to favourites. They also remember that a heart or thumbs-up icon can be used similarly.</p>
<b>26.</b>	<b>Word bubble</b> 	N/A - Only analysed through the UIL survey
<b>27.</b>	<b>Funnel / Filter</b> 	<b>P4 Madrid, P5 Berlin</b> <p>In general, it is useful to offer users the possibility to sort results of their searches or alternative options to be filtered. In delivery apps it's mentioned by participants as a desired feature to filter restaurants in a certain range area or to decide in which order they are shown.</p> <p>When proposed as an alternative to settings/equalization/preferences, it was not considered appropriate.</p>

**Table 13 – Icons catalogue**

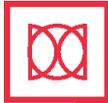
In the following Table 14 the relevant comments about the use of icons in the five pilot sites applications are collected. All comments come from participants’ feedback gathered during UIL exercises.

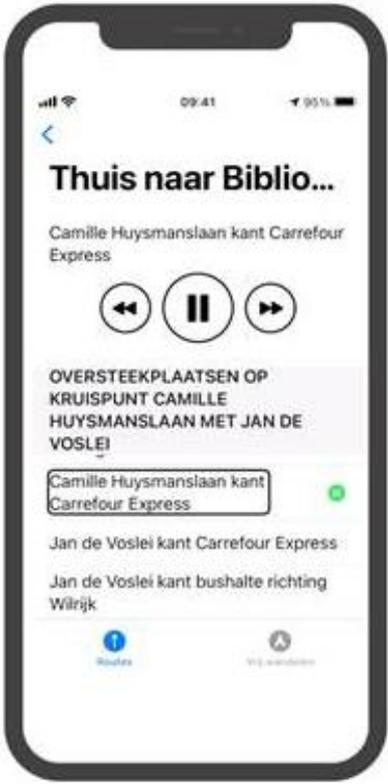
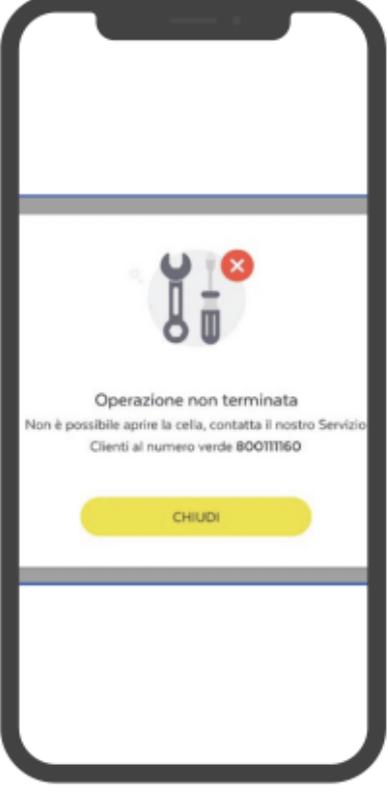




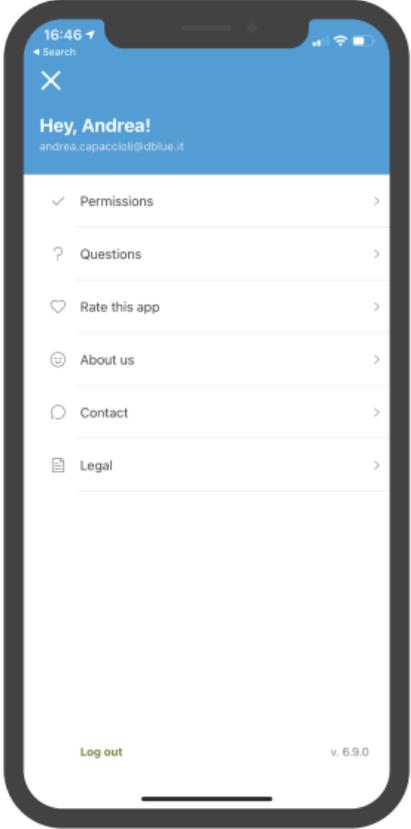
Icon	Pilots' Apps examples	Pros and Cons
Clock		<p><b>Example of use: P4 Madrid</b></p> <p><b>PROs:</b> The contrast and position of the icon is appropriate.</p> <p><b>CONs:</b> Size is too small for users with low-vision; there is no textual explanation and the same icon is used with multiple meanings in the same app, which is against consistency.</p>
Check mark		<p><b>Example of use: P3 – GALILEE</b></p> <p><b>Pros:</b> The checkmark appears next to the drivers' profile picture and it is easily associated with something related to their status.</p> <p><b>Cons:</b> No explanatory text is provided; contrast is not high enough for low-vision or colour-blind people; the checkmarks are usually associated with a colour coding cue, such as green for affirmative/confirmed: the yellow colour may be associated with the idea of an ongoing process, as if driver should still be verified. Also, at first use, some users may think that the checkmark is associated with accepted rides.</p>





<p>Pinpoint</p>		<p><b>Example in use: P2 Antwerp</b></p> <p>PROs: contrast and colours are fine for all users' categories; the distance from other icons is fairly appropriate to people with touch-typing issues; the icon is provided with a textual label which can be read by text-to-speech systems; the icon is used consistently in the app.</p> <p>CONs: the size of the icon is too small for low-vision users.</p>
<p>Tools</p>		<p><b>Example of use: P1 Emilia-Romagna</b></p> <p>PROs: the design of tools is clear, contrast and size are appropriate and the textual description supports comprehension; the spacing across elements is appropriate for all users, including those with touch-typing issues; the icon associated with the red-cross helps the user understand that something is wrong.</p> <p>CONs:</p> <p>The icon meaning cannot be read by text-to-speech systems. Since this function is related with parcel delivery in mailboxes, users with low digital skills or non-native speakers may think that someone will physically provide help to adjust/recover the service.</p>



<p>Heart</p>		<p><b>Example of use: P5 Berlin</b></p> <p>PROs: the icon is associated with a textual label; outline and contrast are fine; colour is absent;</p> <p>CONS: the size of the icon is too small and the distance across the elements is not appropriate for users with touch-typing issues; the icon is used only once in the app, but there is no consistency with other applications, thus people not speaking the language in use by the app may think it's used to add some content to favourites or to rate a specific user.</p>
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**Table 14 - Evaluation of icons used in pilot sites applications**

The same set of icons was included in the UIL survey, in order to collect information about the comprehensibility of each icon’s meaning and the users’ preferences among most common icons related or unrelated with the proposed function or action. The survey aimed at assessing the overall comprehensibility of each icon asking the participants’ ranking of i) the function/meaning listed that better matched the proposed icon and ii) the most appropriate icon, among proposed ones, related to a specific function/meaning (see Table 15)<sup>22</sup>.

#	Icons’ group, name and function	Evaluation (UIL survey)
	<b>MOBILITY SPECIFIC</b>	
<b>1.</b>	<p><b>Clock</b></p> 	<p>UIL survey – Q14 - rate the function that better matches its meaning</p> <ul style="list-style-type: none"> <li>• 56% - set alarms</li> <li>• 20% know current timing of something/someone arriving or of an item that has to be delivered</li> <li>• 10% know the expected time of arrival/delivery something/someone arriving or of an item that has to be delivered</li> </ul>

<sup>22</sup> The questions from Q3 to Q13 – “Rank the most fitting icon related with the proposed function/meaning” a multiple choice Likert 1:4 scale was used to identify the most appropriate icons related to a function/meaning. In Q14- “Rate the function that better matches the icon’s meaning” a single choice Likert 1:4 scale was used to understand the degree of icons’ comprehensibility.

<p><b>2.</b></p>	<p><b>Calendar</b></p> 	<p>UIL survey – Q14 - rate the function that better matches its meaning</p> <p>43% - find a date 25% - view timetables 25% - schedule travel 10% - none</p>
<p><b>3.</b></p>	<p><b>Timetable</b></p> 	<p>UIL survey - Q14 - rate the function that better matches its meaning</p> <p>35% - view timetables 35% - schedule travel 19% - find a date 10% - none</p>
<p><b>4.</b></p>	<p><b>Alarm clock</b></p> 	<p>UIL survey - Q14 - rate the function that better matches its meaning</p> <p>85% - set alarms 10% - none</p>
<p><b>5.</b></p>	<p><b>Hourglass</b></p> 	<p>UIL survey – Q14 - rate the function that better matches its meaning</p> <p>50% - remaining time to arrival/delivery of something/someone 10% - expected time of arrival 29% - none</p>
<p><b>6.</b></p>	<p><b>Checkmark</b></p> 	<p>N/A – this icon was only analysed during the UIL exercises</p>
<p><b>7.</b></p>	<p><b>Payment card</b></p> 	<p>UIL survey – Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</p> <p>The icons proposed in the survey represented a payment card combined with different additional elements: The icon that ranked #1 was that representing a hand holding the card (83% of positive preferences), the #2 was a credit card combined with a dollar banknote (78%) and the #3 was a credit card combined with three different currency coins (66%).</p>
<p><b>8.</b></p>	<p><b>Ticket</b></p> 	<p>UIL survey – Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</p> <p>The ticket represented with pre-cut dots ranked #1 (44% of positive preferences) among those proposed to offer the opportunity to “visualise tickets”, while icon representing a general document was considered least appropriate (29%), even though it is quite common to find it in application, labelled as “travel documents”.</p>
<p><b>9.</b></p>	<p><b>Map</b></p> 	<p>UIL survey – Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</p> <p>This icon was the #1 for the “visualize map” function (82% of positive preferences), followed by a very similar one with no tracking dots (78%). The other options provided represented only pinpoints connected by a route (56%) or only the map (34%). As a conclusion, the combination of the two elements (pin-point and map) helps comprehension.</p>

<p><b>10.</b></p>	<p><b>Pin Point – drop pin and lollipop pin</b></p> 	<p>UIL survey – Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</p> <p>The drop icon ranked #1 among those proposed to represent the “location on map” of someone/something (93% of positive preferences), the lollipop icon ranked #2 together with the compass arrow (43%) and the target circle ranked #3 (34%).</p>
<p><b>11.</b></p>	<p><b>Compass arrow</b></p> 	<p>UIL survey – Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</p> <p>The compass arrow is not considered the clearest one among those provided to locate something/someone on a map (43% of positive preferences). Since it is commonly used by route-planners as map-orientation tool and/or to re-locate the map on current position, users may get confused.</p>
<p><b>GENERAL</b></p>		
<p><b>12.</b></p>	<p><b>Home</b></p> 	<p>UIL survey – Q2 – how certain are you about this icon’s meaning</p> <p>Most respondents are very certain about this icon’s meaning, yet one respondent, as open-ended answer, would associate it with an “address field”.</p> <p>Nevertheless 99% of respondents correctly identified it as the icon bringing to the main page of a website or application and as low as 8% of respondents were slightly uncertain about this meaning.</p>
<p><b>13.</b></p>	<p><b>Hamburger menu</b></p> 	<p>UIL survey – Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</p> <p>This icon was ranked #1 to represent the function “Open menu” (86% of positive preferences). Other options included three vertical or horizontal dots (45% and 43%) and a 2x2 combination or four aligned squares (20%).</p>
<p><b>14.</b></p>	<p><b>Lens</b></p> 	<p>UIL survey – Q2 – how certain are you about this icon’s meaning</p> <p>90% of respondents are extremely certain about the meaning of this icon. Their open answer guess was “search content”. Nevertheless, a single user only associated it with the possibility of zooming-in/enlarging content, which is actually another common use of this icon, especially in non-mobility specific applications. In this case the analogy between the associated digital function and the actual use of the tool in the reality clarifies its context-specific meaning.</p> <p>UIL survey – Q2 – how certain are you about this icon’s meaning</p> <p>Even if more than 90% of respondents are very certain about its meaning as “search content” function, someone correctly mentioned that this icon could also be used to “enlarge/zoom in” contents.</p>
<p><b>15.</b></p>	<p><b>Equalizer</b></p> 	<p>UIL survey – Q3-Q13 – rank the most fitting icon related with the proposed function/meaning</p> <p>When compared with the gear and the tools icon, this icon was ranked as the least appropriate to represent the function used to access application settings (50% of positive preferences).</p>



<p><b>16.</b></p>	<p><b>Gear</b></p> 	<p>UIL survey – Q2 – <i>how certain are you about this icon’s meaning</i></p> <p>The 77% of respondents declared they would expect with extreme certainty this icon to open the application setting menu, if compared to the toolset icon and the equalizer icon, that gained lower rankings.</p> <p><i>UIL survey Q3-Q14 - Rank the most fitting icon related with the proposed function/meaning</i></p> <p>With 96% of positive preferences this is the icon considered ideal to access application settings, followed by the tools icon (68%) and the equalizer icon (50%).</p>
<p><b>17.</b></p>	<p><b>Tools</b></p> 	<p><i>UIL survey Q3-Q14 - Rank the most fitting icon related with the proposed function/meaning</i></p> <p>The tools icon is considered the second choice related with the access to settings functions (68% of positive preferences), after the gear icon.</p>
<p><b>18.</b></p>	<p><b>User profile</b></p> 	<p>UIL survey – Q2 – <i>how certain are you about this icon’s meaning</i></p> <p>More than 15% of respondents declared they are slightly uncertain about its meaning and only 43% feel very certain about it. Most respondents associate it with “user details” or own “personal details”, the most uncertain respondents left the supposed meaning field blank.</p>
<p><b>19.</b></p>	<p><b>Info circle</b></p> 	<p>UIL survey – Q2 – <i>how certain are you about this icon meaning</i></p> <p>Most respondents were very certain about this icon meaning (86%), most likely due to its extensive use in public spaces, especially transport hubs. Nevertheless, when asked about the meaning, some respondents confused it with a power-on icon or an exclamation mark, which can be caused by inappropriate sizing or outline.</p> <p>It is among the least ambiguous icons, yet people lacking digital experience may easily confuse it with “power on” command or with an exclamation mark.</p>
<p><b>20.</b></p>	<p><b>Inbound arrow</b></p>  	<p>UIL survey – Q3/Q13 – <i>rank the most fitting icon related with the proposed function/meaning</i></p> <p>The inbound arrow ranked #1 among the two associated with the “save content” function (87% of positive preferences). Despite its overall performance in the UIL survey, over time the floppy disk icon (86%) will probably become outdated and not intuitive anymore, since the object it represents is no longer used, especially in the mobile device contexts.</p>
<p><b>21.</b></p>	<p><b>Linked dots/ Share</b></p> 	<p>UIL survey – Q3/Q13 – <i>rank the most fitting icon related with the proposed function/meaning</i></p> <p>This icon was ranked #1 among those related with the function “Share content” (79%). The outbound arched arrow ranked #2 (77%) while the minimalistic vertical arrow springing from a box ranked #3 with far lower preferences (36%).</p>



<p><b>22.</b></p>	<p><b>Outbound arrow/Share</b></p> 	<p>UIL survey – Q2 – <i>how certain are you about this icon’s meaning</i></p> <p>This icon was proposed in the survey as one of the possible ones related with the meaning “rate content/app/user” and was considered the least appropriate. The decision to include it as a comparison in such list derived from the need of evaluating its appropriateness to access sharing and rating contents functions, as observed in some of the desk-research applications.</p> <p><i>Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</i></p> <p>This icon ranked #4 with a percentage of positive preferences as low as 4%, the lowest in the whole survey, if related with the function of “rating contents”. It performed better but still ranked lowest also when related with the “share” function (36% of preferences).</p>
<p><b>23.</b></p>	<p><b>Phone handset/Contacts</b></p> 	<p>UIL survey – Q2 – <i>how certain are you about this icon meaning</i></p> <p>Most respondents identified the phone handset as the icon related with the function of making a call, view contact info or contact assistance. Depending on the context the exact meaning may vary, but it’s all time related with some kind of option to initiate a phone call activity.</p> <p><i>Q3/Q13 – rank the most fitting icon related with the proposed function/meaning</i></p> <p>The phone ranked #1 in relation to the “contact support function” (either associated with a text bubble or a mail icon) (83% and 67% of positive preferences) while all other icons representing some kind of texting service alone ranked lower scores (42% and 42%)</p>
<p><b>24.</b></p>	<p><b>Heart/Rating</b></p> 	<p>UIL survey – Q3/Q13 – <i>rank the most fitting icon related with the proposed function/meaning</i></p> <p>Respondents chose the thumbs-up icon as #1 associated with the function “rate content”. The heart and star icons were almost equally rated, with the star icon gaining slightly higher ranking. Comments focused on both icons’ ambiguity since they are often used to access other functions such as “add to favourites”.</p>
<p><b>25.</b></p>	<p><b>Star/Rating</b></p> 	<p>UIL survey – Q3/Q13 – <i>rank the most fitting icon related with the proposed function/meaning</i></p> <p>This icon ranked #2 with 43% of respondents declaring it’s extremely clear that it allows rating the app, the content or a user. On the other hand, more than 15% of respondents think this icon is not so appropriate to access the rating area, when compared with the heart or thumbs up icon.</p>
<p><b>26.</b></p>	<p><b>Word bubble</b></p> 	<p>UIL survey – Q3/Q13 – <i>rank the most fitting icon related with the proposed function/meaning</i></p> <p>This icon ranked #4 and last among those proposed in association with the function “contact support” (43% of preferences against 67% for phone handset icon), which means that respondents do not expect support to happen via chat or texting services, which could be associated more easily with contacting known people or users. Direct contact through phone calls is therefore still considered the most favourite and clearer option to receive service support.</p>



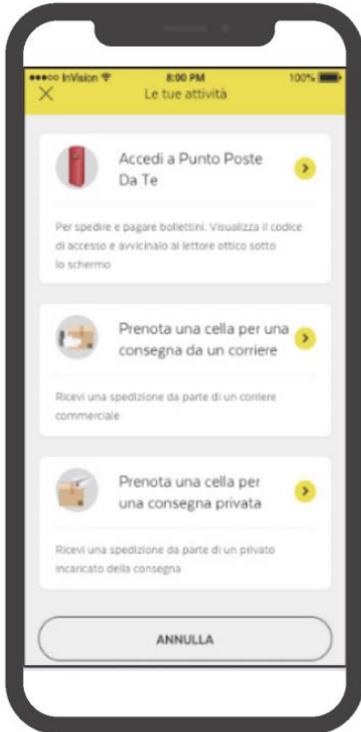
<b>27.</b>	<b>Funnel / Filter</b> 	UIL survey – Q2 – <i>how certain are you about this icon meaning</i>  The funnel is widely used in applications where lists or elements with multiple characteristics are presented. Almost 30% of respondents are very uncertain about its meaning and only 34% are very certain.
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**Table 15 - UIL survey evaluation of icons**

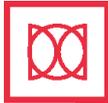


## 7.2. Interfaces analysis results

In the following tables Table 16, Table 17, Table 18, Table 19 and Table 20 the main issues about user interfaces emerged during the UIL exercises have been collected. These tables provide useful insights about the importance of a well-structured application interface to ensure the highest comprehensibility and minimisation of errors. The methodological approach for the collection of input during UIL exercises is described in 6.2 and the full collection of the exercises debriefings is provided in the Annex 3 – UIL exercise: debriefings

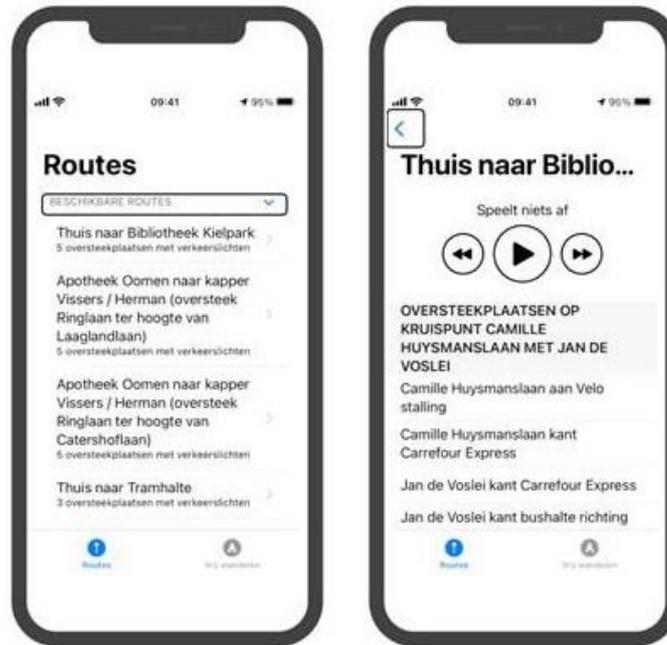
Interface analysis
<p><b>P1 – Emilia Romagna</b></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p><b>Welcome screen:</b></p> <p>Concerning the welcome screen, participants complain that they understand it is related with postal services, but it is not intuitive at all where they should start to get/send their parcel. There is too much content, it's not easy to identify the main purpose of the service unless you read all the lines of text. Icons are not helpful either, they are not intuitive and too complex.</p> <p>Retrieve package: digital signature and QR code procedure to retrieve package is too complex for participants with low digital skills or ageing people. Most of them never heard about one-time passwords (OTP) or QR code at all.</p> <p><b>General:</b> most screens were not so intuitive for participants, who declared they would need some kind of assistance while using it.</p>

**Table 16 - P1 Emilia-Romagna application interface analysis results from UIL exercises**



### Interface analysis

#### P2 – Antwerp



#### Welcome screen:

The welcome screen shall consider very carefully the size of icons, the priority information and the contrast of single elements and their combination/ juxtaposition event though people with visual impairments rely more on-screen readers (transforming text into speech) and auditory icons (sounds and ringtones) while interacting with the app, than on its appealing appearance. The sooner users get to the main feature/service the better, so there is no need for intermediate screens.

#### General:

Good that the whole interface is simple in black and white, gives a feeling of tranquillity to such users. Ensure that text can be read also when enlarged/zoomed. Good that the traffic light auditory sign is different among red and green, and it also appears as pictorial icon on the app (works as a confirmation cue for low-vision).

Selecting trajectory: the voice-over tone is fine and text is short and clear enough. For people on the street information should be reduced to the minimum needed.

Stand at crossroad and choose/select it: the logical order of crossroads should be built in the app, the person should be in focus on traffic while crossing and be able to avoid/mute non relevant information.

Information about status of light: auditory signal is easy to hear but it should autonomously stop beeping quite soon when the crossing is over or be stopped manually by the user who wants to start with the next one (in case of subsequent crossroads).

The tone frequency should be different among green light and red light, not only its speed. Consider adding also a haptic feedback (buzz vibration).

The function “read name of the traffic light” should be separated from the function “tell the status of the traffic light” and lists (e.g. of crossroads) should appear in logical order, not alphabetic.

Context of use is very important; application should not distract users from the surrounding environment (information overload). Support and back-up/alternative solutions should always be easily accessed.

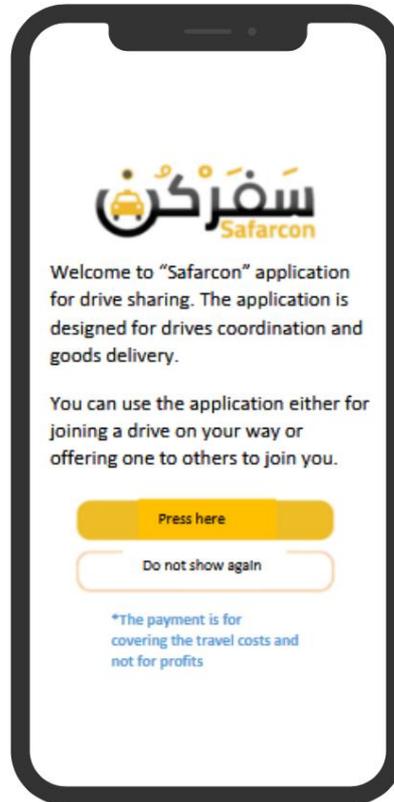
**Table 17 - P2 Antwerp application interface analysis results from UIL exercises**





Interface analysis

P3 - Galilee



**Welcome screen:**

From the welcome screen one cannot say it is a mobility related service/app, the small car is not enough to guess. The dominant colour, yellow, is easily associated with taxi services. Nothing suggests it is a shared-ride service.

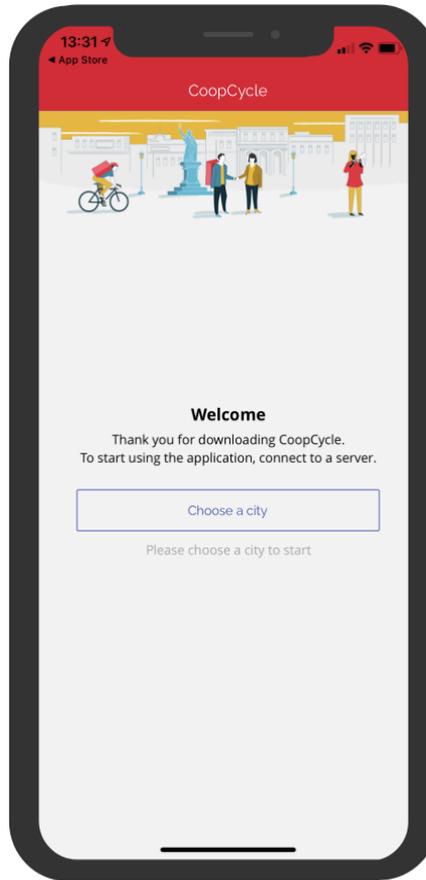
**General:** good to have a lot of textual explanations attached to icons, but colours would be useful to distinguish between some functions provided through icons.

Table 18 - P3 Galilee application interface analysis results from UIL exercises



Interface analysis

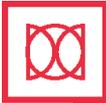
P4 - Madrid



**Welcome Screen:** There is no clear reference to food, but only to the bike-riders. The home screen should not show a list of restaurants but the address of delivery, since that is the most important step.

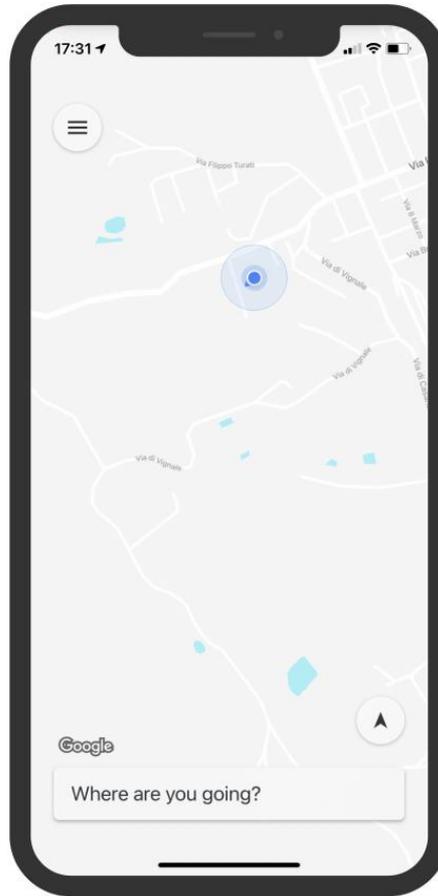
**General:** not clear where the address for delivery should be written; a “close session” feature should be more visible.

Table 19 - P4 Madrid Pilot application interface analysis results from UIL exercises



## Interface analysis

### P5 - Berlin



#### Welcome Screen:

Participants correctly identify that the app is somehow related with route-planning, although no one could really say that it offers ride-sharing services plus chained-trips with local public transport. It's considered positive that the first action required by the user is limited to searching for a destination they would like to reach.

**General:** participants are unsure about what part of the process they are going through and how much time is needed to finalise service purchase.

**Table 20 - P5 Berlin application interface analysis results from UIL exercises**



### 7.3. UIL survey results on DDS and DMS accessibility barriers

In this section results from the UIL survey related with the common barriers experienced by sixty-four (64) over the total eighty-nine (89) respondents are summarized<sup>23</sup>. The background information collected allowed the INDIMO research team to better understand what key factors may influence the accessibility of digital mobility applications. Due to the low sample size, in the context of the INDIMO UIL manual, we did not proceed with segmentation, deviation analysis or identification of predictors linked with the different socio-economical background (age, gender, education, state of employment, caregiving activities and yearly income). We rather chose to deliberately focus on the diversity of respondents found in the small numbers and details. Here some details about the sample composition:

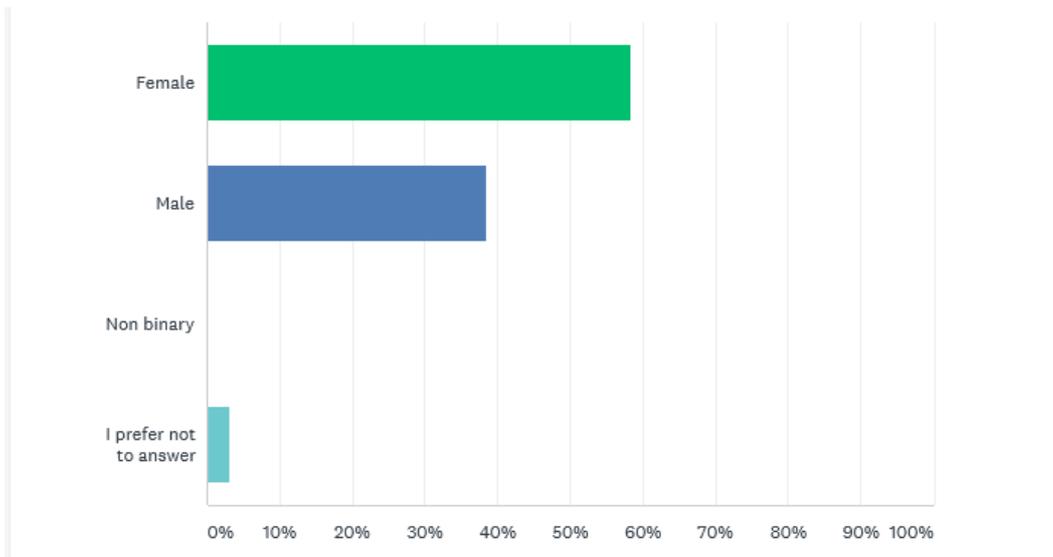
1. **Gender:** a slight majority of respondents is represented by women (Figure 9);
2. **Age:** only 6% of the respondents were aged more than 65 (they represent 20% of the European population in 2019<sup>24</sup>) (Figure 10);
3. 20% of respondents live in **peri-urban** areas and 6% live in **rural** areas (Figure 11);
4. Most respondents are part- or full-time employees, yet the life-work balance of more than 10% of respondents is different from the 40 hours<sup>25</sup> of a European full-time average job (Figure 12);
5. On the two opposite extremes, almost 30% of respondents are busy with daily care-giving activities while 44% declare they only dedicate to such activities less than once in a month (Figure 13);
6. Different income groups are represented (Figure 14);
7. More than 90% of respondents hold a secondary school diploma or higher education degree (Figure 15).

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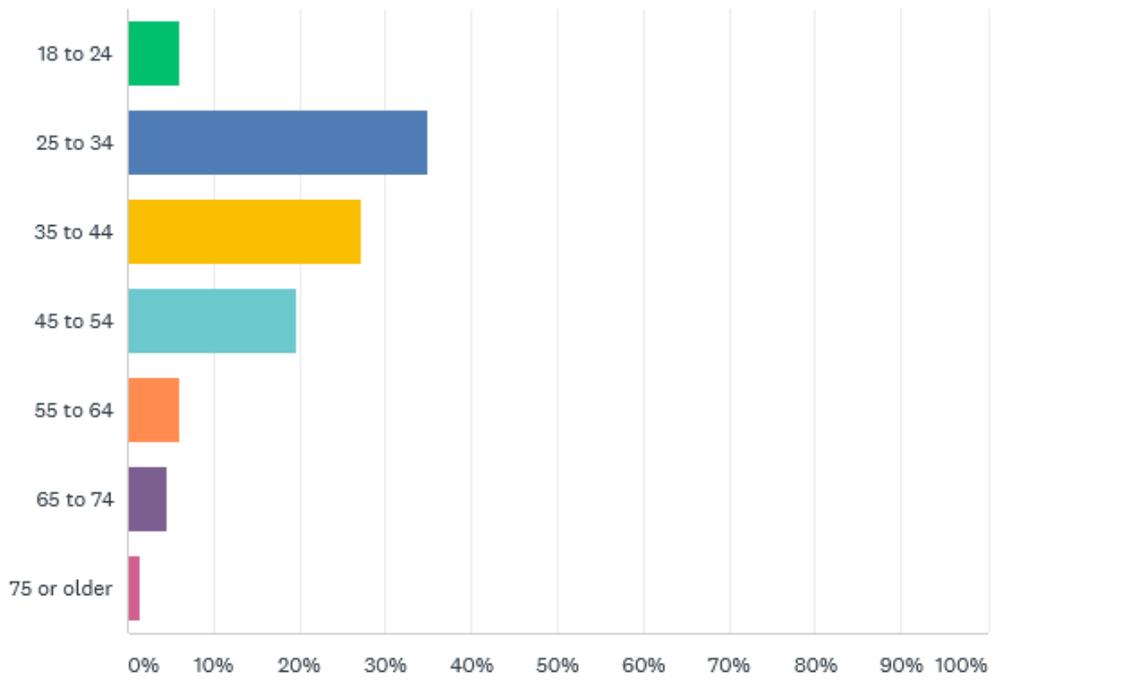
<sup>23</sup> Some respondents left their answers incomplete after icons testing section of the UIL survey

<sup>24</sup> <https://www.statista.com/graphic/1/253408/age-distribution-in-the-european-union-eu.jpg> - last access on 29<sup>th</sup> of June 2021

<sup>25</sup> <https://www.statista.com/statistics/1197097/average-working-hours-eu/> - last access on 29<sup>th</sup> of June 2021

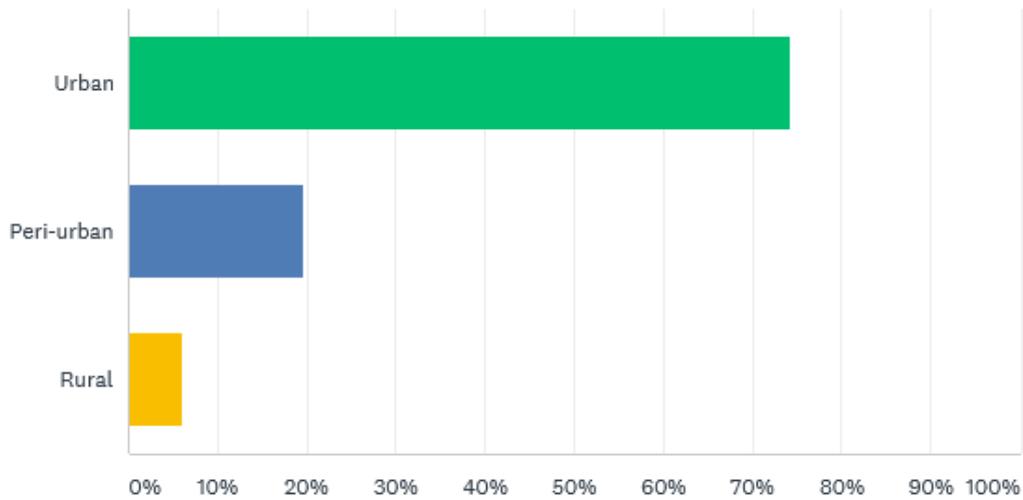


**Figure 9 - Gender distribution**



**Figure 10 - Age groups**





**Figure 11 - Level of urbanisation of living context**

None of the above	1.52%	1
I work 35 hours or more	77.27%	51
I work 25-34 hours	6.06%	4
I work 24 hours or less	3.03%	2
I am a full time student	4.55%	3
I am a part time student (less than 50% of my time)	0.00%	0
I am unemployed	3.03%	2
I am retired	1.52%	1
I prefer not to answer	1.52%	1
Other (please specify)	<a href="#">Responses</a> 1.52%	1
<b>Total Respondents: 66</b>		

**Figure 12 - Situation of employment**



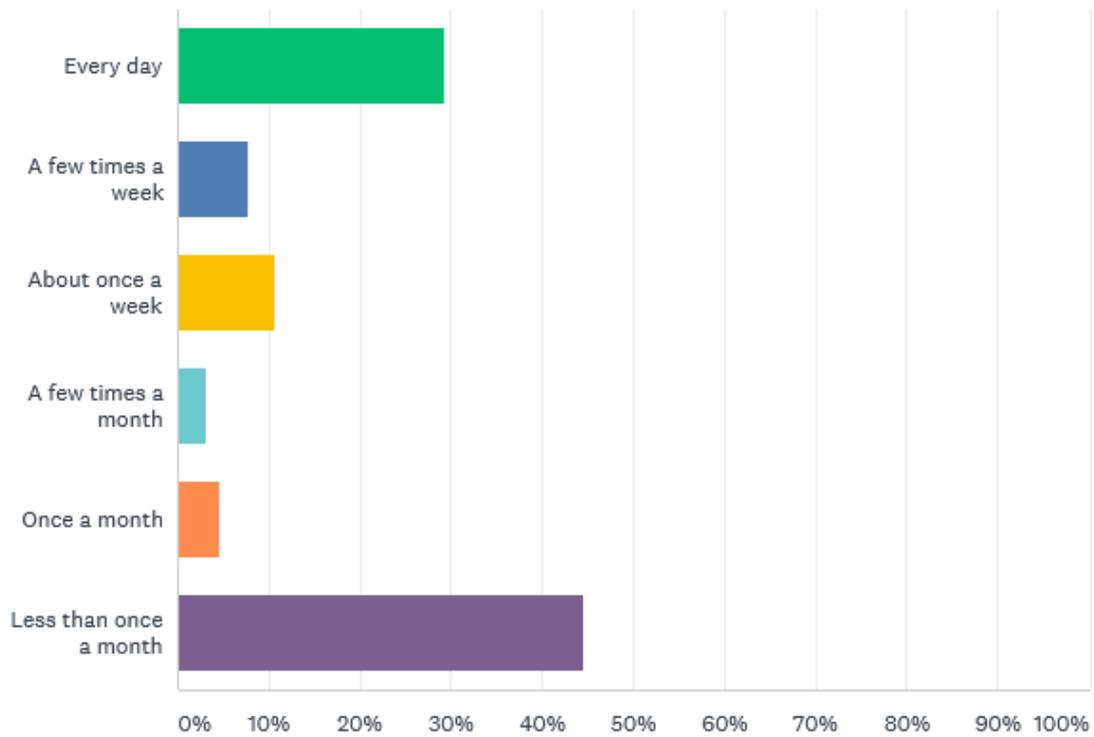


Figure 13 - Frequency of care giving activities

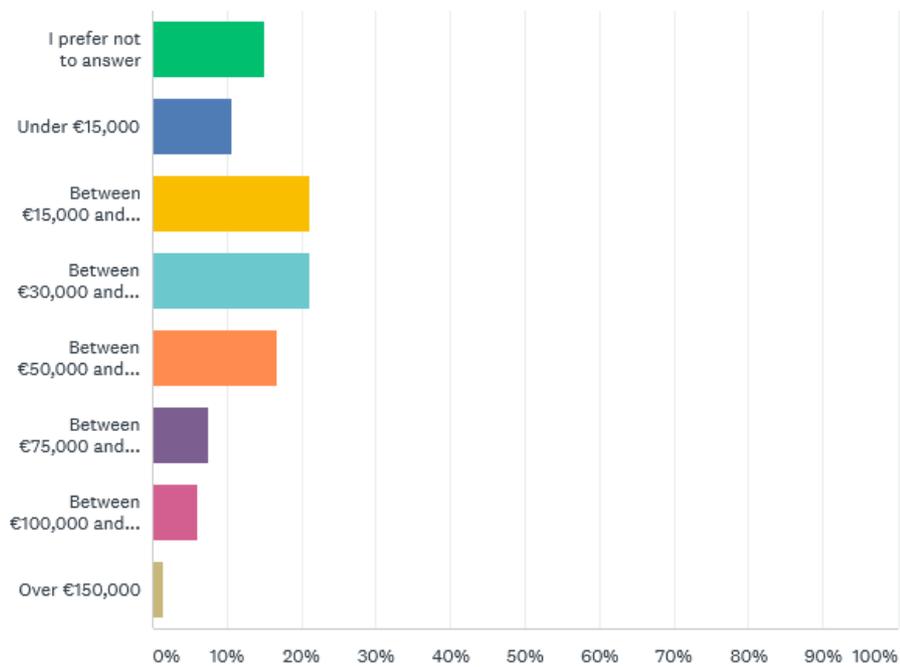
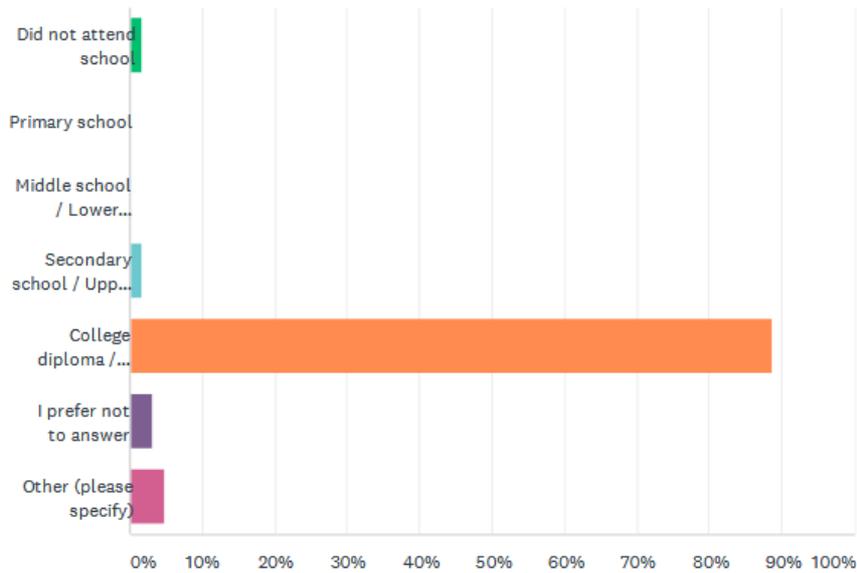


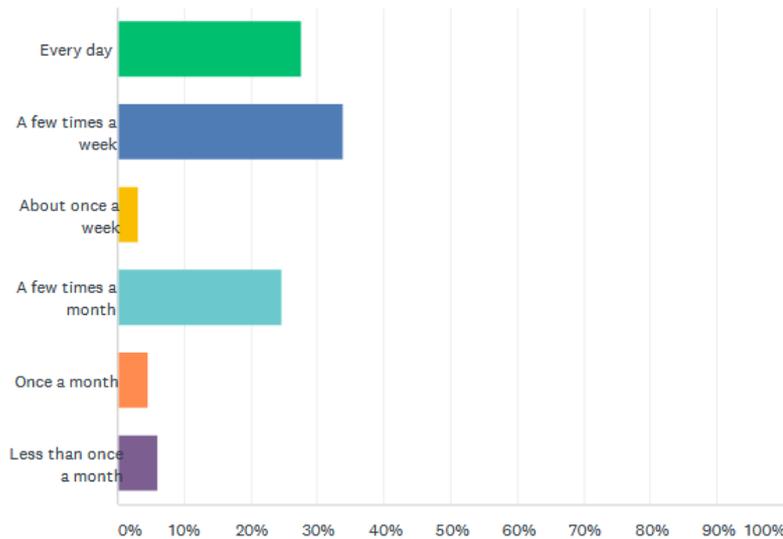
Figure 14 - Household yearly income



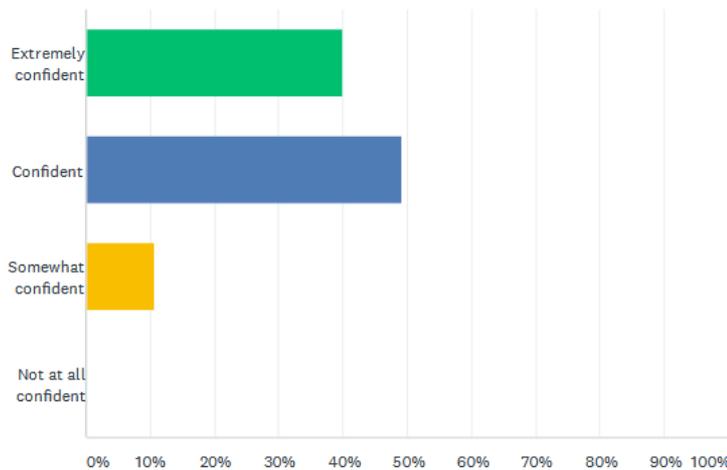
**Figure 15 - Highest level of education**

In the third section (Q16-Q21) we assessed the respondents’ experience with digital mobility and goods delivery applications. As first step, we wanted to assess how confident respondents consider themselves in using such applications and how often they use them.

More than 65% of respondents use mobile applications at least once a week, while 35% use them less than once a week (Figure 16). Almost 90% of respondents self-declared “extremely confident” or “confident” and only 10% of them self-declared “somewhat confident” on a 1:4 Likert scale (Figure 17).



**Figure 16 – Frequency of use of digital mobility and goods delivery apps**



**Figure 17 – Level of confidence in the use of digital mobility and goods delivery apps**

Despite the high level of confidence declared by respondents, when asked about their experience with common barriers encountered while using mobile applications, interesting figures emerged. In Table 21 the main highlights are collected:

**Experience with accessibility barriers preventing the use of a digital application**

**(Q18 - “How often have you encountered the following barriers, due to the poor accessibility of the digital mobility or delivery services you use or would have liked to use?”)**

**Question 18 focused on the respondents’ experience in their everyday life, focusing on the individual perception of barriers due to situational, temporary or permanent limitations**

1. 18% of respondents due to Covid-19 stopped using touchscreen terminals and asking unknown people when they needed support in using a digital application
2. 10% had problems related with scarce readability of objects, texts or images
3. 8% could not use a digital app due to physical limitations
4. 8% could not understand the terminology used
5. 8% was not proficient with the local language used by an app
6. From a gender perspective, almost 5% felt unsafe or unsupported using a service provided by an app
7. More than 5% experienced difficulties due to temporary or situational impairment
8. Almost 5% can get little or no support at all from people around them
9. More than 3% experienced lack of support in using digital apps due to Covid-19 confinement
10. More than 3% admit low familiarity with digital services in general

	NEVER	RARELY	OFTEN	ALWAYS	TOTAL
Covid-19 provisions scared me from using touchscreen terminals or asking for help to other people while using a digital app	56.25% 36	25.00% 16	15.63% 10	3.13% 2	64
I could not use a digital app due to scarce readability of objects, texts or images	34.38% 22	54.69% 35	10.94% 7	0.00% 0	64
I could not use a digital app due to physical limitations that prevented me providing the input required	60.94% 39	31.25% 20	7.81% 5	0.00% 0	64
I cannot understand the terminology used by digital apps	59.38% 38	32.81% 21	7.81% 5	0.00% 0	64
I do not speak/understand the language used by local digital apps	65.63% 42	25.00% 16	7.81% 5	1.56% 1	64
I had limited access to the services provided by a digital app since, from a gender perspective, I felt unsafe or unsupported	71.88% 46	23.44% 15	4.69% 3	0.00% 0	64
I experienced difficulties using a digital app due to situational or temporary impairments	53.97% 34	39.68% 25	4.76% 3	1.59% 1	63
I experience lack of support in using a digital app from other people due the fact I do not have contacts with anyone who can offer it	79.69% 51	15.63% 10	4.69% 3	0.00% 0	64
I experienced lack of support in using a digital app from other people due to Covid-19 confinement	78.13% 50	18.75% 12	3.13% 2	0.00% 0	64
I have low familiarity with digital services in general	79.69% 51	17.19% 11	3.13% 2	0.00% 0	64

**Experience with accessibility barriers while using a digital application**

**(Q19 - “How often did you experience situations similar to the ones described by the following statements, while using digital applications?”)**

**Question 19 focused on the respondents’ experience, focusing on the information, functions and customisation options provided by the applications.**

1. Almost 20% of respondents have issues reading textual information and rarely have access to options for customisation of text size
2. To more than 15% of respondents, the pictograms and the related descriptions of available functions are rarely appropriately sized and spaced.
3. To more than 10% of respondents the information provided in-app is not sufficient to allow an intuitive use of the services.
4. More than 25% of respondents declare that available commands are not intuitive neither customisable, based on their needs
5. More than 20% of respondents admit that it takes them too long to identify essential information

	NEVER	RARELY	OFTEN	ALWAYS	TOTAL
I can easily read all textual information and/or customise text size settings	3.13% 2	15.63% 10	65.63% 42	15.63% 10	64
In my experience pictograms and/or descriptions of available functions are appropriately sized and well spaced	0.00% 0	15.63% 10	76.56% 49	7.81% 5	64
The information provided in-app is helpful enough to allow me an intuitive use of the service	3.17% 2	7.94% 5	82.54% 52	6.35% 4	63
Available commands are simple and intuitive and/or I can customise them depending on my specific needs	1.59% 1	26.98% 17	71.43% 45	0.00% 0	63
It takes me too long to identify essential information	6.25% 4	71.88% 46	21.88% 14	0.00% 0	64

**Experience with accessibility barriers related with the available support provided by a digital application**

**(Q20 - “How often did you experience situations similar to the ones described by the following statements, while using digital applications?”)**

**Question 20 focused on the respondents’ experience, focusing on support provided by the applications during sign-up process, when errors occur and about personal data management.**

1. More than 40% of respondents declare that the applications they use do not provide tips or tutorial supporting first use
2. More than 40% of respondents declare they are rarely or never aware about the expected time for finalising the ongoing processes.
3. More than 40% of respondents declare they have difficulties finding a point of contact (e.g. live chat, chat-bot, call-centre, direct e-mail)
4. More than 20% often experience unexpected outcomes when clicking on icons or pictograms
5. Less than 20% of respondents can easily understand Terms and Conditions and manage their personal data through the Privacy Policies.

	NEVER	RARELY	OFTEN	ALWAYS	TOTAL
After a new registration/installation, the application provides me with tips or tutorials to learn how to use the service	4.69% 3	34.38% 22	59.38% 38	1.56% 1	64
While using an application I know how long it will take me to finalise the desired process	7.81% 5	34.38% 22	54.69% 35	3.13% 2	64
I can easily understand how to contact the support center when needed, either through a chat, phone number or e-mail address	7.81% 5	35.94% 23	53.13% 34	3.13% 2	64
If an error occurs, most applications I use provide me with appropriate error handling services and error prevention tips	23.44% 15	56.25% 36	20.31% 13	0.00% 0	64
I click on an icon/pictogram and what happens next is not what I expect	7.81% 5	71.88% 46	20.31% 13	0.00% 0	64
Thanks to the Terms and Conditions of the service I can easily retrieve and modify my personal data and decide how the service provider is collecting and using them	37.50% 24	45.31% 29	14.06% 9	3.13% 2	64

**Table 21 – Common accessibility barriers**

## 8. Recommendations for the design of accessible and inclusive interfaces

In this section a list of recommendations is provided, ranging from those directly coming from the research carried out in the task T2.2 – Universal Interface Language (sections 6.2 and 6.3), recommendations regarding the inclusive design built on the literature review and desk research and the more general ones related with digital accessibility issues. The recommendations are intended for i) service providers, ii) developers and iii) designers who wish to offer more inclusive digital services.



Far from being exhaustive, we hereby propose a handy UIL manual, where we accompany each set of recommendations with a selection of useful links and references. The UIL manual contains not only links to standards and regulations, scientific papers and well-known researches, but also offers suggestions from informal and well-informed communities of practice composed by those people who struggle and succeed in finding viable solutions that we, the wrongly called “average users” minority, would have never thought about.

The section is organised as follows:

- Recommendations based on the empirical research in the INDIMO project addressing accessible user interfaces, with a focus on the visually impaired people, and inclusive selection and/or design of icons (section 8.1);
- Inclusive design recommendations derived from literature and desk research about concerning user-testing and recruitment, preliminary actions related with development and inclusive design tips (section 8.2);
- High level general recommendations addressing the different INDIMO target groups (section 8.3).

## 8.1. Recommendations based on the empirical research in the INDIMO project

One of the most important findings of our study, especially from the insights gained in WP1, is that it is becoming more and more difficult to apply user segmentation: there are huge differences across user groups but also within user groups. A person’s travel preferences can vary, depending on the specific context (travelling alone / with others, travelling for work / leisure, making a chain-trip or not, having access to public transport or a private car etc.). Taking into account the whole lifespan and life changing conditions of human beings, results in higher trust and reliability.

According to the insights gained during CoP UIL exercises and interviews in WP1, a priority issue is the poor accessibility of lengthy legal texts (e.g., Privacy policies, Terms & Conditions, passengers and customers rights), which are rarely read by users, oftentimes limited by time constraints. Despite being the least accessible contents, they are considered priority information by most users (Singh, Sumeeth, & Miller, 2011) (D2.6). Another issue identified is the people’s need for empowerment when deciding to start using a new digital mobility service. Applications’ features should support their autonomy and learning attitude from the first-use to the more complete experience of all advanced options.

### 8.1.1. Inclusive user interfaces

In Table 22 recommendations for the design of inclusive interfaces for digital mobility applications are collected and grouped into the same five categories used by the WCAG guidelines: *perceivable, adaptable, robust, operable and understandable* (W3.org, 2018). This set of recommendations is directly derived from the experience gained during UIL exercises and UIL survey and the choice of using the same categorisation used by the WCAG guidelines is due to the fact that globally they represent the most acknowledged source of information about digital



content accessibility and, by doing so, we hope to offer UIL manual users a sample of recommendations aligned with its structure.

## Recommendations for inclusive user interfaces from the INDIMO project

### Perceivable interface

- **Welcome screens** are often overlooked, despite being the first hook to catch users’ attention. The service provided should be fast recognised, clearly stated and navigation facilitated by labels and tips. Especially in first screens, information overload should be avoided thus it is important to provide direct access to the few features needed to easily access the service.
- **Colour coding** brings a lot of information to users, though it’s very much related to culture. Global standards and guidelines fail in providing information on this concern. The use, misuse and non-use of colour can be misleading in different ways, depending on the context of use and socio-cultural environment. Always call colours into doubt, also when they may be obvious (e.g., standard coupling of red and green for go/no go actions) and test them with diverse people with different backgrounds.
- **Colour themes and backgrounds** are responsible of the first overall impression of the application interface. Situational impairments or changing conditions shall be considered when choosing the right combination. Solutions could be identified for contextual conditions affecting perception, for all kinds of users and on different sensory channels (e.g. road navigation maps offering light-sensitive backgrounds, which change dynamically when sensors detect low-light conditions such as car galleries).
- **Contrast** is very important to colour-blind people: to prevent loss of information carried by colours or misunderstandings, developers should design mock-ups in grayscale and choose colour palettes and opacity options based on the preliminary results of online contrast checking tools.
- **Tutorials** are highly appreciated by end-users, especially those with lower digital skills. Consider realising first-use tutorials in different media formats and languages and easy-to-read textual contents, to ensure all users find the most appropriate to their needs.

### Adaptable interface

- **Sorting** of elements in a list shall be accurate: sorting has to make sense depending on frequency of use and process priority, not alphabetical; whenever possible offer the option to choose sorting order and filter options.
- Foresee the possibility to specify **accessibility settings**. A non-exhaustive list of required options from our research are: personalization options to adapt the application to a specific condition, personalized notifications about accessibility issues (e.g. disruption, elevators out of service), voice-based commands and





directions (search, route planning, navigation).

- Wherever possible, add **inclusive fields** where users can specify additional needs.
- Offer users the possibility to send **suggestions and feedback** through a form or a dedicated contact point to increase accessibility and inclusivity.

### Robust interface

- Implement **constraints** to ensure the users are not required to insert identical data multiple times, offering options to verify, edit or specify changes before proceeding with transport or delivery service order confirmation.
- Offer users the **possibility to exchange and share useful tips**, for example including their suggestions in a dedicated area linked to the FAQ (frequently asked questions) area.
- Offer users the possibility to **rate and review** your application in terms of accessibility, as a transparent and open area. Thanks to it insights for further improvements will be gained.
- Set a **long-term strategy** to become a trustworthy and inclusive service provider, by joining prominent communities who can witness, assess and/or certify your level of accessibility.

### Operable interface

- Offer users explanations concerning the **accessibility limits** of your services.
- Build connections with existing networks of international or local organisations committed to inclusion<sup>26</sup> that could offer bridge vulnerable users’ needs to the developers’ team. Include their names and contacts in the users’ support area. Taking advantage of the information collected through dedicated forms, contact-point and organisations’ network, plan to periodically improve your service accessibility and let users know about your commitment.
- Advanced strategies for **error-prevention** could be explored, such as different user input constraints (e.g. poka-yoke) (Shigeo, 1986).

### Understandable interface

- A full and **easy access to your Privacy Policy, Terms of Use and Personal Data Treatment information** should be provided to all users, especially vulnerable-to-exclusion users, mitigating readability issues through easy-to-read texts, visual explanations and simplified navigation across contents.
- The possibility of **editing personal data** should always be available for users, posing

<sup>26</sup> Local communities include not only NGOs or volunteers, but also customers’ associations or organisations dedicated to digital inclusion in broad terms.





no time-limits and no risk of data loss during compilation. Also, a higher control and support should be offered, for example offering direct link to organisations that users can call anonymously to receive help (trusted referees).

- Provide **Privacy Policy and Terms of Use in multimedia formats** (short videos or animations, sign-language or audio-recordings) summarising the main points. Split such contents in smaller packages, in order to be able to easily replace with updated versions.
- Offer **online and offline tutorials** as first-use guidance in different formats, including the option to skip it if users prefer to find out themselves.
- Digital applications need to be modified or enhanced often and their longevity is limited. Consider **splitting the tutorial in smaller parts**, with a clear focus on the main features, to increase accessibility and longevity of your application with a limited investment.

**Table 22 - Recommendations for inclusive user interfaces from the INDIMO project**

### 8.1.2. Developing for the visually impaired and blind people – focus on the Antwerp case

This set of recommendations is more specifically addressed to digital applications offering services to those who live with sight impairments, from the least to the most serious ones. These recommendations were derived mainly from the insights gained during the UIL exercise session with the INDIMO CoP of the Antwerp pilot site (Pilot 2) (Table 23).

#### Recommendations for inclusive user interfaces from the INDIMO project

##### Support simultaneously autonomy and mutual learning

Developers should consider the need for autonomy of all people using their applications and simultaneously support the users’ attitude to peer-to-peer learning (asking other users, friends or even unknown people support). Applications dedicated to the visually impaired should therefore be comprehensible enough to all people who do not experience the same barriers, in order to ensure that support can be offered by friends, family or caregivers in case of need. Asking for assistance in using a new software or application is a common habit to all users during first exploration of a new app. To go the extra mile, developers should ensure that official contact-points on multiple channels are available at all times, prepared to offer proper and prompt assistance if the application is not working as expected.

##### Prepare for the unforeseen

Assume users will rarely use the application in the ideal situation, on the contrary imagine all the potential deviations since they will show-up sooner or later. As an example, a non-exhaustive list of potential variations in the context of use emerged from the UIL exercise in the Antwerp pilot, related with street crossing is provided in Table 24.



### Test your auditory and haptic icons

As for visual icons, also auditory and haptic icons should be tested with the people who will most benefit from such integration: the blind people and the visually impaired. To go the extra mile, actual blindfold challenges could be an activity offering important insights to service providers and developers and it does not require much effort or cost.

#### *Useful links*

- <https://www.orcam.com/en/blog/being-blind-for-a-day-dialogue-in-the-dark/>
- <https://www.youtube.com/watch?v=PUUpMoRoSal>

### Design, test and implement auditory labels

Implement auditory labels, including the possibility to turn them on and off. Messages presented using a voiceover seem to be assimilated with less effort than the same messages presented through visual media and all users could benefit from their advantages.

#### *Useful links*

- Sticht, T. G. (1969). Learning by listening in relation to aptitude, reading, and controlled speech (Tech. Rep. No. 69-23). Alexandria, VA: Human Resources Research Organization
- <https://hearinghealthmatters.org/waynesworld/2014/auditory-icons-earcons-speech/>

### Be careful with multimodal interaction

In user interfaces multimodal interaction is defined as the option for the users of a software or application to receive the same message on different sensory channels, thus ensuring redundancy. An effective multimodal interaction requires that information presented to the different sensory channels is coordinated and made congruent informational as well as spatially and temporally (Bussemakers, De Haan, & Lemmens, 1999) (Brewster, 2002).

There are specific guidelines to develop auditory and haptic icons and ensure they are correctly designed and safely interacting with the other parts of the user interface. In our Antwerp case study, a blind or low vision person should already pay attention to complex information on multiple sensory channels: auditory, tactile and haptic (with their feet, sticks and hands), olfactive (some may recognize the smell of different vehicles and also gain information about objects' distance).

To successfully integrate in your digital application environmental cues and the guidance about the current status (e.g. of stop lights), multimodal interaction should not be too invasive or cause information overload that may cause anxiety and pose risks.

#### *Useful links*

- Human Factors (HF); Guidelines on the multimodality of icons, symbols and pictograms, ETSI IPR - (ETSI Technical Committee Human Factors, 2002)



- Barbara Leporini & Fabio Paternò (2008) Applying Web Usability Criteria for Vision-Impaired Users: Does It Really Improve Task Performance? - (Leporini & Paternò, 2008)
- Dingler, T., Lindsay, J., Walker, B.N. Learnability of sound cues for environmental features: auditory icons, earcons, spearcons, and speech - (Dingler, Lindsay, & Walker, 2008)
- <https://hearinghealthmatters.org/waynesworld/2014/auditory-icons-earcons-speech/>

**Table 23 - Recommendations for inclusive user interfaces from the INDIMO project – focus on the Antwerp case**

The Table 24 reports an example of context-of-use brought by users involved in the UIL exercise in Antwerp, who described to what extent their experience with street-crossing can be influenced by the built environment and how a more inclusive approach to the development of services and products should take their experience and needs into higher consideration.

How we imagine ideal pedestrian crossings	How pedestrian crossings really are
Symmetric/Orthogonal	Asymmetric/Irregular
Straight	Bending/Curved
Flat and safe	Cracked and corrugated
Visible white stripes	Depleted white stripes
Only one kind of vehicle	Several vehicles (cars, trucks, trams, buses, bikes, motorcycles, scooters...drones)

**Table 24 - Imagination versus reality of a pedestrian crossing**

### 8.1.3. Choosing the appropriate set of icons

In our UIL exercise sessions, the mutual exchange across software developers and users resulted in raised awareness about the ambiguity of icons and of related interactions, both as standalone elements and in the overall interface context.

All participants realised that even the most used and common icons can be very ambiguous when the digital app interface does not support comprehension, for example when textual labels and or multi-channel cues are not available (text+icon; haptic+auditory).

The following list included in Table 25 reports the main recommendations for the design, selection and integration of pictographic icons for mobile applications, especially those related with transport and delivery services.

#### Recommendations for choosing the appropriate set of icons

##### Evaluate consistency of icons with standards and competitors

Find the right balance between using recognizable icons and ensuring comprehensibility, doing some research in advance about icons used in other applications offering similar services and referring to existing standards.



**Ensure internal consistency of icons**

As for all other digital contents of any user interface, internal consistency in the use of icons is important to support comprehension and avoid users get easily confused while trying to interpret the reason why a certain icon was used with different meanings in the same app. Every function, object, action or interaction, if provided with an icon, should be represented univocally.

**Label icons**

Yes, icons should come with a text label, always. Our research and literature confirm that comprehension rates of icons increased consistently if combined with labels. If you think they are too invasive, an option could be offering users’ the possibility to activate or deactivate them.

**Get familiar with naturalistic observation**

Watching a real *first-time user* interact with your interface, be it a digital or paper prototype, will help you determine whether the set of icons you chose is good enough and appropriate for the scope.

**Test, test, test**

Test the icons both for recognisability and memorability. Ask a repeat set of users if they can remember the icon’s meaning after being told what it represented a couple weeks earlier. If possible, differentiate methods for testing your icons to ensure you have a variety of results to guide you.

**Consider flat design of icons**

The most recognizable icons, wrongly considered “universal icons”, do not require a redundant design since they are those most easily understood (section 3.2.1). Therefore, we suggest to keep those icons as minimalistic as possible, but still giving enough details to dissolve doubts. Keep in mind that the level of ambiguity may increase over time (e.g. the famous “floppy disk” example) or be misunderstood in diverse socio-cultural context (e.g. dress-codes of human pictograms).

**Use skeuomorphism only if essential**

Skeuomorphs are symbols or other objects on a computer screen that look, mimic or sound like a physical object in order to suggest their purpose. As an example, a three-dimensional design for the representation of least familiar actions or objects may increase comprehension since it increases its affordance, yet it becomes a tricky issue when seen from an icon usability point of view: icon details may be too small or hardly perceivable from a certain angle or distance, or also generate higher confusion in the user and the expected outcome resulting from interaction. Use it only when essential and include labels, descriptions or other confirmation cues.

**Limit the use of animated icons**

Icons in motion graphics may be helpful explaining a detailed sequence of actions, thus increasing comprehension rates to a certain degree. Simultaneously, it can generate confusion or information overload, or even pose risks to people with specific cognitive impairments (e.g. animated GIFs shall never go faster than 3 flashes per second). Test alternative options in advance and in any case offer the possibility of stopping animations or disabling the triggers activating them.

*Useful Links*

- Annex 6 - Preview of an icon providing an icon card example and analysis template
- <https://www.nngroup.com/reports/designing-for-young-adults/>
- <https://www.interaction-design.org/literature/article/flat-design-an-introduction>
- <https://99percentinvisible.org/article/biohazard-symbol-designed-to-be-memorable-but-meaningless/>

Table 25 - Recommendations for choosing the appropriate set of icons

## 8.2. Inclusive design recommendations

### 8.2.1. Inclusive user-testing recruitment

Thanks to the experience gained during the fieldwork research in INDIMO, especially with the recruitment task required to establish COP and CCC communities, recommendations about user –testing were collected in the following Table 26. Such recommendations are built on the literature research that our team sought and applied to recruit vulnerable users and to build more inclusive sessions. Such recommendations are relevant for all professionals testing the accessibility of both prototypes and fully-developed applications.

**Recommendations for inclusive user-testing recruitment**

**Ensure continuous and iterative engagement**

Invest a part of your time and money from the early phases to build a network of people who will participate in design iteration through co-creation workshops and interviews. The INDIMO Co-creation Community and the INDIMO Communities of Practice are intended to ensure cooperation across developers and design experts and all the potential customers left out by traditional user-testing, namely the people who experience barriers in using digital mobility applications. Due to these barriers, they are hardly reached by traditional engagement campaigns so a targeted strategy should be put in place. If you typically use a recruiting firm to get usability testing participants, ask if they have any experience with recruiting people with disabilities. Also, reach out to local disability advocacy groups as they may have a pool of willing participants that want to help out and get their voices heard.

*Useful Links*



- [INDIMO Communities of Practice](#) and [Co-Creation Community](#)
- [National Council for the Blind in Ireland offers accessibility review services](#)

**Build direct involvement of a diverse pool of target users**

Directly contact and involve organisations and associations run by or dedicated to people with vulnerabilities, build trust offering rewards and/or refunds to people willing to participate and ask them how to better organise test-sessions to meet their specific needs. As a long-term strategy for your company or design firm, consider contracting a diverse group of people that can be part of your design team, increasing access to employment and your own reputation.

*Useful Links*

- [234 Tips and Tricks for Recruiting Users as Participants in Usability Studies, Deborah Hinderer Sova, Jakob Nielsen, 2003](#)
- [TRIPS project co-design guidelines](#)

**Take care of meeting sessions set up**

Both online and real life meetings and workshops present barriers to inclusion. Regulations are meant to comply with a minimum standard, but if you really want your participants to enjoy the activities you organise and provide honest feedback, you should share and verify your plans with them and collect their suggestions prior to the meeting. Empathize with other people’s needs and you’ll be rewarded by the experience.

*Useful Links*

- [Venue checklist for real-life meetings, Irish National Disability Authority, 2005](#)
- [Accessible online meeting guidelines, Irish National Disability Authority, 2005](#)
- [Live captions in more languages](#)

**Prepare briefing and debriefing templates**

Define a clear and simple process for you and your collaborators to follow, using existing templates or building your customised set. Instruct your team members to follow the same guidelines and track results in the more efficient and systematic way as possible.

*Useful Links*

- [Usability tests templates - Digital.gov team in the U.S. General Services Administration \(GSA\) Technology Transformation Service](#)
- [Norman Nielsen’s group UX research methods](#)

**Go the extra mile and give a chance to innovators**

The internet is an extremely abundant Pandora’s pot, where you can meet all kinds of people with impairments who are also technology geeks. There are communities keen to contribute to

research and development of new solutions in all fields. Invest time to combine desk research out of academic papers and regulations, with the informal knowledge available across the several networks of gamers, bloggers and accessible internet trend-setters.

*Useful Links*

- [Game Accessibility Guidelines and checklists](#)
- [Deaf gamers’ communities on twitch](#)
- [Microsoft games accessibility guidelines](#)

**Table 26 - Recommendations for inclusive user-testing recruitment**

### 8.2.2. Plan the development of inclusive mobile interfaces

Mobility applications are used for one of the most important activities we run daily: moving ourselves, help other people move or transport goods. When developing accessible interfaces, you will have to find the right balance between your creative idea, the accessibility needs of all potential users and the required adherence and consistency with the service/company identity. The W3 initiatives for the Web accessibility are continuously updated and enhanced. Most software developers should get familiar with their provisions (W3.org, 2018). Those we considered most useful in the UIL context are collected in Table 27.

#### Recommendations from WCAG guidelines

##### Comply with at least AA level WCAG guidelines

In the best-case scenario, you will develop the mobile service applications involving end users since early phases and you will also have the freedom to define the visual identity yourself. The W3 guidelines can be considered the main reference for developers who want to receive clear guidance and technical details about coding a digital content in compliance with accessibility regulations. Reaching at least the AA level is mandatory for all web-pages since 2020 and it mainly implies a responsible and structured coding which ensures basic accessibility and enables people with low to heavy impairments to interact and operate with web-based contents. This means that web-pages will be coded in a way that is readable by assistive technologies whose role is that of “translating” the contents and offering interaction options to specific users.

*Useful links*

- [WCAG 2.1 Accessibility Guidelines](#)
- [W3C initiative Developers area](#)

##### Get familiar with the integration of user-agents and assistive technologies with mobile devices and applications

There is an important distinction between mainstream user agents and assistive technologies. User agents provide some features to assist individuals, including people with and without disabilities. Assistive devices target narrowly defined populations of users with specific

disabilities. Ensure that your application allows integration with the highest number of the available assistive technologies:

- Screen magnifiers
- Screen readers (e.g. TalkBack, VoiceOver)
- Text-to-speech software (TTS)
- Speech recognition software
- Alternative keyboards
- Alternative pointing devices
- Gaze-control commands
- Voice commands
- Custom controllers

To ensure contents are accessible with assistive devices, the WAI-ARIA working group which is part of the W3C Consortium, created the Accessible Rich Internet Applications Suite. The ARIA suite defines a way to make Web content and Web applications more accessible to people with disabilities. It especially helps with dynamic content and advanced user interface controls developed with HTML, JavaScript, and related technologies. Without WAI-ARIA certain functionality used in websites are not available to users with impairments, especially people who rely on screen readers and people who cannot use a mouse.

#### *Useful links*

- [https://www.etsi.org/deliver/etsi\\_EN/301500\\_301599/301549/02.01.02\\_60/en\\_301549v020102p.pdf](https://www.etsi.org/deliver/etsi_EN/301500_301599/301549/02.01.02_60/en_301549v020102p.pdf) - pag.70
- <https://developer.mozilla.org/en-US/docs/Learn/Accessibility/Mobile>
- <https://www.nngroup.com/articles/mobile-ux/?lm=mobile-usability&pt=book>
- <https://www.w3.org/WAI/standards-guidelines/aria/>
- <https://www.understood.org/en/school-learning/assistive-technology/assistive-technologies-basics/assistive-technology-thats-built-into-mobile-devices>

#### **Stay updated with the best practices from W3G Mobile Web Initiative**

This recent technical report is continuously updated and it specifies best practices and recommendations for delivering accessible content to mobile devices. The principal objective is to improve the user experience of the Web when accessed from such devices. These recommendations are in part derived from the Web Content Accessibility Guidelines [WCAG]. As noted above, the Mobile Web Best Practices scope is limited to matters that have a specific mobile relevance. Recommendations are structured in a similar fashion as WCAG Guidelines and are intended to be more illustrative than exhaustive.

#### *Useful links*

- W3C Best practices for mobile accessibility - <https://www.w3.org/TR/mobile-bp/>
- Web Accessibility Evaluation Tool - <https://wave.webaim.org/>
- Testing Web content for accessibility: <https://webaim.org/resources/evalquickref/>

<b>Follow the usability ABC - Always Be Checking</b>
<p>Test your design, keep it simple and iterate. Keep in mind that mobile is less forgiving than desktop, thus provide fully responsive design which is appropriate to small screens. Applications are used while doing other things, so be sure every process can be saved if an interruption occurs, and completed afterwards. Leave all non-essential information in secondary screens and structure navigation based on usage-driven data and observations. Sort contents based on priority of use, not alphabetical. There are plenty of usability templates and tools online, both free and with subscription fees.</p>
<p><i>Useful links</i></p> <ul style="list-style-type: none"> <li>▪ <a href="https://www.nngroup.com/reports/mobile-website-and-application-usability/">https://www.nngroup.com/reports/mobile-website-and-application-usability/</a></li> <li>▪ <a href="https://userbrain.net/blog/free-usability-testing-tools">https://userbrain.net/blog/free-usability-testing-tools</a></li> <li>▪ <a href="https://section508coordinators.github.io/TrustedTester/">https://section508coordinators.github.io/TrustedTester/</a></li> </ul>
<b>Test your icon set usability</b>
<p>Do desktop research first and familiarize yourself with icons used by competitors and with icons commonly used on the platforms that you target, as those will be most recognizable to your users. Use the UIL exercise template and adapt it to your needs when organising a test-session with the vulnerable-to-exclusion group of people ( Annex 2 – UIL exercise: instructions for moderators and example).</p>
<p><i>Useful links</i></p> <ul style="list-style-type: none"> <li>▪ <a href="https://www.nngroup.com/articles/icon-usability/">https://www.nngroup.com/articles/icon-usability/</a></li> <li>▪ <a href="https://www.toptal.com/designers/ui/icon-usability-and-design">https://www.toptal.com/designers/ui/icon-usability-and-design</a></li> <li>▪ <a href="https://ia.net/topics/on-icons">https://ia.net/topics/on-icons</a></li> </ul>

Table 27 - Recommendations from WCAG guidelines

### 8.2.3. Design inclusive mobile interfaces

Designers know that before even drafting the raw prototype of a new application, it is recommended to define its preliminary structure and the quantity of information (amount of text, amount of elements, amount of processes/services offered). This preliminary structure is already sufficient to draft a very basic content tree-graph and a development timeline. In Table 28 main design recommendations derived from the literature, once again mainly from WCAG guidelines (W3.org, 2018), selecting those we considered most useful in the UIL context and that are related to interfaces supporting intuitive comprehension.

<b>User interface design recommendations</b>
<b>Involve users in the prototyping phase</b>
<p>The preliminary project of a new application can be presented as a minimal prototype to small groups of people. Through journey maps and personas, important insights can already be</p>



collected and there is a large amount of methods to engage people at risk of exclusion, from the least to the most structured, of which usability testing is only one branch.

### Define clean style sheets

When your prototype is acceptable, the layout and style sheets can be defined. Often mobile applications are developed by small groups of people, sometimes by a single person. It is important that all people involved in this process are fully aware of the W3G provisions. Digital mobility applications, similarly to webpages, are equipped with information about internal style rules. Such rules are generally (but not exclusively) coded into CSS (*Cascading Style Sheets*), a language for describing the rendering of HTML and XML documents on screen, on paper, in speech, etc. It defines colour-related properties and values of texts, backgrounds, borders, and all other visible elements of each screen template or of a group of similar screens. When developing a new application compiling a CSS stylesheet will need an attentive care. It is the file where most of the information about interface elements' is stored. It is fundamental that a mobile application CSS sheet is compliant with the W3G provisions about contrast, colour and size of textual and visual contents (W3.org, 2016).

### Assess diverse contexts of use

Due to mobile devices' reduced pocket size, there is an indefinite number and diversity of contexts of use if compared to digital contents visited through desktop screens. Contextual inquiries can help collect information on how applications are used by vulnerable-to-exclusion people, observing them using their own devices in a natural setting and allowing to spot weak points of the application. We suggest that a working demo is tested with the test-user's personal device, in her/his living context and in multiple environments in which she/he would use the application. The results will spot weak points of the application which can be more easily revised in the early stages of development.

### Verify colour palettes

Colour is a very important feature of icons and user interfaces. It is used to convey important information, about the availability and/or status of an action or object. But not all people perceive the colours in the same way, thus the digital applications' colour palette should support all forms of colour perception and never use colour only to convey information about an action or content. Colour can be also used to identify intuitively interface components with similar functionality and to make content hierarchy comprehensible, but using too many colours should be avoided: complex interfaces should make a careful use of colours and follow the principle of minimalistic design reducing the number of colours to the minimum. When choosing the colour palette or icons colour, avoid using only logotype colours. Colours have strong cultural

implications and taking them into consideration, both as potential strengths and weaknesses, may result in a better market positioning of the service<sup>27</sup>.

### **Be aware of colour relationship with cultural backgrounds**

Differently from drawings and digital art, icons in digital mobility applications must be easily and rapidly identified in their meaning. Instead, oftentimes icons colours adhere to those used by the company visual identity. If on one hand this may apparently improve the unity and thus reduce the complexity of information, there is a risk causing miscomprehension and ambiguity. Both at a global level and locally, there are specific colours linked to specific concepts or meanings. Ask local people to provide feedback about your icons' colours and overall application colour palettes to prevent related errors.

### **Never overlook contrast**

Ensure contrast ratio of text blocks is at least 4:5:1, except for very large texts, purely decorative images or backgrounds or parts of brand names or logotypes. Do not design contents in a way that is known to cause seizures or physical reactions, especially to people with cognitive impairments or specific sensitivities (synaesthesia, epilepsy, etc.)

### **Keep consistency in fonts and spacing**

Font design is nowadays a fully independent branch of what can be called “digital art”. The temptation of using peculiar styles and playful combinations can be considered a positive attitude when designing contents that need to be highly recognizable. But essential information should always be easily read and identified. All users would suffer while reading long text blocks using fonts with low reading-speed (Rubin, Feely, Perera, Ekstrom, & Williamson, 2006) and a text spacing that is too different from the standard single-spacing (Legge, 2016). People suffering of temporary or permanent visual impairments would abandon it immediately. Apply to all essential information a font style that is approved and validated for visual and cognitive impairments and leave the artistic touch for logotypes, decorative elements or fillers.

### **Provide customisation, personalisation and adaptation options**

Offering the possibility to partially customise the theme (colour, contrast, fonts and content behaviour), provided that at least one of them is fully-accessible, is one of the possible solutions to satisfy both the need for a nice-looking applications and to provide clearer and simpler versions to users who prefer to use the service in a more efficient and safe fashion, according to their specific needs (Saffer, 2007) .

Full personalisation is also an option, but vulnerable-to-exclusion people would probably find it difficult to configure their version without support. If personalisation options are offered, a guided procedure and support for first configuration must also be provided. Inclusive adaptation

<sup>27</sup> <https://informationisbeautiful.net/visualizations/colours-in-cultures/> - last visited on 28/06/2021

is a tricky topic since it requires in-depth knowledge about all possible contexts of use and all the specific needs of vulnerable-to-exclusion people. Moreover, it's important to allow users to deactivate adaptive contents in case of need (e.g. high battery consumption). Customisation, Personalisation and Adaptation may sound as features that only digital experts are able to configure. In INDIMO, thanks to our COPs and Co-creation communities, we are sure that it's a matter of human-centred design, training and experience. When people get familiar with an application (from basic to advanced users), they appreciate the possibility of configuring it according to their needs. Offering such option and the possibility of saving preferences when switching to new devices or reinstalling the application would make the personalisation process worth the time spent in it. Some people would also appreciate the possibility of sharing their preferences with peers or friends with similar needs. Offering users this option could be a good strategy to foster peer-to-peer promotion of the app.

*Useful links:*

- <https://www.w3.org/TR/WCAG/#contrast-minimum>
- <https://webaim.org/resources/contrastchecker/>
- <https://webaim.org/resources/linkcontrastchecker/>
- [https://www.etsi.org/deliver/etsi\\_EN/301500\\_301599/301549/02.01.02\\_60/en\\_301549v020102p.pdf](https://www.etsi.org/deliver/etsi_EN/301500_301599/301549/02.01.02_60/en_301549v020102p.pdf) pages 57 – 70
- <https://www.w3.org/TR/WCAG21/#use-of-color>
- <https://www.w3.org/TR/css-color-3/#SRGB>
- <https://accessible-colors.com/>
- <https://informationisbeautiful.net/visualizations/colours-in-cultures/>
- <https://www.w3.org/WAI/standards-guidelines/shared-experiences/#color>
- <https://contrastchecker.online/>
- <https://www.nngroup.com/articles/contextual-inquiry/>

**Table 28 - User interface design recommendations**

## 8.2.4. Recommendations from other communities

### 8.2.4.1. The UX designers' community

This set of recommendations draws from the experience of UX designers' communities whose input, found during desk research, was deemed relevant by our team. In Table 29 the one and only recommendation is to check-out how they collaborate as a learning community. The UX designers' community can be considered as an informal, loose and open community of web-content designers who share experiences and ideas online, in order to reach higher quality results.

### Recommendations from online UX designers' communities

#### Ensure continuous and iterative engagement

UX designers are everywhere online and as all other IT experts, they often use open platforms to discuss and find solutions on a collaborative and voluntary basis. The open source internet



browser Mozilla created a checklist for mobile accessibility requirements, which is continuously updated and evolves as new patterns arise.

*Useful links*

- <https://developer.mozilla.org/en-US/docs/Learn/Accessibility/Mobile>
- <https://www.w3.org/WAI/standards-guidelines/aria/>
- <https://www.w3.org/TR/wai-aria-1.1/>

**Table 29 - Recommendations from online UX designers' communities**

**8.2.4.2. The gamers' community**

Video-game players and online gaming communities can be considered among those who are pushing accessibility of digital tools and software beyond regulations and basic accessibility. This communities collaborate with games developers and creatively try to find new and disrupting solutions. In Table 30 we collected a few top-tips found on dedicated online pages during desk research, provided by and for each different group of people with impairment. The full list of gaming accessibility guidelines is provided in the useful links at the bottom of the table.

**Recommendations from gamers' communities**

**Use a design-for-all approach**

- All users will appreciate to customise interface settings and save them. Such personalised options could control several applications so that they have the possibility to activate it at their convenience.
- Users with any kind and level of impairment may need slower or more precise options for giving input to the application (e.g. zooming the camera, clicking on buttons).
- Users with any kind and level of physical disabilities may need to rearrange, hide, magnify or rearrange spacing and positioning of some components of the user interface to ensure they can operate with them more easily.
- After a certain period, depending on different factors, users may have issues recalling how to use the application and may need to review the initial training tips, their control options and their action history.
- Users may need assistance to progress through the app's environment. Offer tips and suggestions depending on time or number of input errors, a FAQ section link provided when a known error is triggered and human-assistance when the user find barriers in finalising a process for a long time or for several times.
- Users may need training sessions and to practice before using the app with full competence.
- Users may need to reduce the speed of the information they are receiving (e.g. scrolling text, audio or video contents, pop-up contents).
- Users may prefer to use particular communication options when contacting support

(e.g. chat only, voice only).
<b>Care for the visually impairments</b>
<ul style="list-style-type: none"> <li>• Users with colour vision deficiencies may need symbols alongside colours to distinguish between different information. Users with low vision may need a higher contrast to distinguish information in the foreground from the background.</li> </ul>
<b>Care for the auditory impairments</b>
<ul style="list-style-type: none"> <li>• Users who use captions on screen may need to personalise contrast background to distinguish the text provided.</li> </ul>
<b>Care for the Cognitive impairments</b>
<ul style="list-style-type: none"> <li>• Users with cognitive disabilities may need to reduce the number of controls to create a more memorable interface.</li> <li>• Users with slower-than-average reading or input ability may prefer to map several actions to a single action or automate a process: offer users the possibility to do so with the option of saving or automating a “recurrent action” and easily find it when they need it.</li> <li>• Users with learning disabilities such as dyslexia may prefer a different font for texts. Offer the opportunity to switch between different theme-fonts or choose a font certified for full accessibility, for example those classified as Sans Serif (e.g. Arial, 14pt)</li> </ul>
<p><i>Useful links</i></p> <ul style="list-style-type: none"> <li>▪ <a href="http://gameaccessibilityguidelines.com/full-list/">http://gameaccessibilityguidelines.com/full-list/</a></li> <li>▪ <a href="https://accessible.games/accessible-player-experiences/">https://accessible.games/accessible-player-experiences/</a></li> <li>▪ <a href="https://caniplaythat.com/reviewing-guide/">https://caniplaythat.com/reviewing-guide/</a></li> <li>▪ <a href="https://www.oneoddgamergirl.net">https://www.oneoddgamergirl.net</a></li> <li>▪ <a href="https://www.twitch.tv/deafgamerstv">https://www.twitch.tv/deafgamerstv</a></li> </ul>

Table 30 - Recommendations from gamers' communities

### 8.3. General recommendations

While in T2.2 we investigated interface icons, which is one key element of digital mobility systems, through the survey, user testing and Communities of Practice we also gained additional insights that concern the co-design of digital mobility services, the regulatory framework and the needs of the broader stakeholder environment.

These general findings resonate with the findings of Task 1.4 of the INDIMO project, where key stakeholders (policy makers, operators and developers) were interviewed about the barriers and

drivers of accessibility and inclusion in digital mobility services. The recommendations below will be used to build the INDIMO Policy Evaluation tool (Task 2.5).

### 8.3.1. Digital mobility and goods delivery service providers

- Service providers and business-developers should think in a long-term perspective and invest a proper amount of time, money and effort to test their ideas and prototypes, taking advantage of the experience and knowledge of the real experts, namely those vulnerable-to-exclusion users who can provide real feedback about accessibility and usability of their products. This confirms our findings presented in (D1.4) where the interviewed stakeholders (developers and policy makers) confirmed the importance of involving potential future users in the development of applications and services as a key requirement.

### 8.3.2. Policy Makers in the field of digital accessibility

- Policy makers shall consider digital mobility and goods delivery applications the same way they consider public transport services and the purchase of basic goods: essential. The cost-benefit analysis of private companies will always self-assess that investing in accessibility and inclusivity is a “disproportionate burden”, thus marginalising persons with any degree of limitation, which represents as much as 24% of the total population (INCLUSION H2020 project, 2017). Comprehensive regulatory frameworks - as suggested in (D1.4) may set minimum requirements for accessibility and inclusion and also reward operators that go the extra mile to improve their services for vulnerable people.

### 8.3.3. Software developers and designers

- Software developers and designers should gradually explore and learn how to master mobile interfaces accessibility.

### 8.3.4. Institutional decision makers

- INDIMO project supports and integrates the high-level recommendations of the INCLUSION project (section 3.6) with the further ambition of a dedicated and coordinated task force at EU level dedicated to inclusion and accessibility. The task force could be hosted on the already existing ETM Forum<sup>28</sup> or a similar online platform where mobility and goods delivery service providers and local authorities can find both offline and online resources, such as web-based online tools (e.g. the INDIMO Toolkit) which can be used to learn how to develop targeted step-by-step processes and download checklists to solve accessibility issues. The same platform can be the access point to dedicated trainings, to other existing communities of vulnerable-to-exclusion users or their representatives. Thanks to networking features included in the platform all stakeholders can find opportunities for

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<sup>28</sup> European Transport and Mobility Forum – [www.etmforum.eu](http://www.etmforum.eu) – last access on 29<sup>th</sup> of June 2021



cooperation with digital service providers and software developers. The platform shall be open for access to individuals who are available to be contacted (and contracted) for user-testing, other entities or bodies who can offer accessibility and inclusivity consultancy services and public or private institutions working on inclusion from different perspectives.

## 9. Lessons Learnt

This section should include the key lessons learnt in the process, from the collection of data, through research bottlenecks and challenges.

### *Key-lessons*

- Involving vulnerable-to-exclusion users requires a significant amount of time and honest commitment since it is not easy identifying and convincing them or their representatives to participate.
- Recruitment and relationship building from now on could focus more on creating an open and direct relationship with the people involved, both end-users and their representatives) to ensure continuity and trust building.
- It has been a challenge to engage people with the characteristics we wanted to address in online meetings and activities. COVID-19 made it even harder since many people declared connection tiredness. A small positive remark is that, for some people, it was easier participating directly from their houses instead of being required to reach a meeting in person.
- Tools for online events are not yet accessible enough and there are few and poorly designed alternatives to overcome such barriers (live captions, interactive boards, WebEx meeting platforms). In many cases WhatsApp and Zoom resulted as the most feasible options, since they were already used on a daily basis by most users.
- Consortium members, the authors of this document and all involved participants were surprised by the richness of insights gained from the discussion about the app usability and used icons during UIL exercise sessions. We believe the open and non-judgmental setting was an important feature, together with the few preliminary knowledge of participants about the applications which allowed more problems and consequent ideas for improvement emerge.

### *Suggestions for future research*

- Involve directly the disabled gamers' communities since they are overall very proactive towards digital solutions and they can advocate and support INDIMO project's research activities and digital inclusion in general.



## 10. Conclusions

The deliverable **D2.3 Universal Interface language (UIL) – Version 1** provides UX/UI designers, developers and service operators with a set of guidelines and examples to support them in the design of inclusive and accessible interfaces between transport users and digital mobility and delivery systems. These mainly consist of:

- A catalogue of recurring icons in digital mobility and delivery applications (i.e., general ones and mobility-related);
- A set of recommendations for the design of accessible and inclusive interfaces (i.e., general recommendations and recommendations from the INDIMO project) covering different topics.

The icons catalogue, the recommendations and all the other insights included in this document were generated through a detailed literature review, best practices collection and a user-centred design (UCD) methodological approach that applies the Universal Design principles and puts the INDIMO Communities of Practices and Co-Creation Community in the middle of the process.

This first version of the UIL will be tested in the Pilot phase 2 (T3.4) to assess and redesign pilots' digital mobility and delivery services. Useful insights and suggestions for its improvement will come out from the two re-design workshops planned in each pilot site. The second version of this document (i.e. D2.4 Universal Interface Language – Version 2) will be reviewed and ameliorated accordingly. It will be also “reshaped” from the information architecture and graphic design points of view. A new information structure and graphical organization will be provided. The aim is to make the UIL more readable and “navigable” by our target groups (i.e. designers, service operators, developers, ...) that need an operational approach to the information for its easy applicability. For this purpose, a set of icon cards will be included in the version 2. They are developed thinking about an easy-to-use digital or printable document to report results of icon's accessibility and usability evaluations. An example of one icon card and the empty printable card template in their draft version are included in the current document (Annex 6 - Preview of an icon usability and accessibility template).

Moreover, the UIL - version 2 will also include further content as described in the DoA that is missing in the current version of the document. The new part will address the following topics focusing on the needs of vulnerable users:

- «Physical path and constraints supporting effective and safe space navigation in crowded environments»;
- «Multi-channel integrated communication campaigns for transport services targeted to multi-cultural and multi-language passengers».

In this first version of the UIL the above issues are not yet included since they are considered sub-topics that shall be further explored only after the main structure and content of the Universal Interface Language has been established and consolidated with target users' feedback.

## 11. References

### 11.1. All references in the document

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### 8.1.1 Inclusive user interfaces

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- <https://www.youtube.com/watch?v=PUupMoRoSal>

### 8.1.2 Developing for the visually impaired and blind people – focus on the Antwerp case

- <https://hearinghealthmatters.org/waynesworld/2014/auditory-icons-earcons-speech/>

### 8.1.3 Choosing the appropriate set of icons





- <https://www.nngroup.com/reports/designing-for-young-adults/>
- <https://www.interaction-design.org/literature/article/flat-design-an-introduction>
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### 8.2.1 Inclusive user-testing recruitment

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- <https://www.indimoproject.eu/co-creation-community/>
- <https://www.ncbi.ie/supporting-you/technology/accessibility-review-service/>
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- <https://digital.gov/resources/digitalgov-user-experience-resources/digitalgov-user-experience-program-usability-starter-kit/>
- <https://www.nngroup.com/articles/which-ux-research-methods/>
- <http://gameaccessibilityguidelines.com/why-and-how/>
- <https://www.twitch.tv/deafgamerstv>
- <https://docs.microsoft.com/en-us/gaming/accessibility/guidelines>

### 8.2.2 Planning the development of inclusive user interfaces

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- <https://www.w3.org/developers/>
- [https://www.etsi.org/deliver/etsi\\_EN/301500\\_301599/301549/02.01.02\\_60/en\\_301549v020102p.pdf](https://www.etsi.org/deliver/etsi_EN/301500_301599/301549/02.01.02_60/en_301549v020102p.pdf)
- <https://developer.mozilla.org/en-US/docs/Learn/Accessibility/Mobile>
- <https://www.nngroup.com/articles/mobile-ux/?lm=mobile-usability&pt=book>
- <https://www.w3.org/WAI/standards-guidelines/aria/>
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- <https://www.w3.org/TR/mobile-bp/>
- <https://wave.webaim.org/>
- <https://webaim.org/resources/evalquickref/>
- <https://www.nngroup.com/reports/mobile-website-and-application-usability/>
- <https://userbrain.net/blog/free-usability-testing-tools>
- <https://section508coordinators.github.io/TrustedTester/>
- <https://www.nngroup.com/articles/icon-usability/>
- <https://www.toptal.com/designers/ui/icon-usability-and-design>
- <https://ia.net/topics/on-icons>

### 8.2.3 Design inclusive mobile interfaces

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- <https://www.w3.org/TR/WCAG/#contrast-minimum>
- <https://webaim.org/resources/contrastchecker/>
- <https://webaim.org/resources/linkcontrastchecker/>
- [https://www.etsi.org/deliver/etsi\\_EN/301500\\_301599/301549/02.01.02\\_60/en\\_301549v020102p.pdf](https://www.etsi.org/deliver/etsi_EN/301500_301599/301549/02.01.02_60/en_301549v020102p.pdf)
- <https://www.w3.org/TR/WCAG21/#use-of-color>



- <https://www.w3.org/TR/css-color-3/#SRGB>
- <https://accessible-colors.com/>
- <https://informationisbeautiful.net/visualizations/colours-in-cultures/>
- <https://www.w3.org/WAI/standards-guidelines/shared-experiences/#color>
- <https://contrastchecker.online/>
- <https://www.nngroup.com/articles/contextual-inquiry/>

#### *8.2.4 Recommendations from other communities*

- <https://developer.mozilla.org/en-US/docs/Learn/Accessibility/Mobile>
- <https://www.w3.org/WAI/standards-guidelines/aria/>
- <https://www.w3.org/TR/wai-aria-1.1/>
- <http://gameaccessibilityguidelines.com/full-list/>
- <https://accessible.games/accessible-player-experiences/>
- <https://caniplaythat.com/reviewing-guide/>
- <https://www.oneoddgamer.com/>
- <https://www.twitch.tv/deafgamerstv>

# Annex 1– Accessible user-interfaces: best practices at European and international level

## Testing guidelines

During the analysis testing personnel went through a semi-structured checklist to map the existence of inclusive interface and service solutions, where the following aspects were assessed:

- general usability;
  - accessibility of main functions and settings;
  - personalisation options of the graphical user interface (e.g., showing a map on the main screen can be confusing for a visually impaired person using text-to-speech software);
  - clarity of non-textual information (icons, POIs, etc.);
- (public transport) route planning;
  - accessibility settings (e.g., barrier-free routes, indications for visually impaired people);
  - personalisation options of the service (e.g., using only specific types of transport);
  - availability of (real-time) guidance and navigation;
- real-time notifications;
  - information about service availability, service changes;
  - personalization accommodating specific needs;
- voice-based options;
  - searching;
  - navigation;
- user settings;
  - saving/deleting of previous searches, itineraries, points of interest;
  - saving of user-specific needs;
  - balance in personalisation and amount of personal data collected;
- additional features supporting vulnerable-to-exclusion users.

According to these aspects the main findings from each application are described in the following paragraphs.

## Global routing and vehicle/ride sharing applications

Many people for everyday life use global applications during travel instead of city-specific services. The most common such solutions are built-in maps of smartphones and community-driven navigation software. Vehicle and ridesharing applications also examined here, although

with less details as many of these services are not accessible in themselves (e.g., visually or mobility impaired people cannot use shared e-scooters).

### Google Maps

Commonly used application for searching location-based data and navigating by various transport modes (walking, cycling, driving, public transport). It provides a built-in voice-based search in many languages. It also offers offline options (by downloading detailed map parts) and many options for saving favourite places which can be later accessed faster. Navigation is provided with visual signs (even VR-like) and with detailed voice-based information (Figure 18). Public transport routes are provided with accessibility information of the PT vehicles (and this information can be also rated during the travel) – also accessible route can be planned. Accessibility information of PT vehicles can depend on available databases so it can vary among different countries and regions.

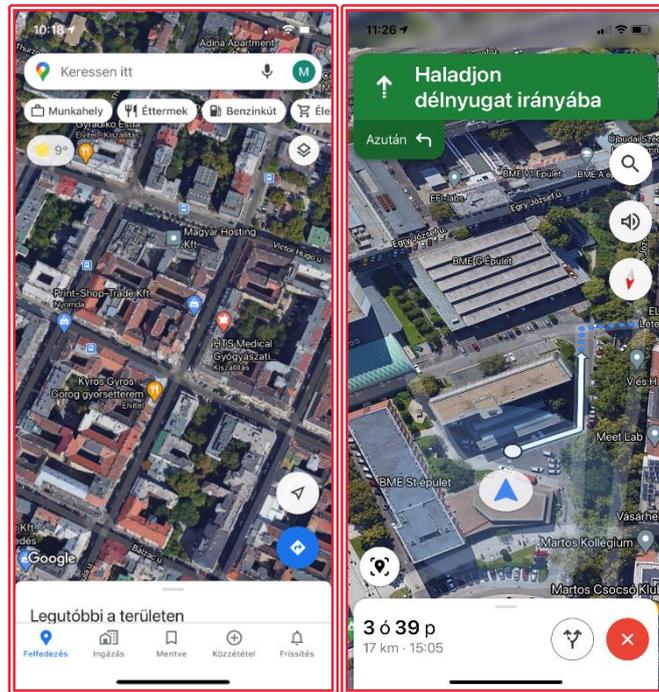


Figure 18 - Screenshots from Google Maps application

### Maps (Apple)

Location based search and navigation application which works well with the built-in voice control of iPhones, although its usability is limited because it manages only a handful of languages and POI database is largely limited outside the United States. Planning routes by different transport modes are available, although no accessibility information (e.g., low-floor vehicles) is provided for public transport.

### Waze

Waze provides navigation specifically for car-drivers, using real-time data from other users' travels. From accessibility standpoint it provides built-in voice search in many languages (uses the same database as Google Maps).

### Uber

Uber is a frequently used ride-hailing application which is currently banned in many countries due to uncertain regulations and debates against taxi service providers. Uber offers specific service for users with special needs, which is called Uber Assist. Drivers with appropriate certificates will drive the ordered car in order to assist the users. Other than that, the application does not provide any accessible options, most interestingly the specific need of a vulnerable user cannot be saved into the user profile.

### Moovit

Moovit application covers public transport and bike (shared bike as well if available) transport for many cities all over the world. Many of these cities do not have any available local applications. It provides a useful notification option when using public transport in addition to the info about the vehicle's accessibility (Figure 19).

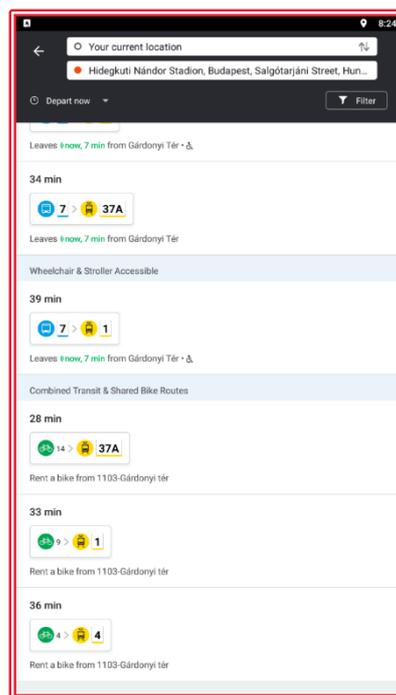


Figure 19 - Screenshot from Moovit application

## Digital delivery applications (including smart boxes)

Many digital delivery applications (Amazon, DHL, Wolt, Bolt, Alza) were tested to find good solutions for people with specific needs, but these services do not really focus on such solutions. Although some good examples were also found, which are listed below.

### DHL application

The application itself does not provide special functions for vulnerable groups but offers a service point finder with several options where an accessibility choice selection could be easily included (Figure 20).

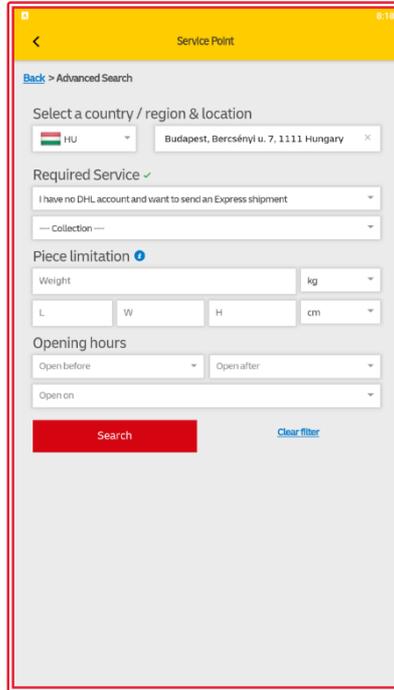


Figure 20 - Screenshot from DHL application

### Alza

Alza provides smart boxes as an option of delivery throughout many countries. Its service-point finder also gives information about the accessibility of these boxes (Figure 21) and also, a photo of the place where the box is. Details of the pick-up boxes are only available in local language, as this info is opened on a separate form.

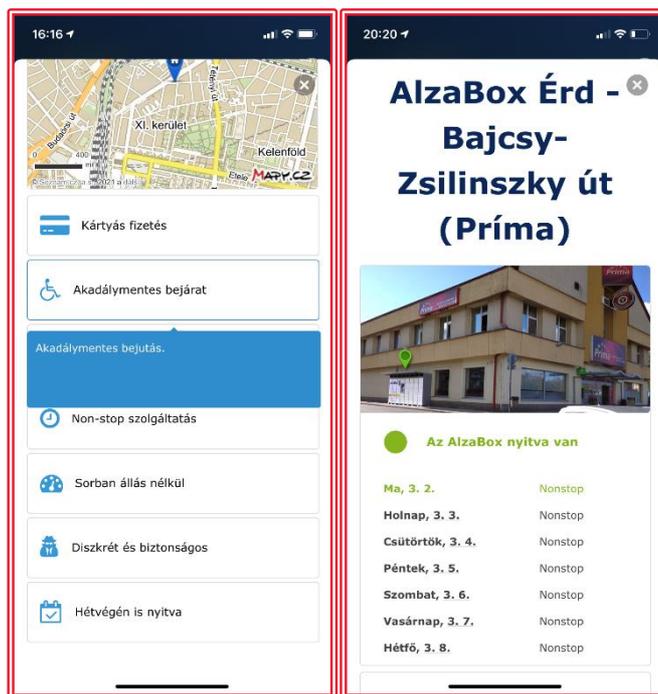


Figure 21 - Screenshots from Alza application

## Public transport applications – Europe Mediterranean Region

The countries included the Europe Mediterranean region can be seen on Figure 22.



Figure 22 - countries of the Europe Mediterranean area

### France

The official application for Lyon’s public transport (TCL app) provides real-time information of accessibility (e.g., lifts and escalators available and unavailable on different stop of a line) on stations and also has notification options (Figure 23).

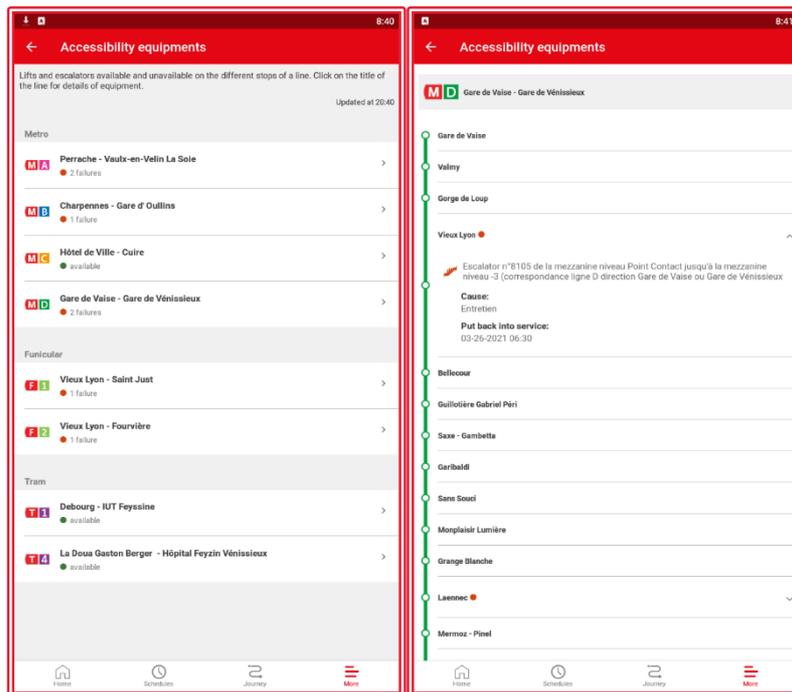


Figure 23 - Screenshots from TCL application

Unfortunately, other public transport applications in France (e.g. Next Stop Paris, Keolis TBM – Bordeaux, RTM – Marseille) are available only in French (except for Paris) and usually do not provide any information about accessibility and give no options for accessible route planning. The only good practice to be highlighted that they all provide notifications about service updates.

### Greece

In Athens, there are two different applications for public transport (OASA Telematics mostly for bus services and Μετρό και Τραμ Αθήνας – Metro kai Tram Athinas for metros and trams). Accessibility options are not provided, the latter is only available in Greek.

### Italy

In Italy the picture of applications varies greatly between cities. In Milan, ATM Milano Official App provides accessibility information and signs on a static map (including stations accessible by using wheelchair) in addition to a three-page description of inclusive use of public transport. A detailed table is also provided about the mobility impaired aiding equipment available on each station. The demand responsible service Radiobus is also integrated which may be useful for vulnerable to exclusion people for reaching public transport from areas not fitted for use with any impairment. It may be also helpful during off-peak and night periods when not all the services are operated with full frequency.

Turin (GTT – TO Move) and Genoa (AMT Genova) applied external solutions into their application: Turin uses the web-based journey planner, Genoa’s app based generally on Google Maps. The accessibility options depend on these services, Turin’s route planner supports accessibility options (although it did not work during testing).

Rome offers a hardly reachable application, Viaggia con ATAC, and this software does not provide any accessibility options at all.

## Public transport applications – Northern European region

The countries included the Northern European region can be seen on Figure 24.

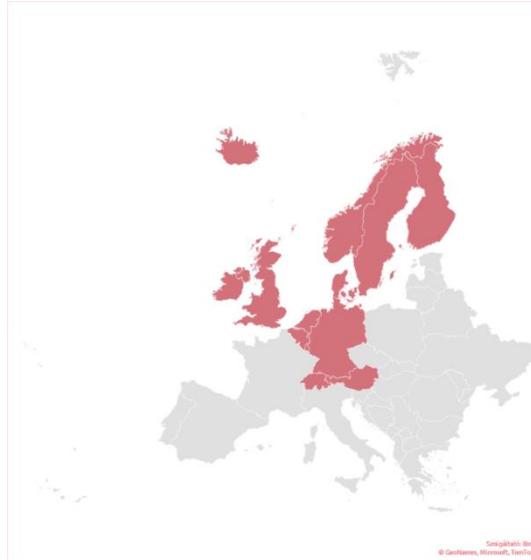


Figure 24 - countries of the Northern European region

### *United Kingdom*

London's all-around public transport application, TfL Go (Figure 25) provides a minimalistic design with two main buttons featured on the opening screen:

- a big icon for step-free mode;
- a big icon for service updates.

Step-free mode changes all settings to barrier-free navigation which also changes the background map, showing in original colour only the accessible stations and routes. Service updates are managed in a special way as lines are showed with their names and colours which may be difficult to identify for passengers who are not familiar with the network.

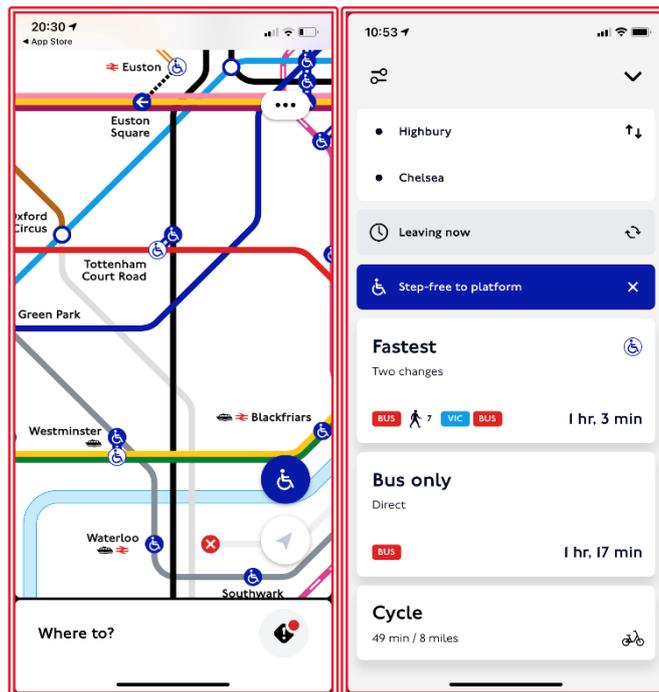


Figure 25 - Screenshots from Tfl Go application

Liverpool offers the Merseytravel application for public transport users, which provides a multimodal route planner with various mobility options, e.g., the passenger would like to use stairs, escalators, elevators (Figure 26).

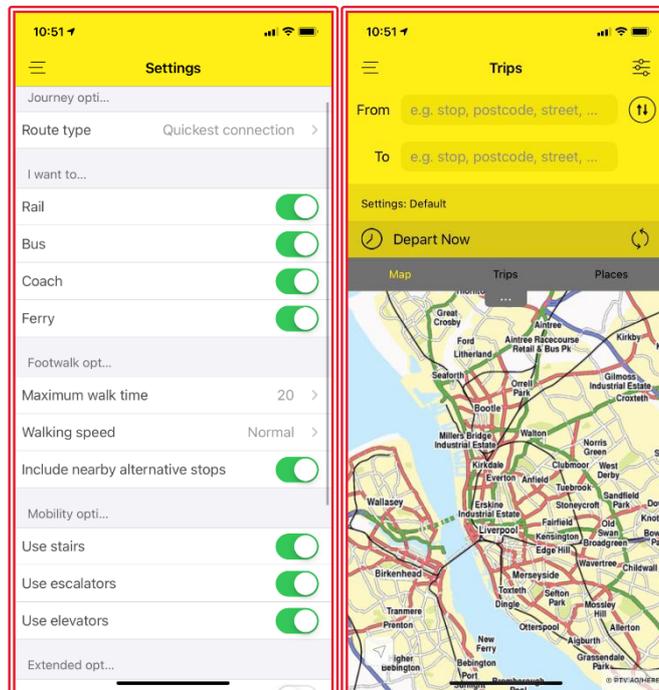


Figure 26 - Screenshots from Merseytravel application

Sweden



Stockholm’s official public transport application is the SL-Journey planner and tickets application (Figure 27). Regarding accessibility, it offers a downloadable accessibility information leaflet, which promises accessibility as a standard. Therefore, it does not offer accessibility options at the journey planner. It features also chat and call options with customer service (and also another contact in case of security issues), but it ms to work only in Swedish. Service updates are also provided only in Swedish. As the name suggests, online ticketing is included in the application.

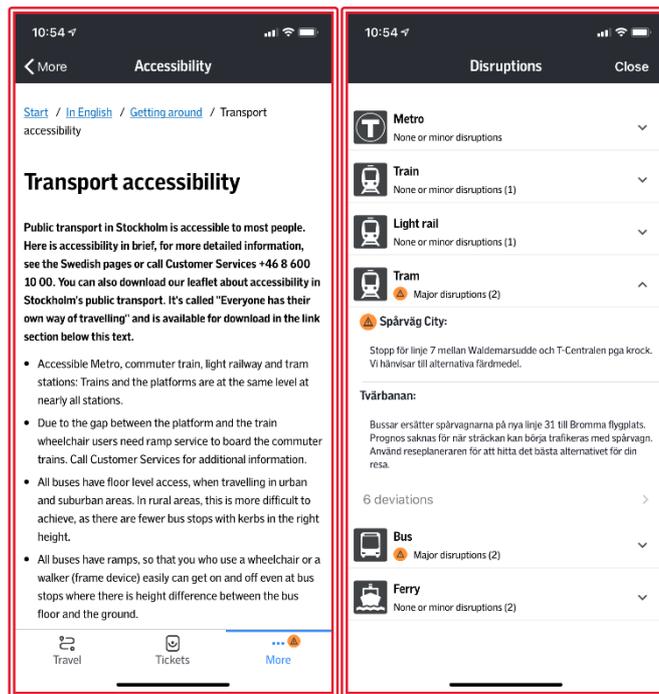


Figure 27 - Screenshots from SL journey planner and tickets application

### Germany

Germany offers many good practices from which two application were tested in details. Hamburg’s HVV application (Figure 28) opens with a quick introduction which goes through the main features of the app and how to use them. The application includes a route planner with accessible connection options (if any impairment is set, the planner offers connection hubs where the transfer is available with the specified impairment) and navigates throughout the journey by alarms at hop on/off and transfer. It also features a widget function for purchasing tickets and showing tickets already purchased, making easy to find tickets when inspecting. Notifications and chosen connections can be monitored with Apple Watch. Some service updates were provided only in German.

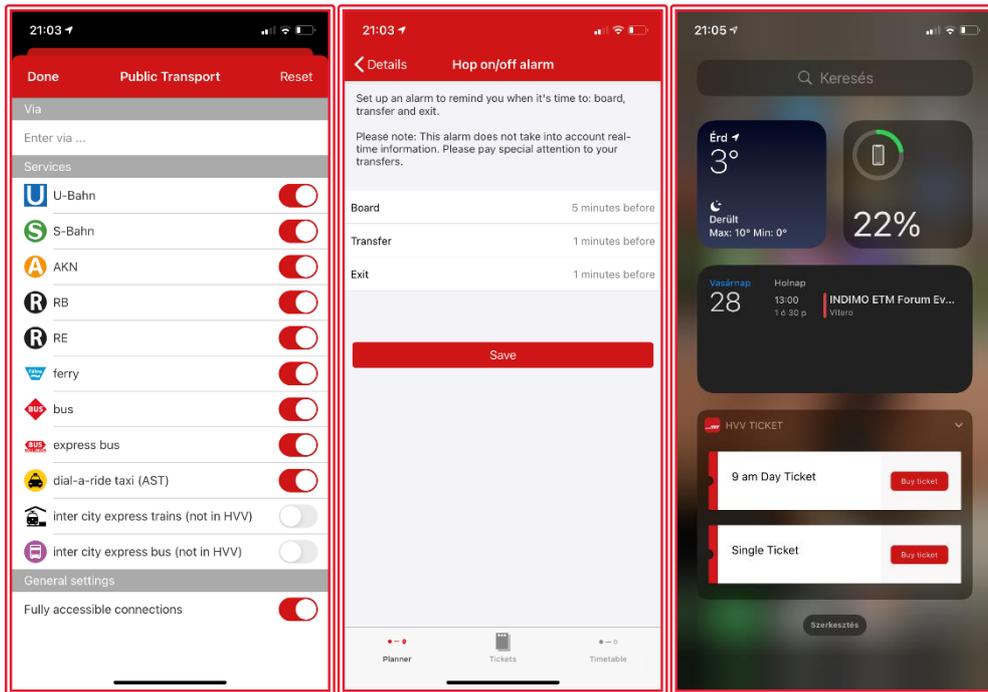


Figure 28 - Screenshots from HVV application

Berlin’s BVG App (Figure 29) uses also a quick introduction opening. However, its main screen is a dashboard, which can be edited by the user selecting several options (i.e. accessibility options, walking speed, direct connections only, etc.). Concerning the accessibility options, when planning a route, the application gives a limited and a barrier-free option as well for passengers and offers a live navigation throughout the journey. It also contains ticket purchasing options for planned routes or for longer timeframes.

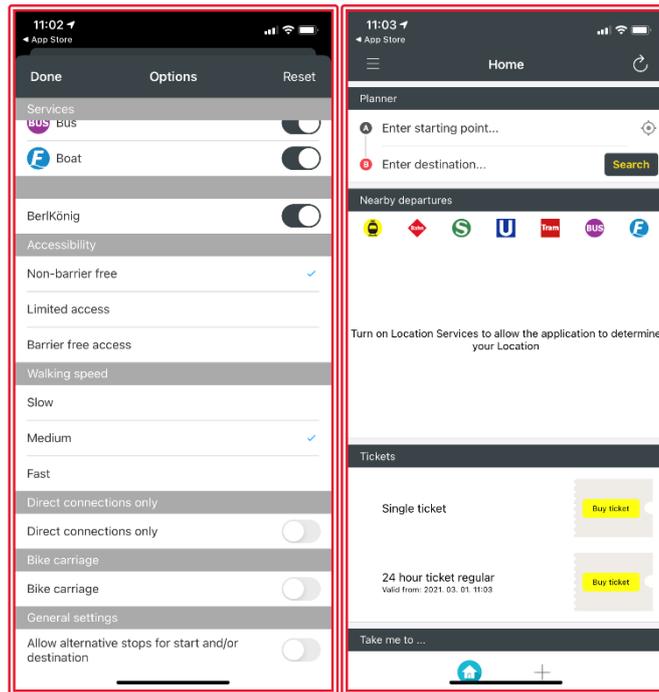


Figure 29 - Screenshots from BVG application

### Switzerland

When using public transport in Zurich (and actually in whole Switzerland) passengers can use ZVV application (Figure 30). As the German apps, it opens with a quick introduction and has an editable opening screen, which can be set to the user's preference (e.g. fully accessible connections). Enables route planning and ticket purchasing for all public transport options throughout Switzerland. It also offers many options for barrier-free travel. Real-time notifications about planned routes and service updates can be edited by lines. In settings, it allows further management of permissions (it only asks for unnecessary permissions at first opening).

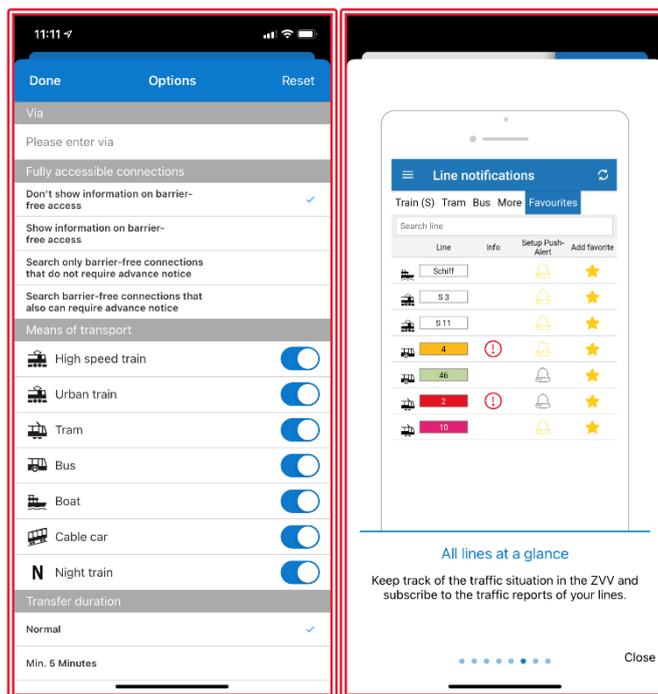


Figure 30 - Screenshots from ZVV application

### Public transport applications – Eastern European region

The countries included in the Eastern Europe region can be seen on Figure 31. Despite not including them on the map, the analysis of the area also included cities from Russia, Turkey, and Cyprus.

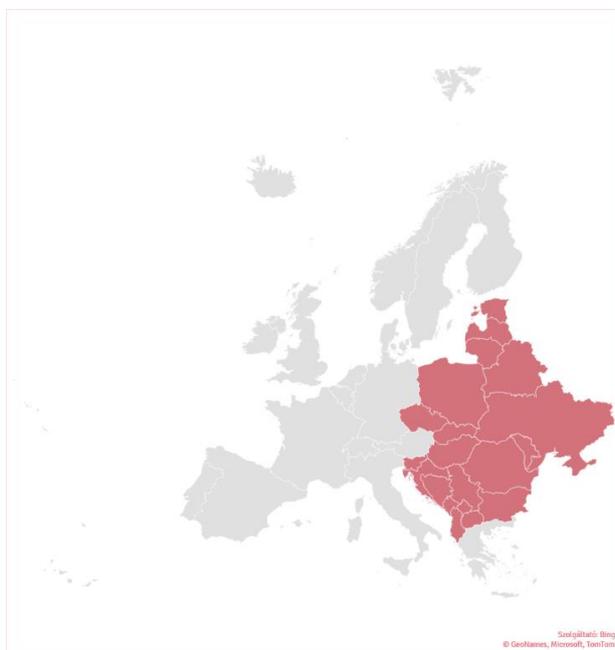


Figure 31 - countries of the Eastern European region

### Czech Republic

In Prague the official public transport application PID Lítačka (Figure 32) offers various accessibility functions: routes can be planned with two optional filters (“low floor only” and “wheelchair accessible only”), and it also offers accessibility information about stations and vehicles. Another really useful capability is the built-in ticketing system, which covers local and regional services.

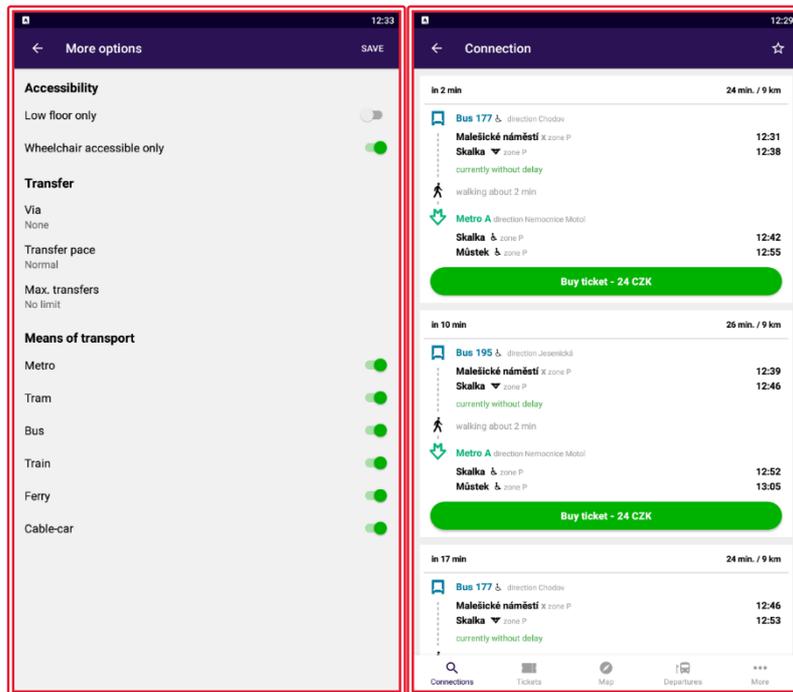


Figure 32 - Screenshots from PID Lítačka application

### Poland

In Poland, the most popular public transport application is developed by an independent company CITY-NAV sp. z o.o., and their “Jakdojade: public transport” application (Figure 33) covers many cities in Poland (e.g. Warsaw, Krakow, Katowice). It has a ticketing option (including local and regional services, as well), but otherwise its functionality ms to be limited: it has only two more features, a timetable browser (sorted by route numbers) and a route planner. The latter has an accessibility option, but there is no displayed accessibility information about vehicles or stations.

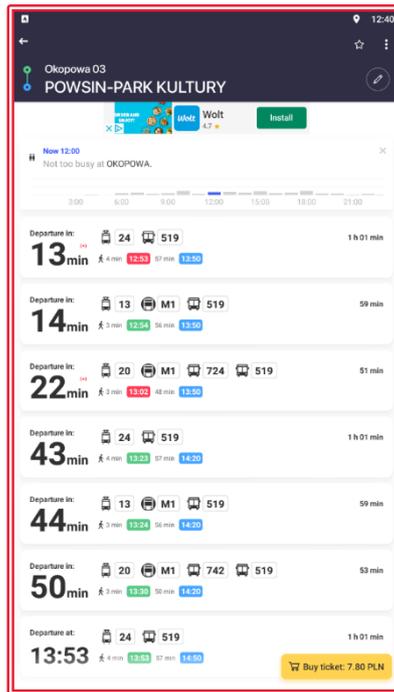


Figure 33 - Screenshot from Jakdojade: public transport application

### Hungary

In Budapest two public transport applications are used by considerable number of users. The official “BKK Futár” (Figure 34) and the non-official “Budapesti Menetrend” both access the real-time and static service data provided by the service organizer (BKK) and have similar features. The main differences between them are their interface and customization options. They offer various accessibility functions: routes can be planned with low floor option, and they also offer information of barrier-free approach of stations and vehicles. Both are available in English (and Budapesti Menetrend is also in other languages).

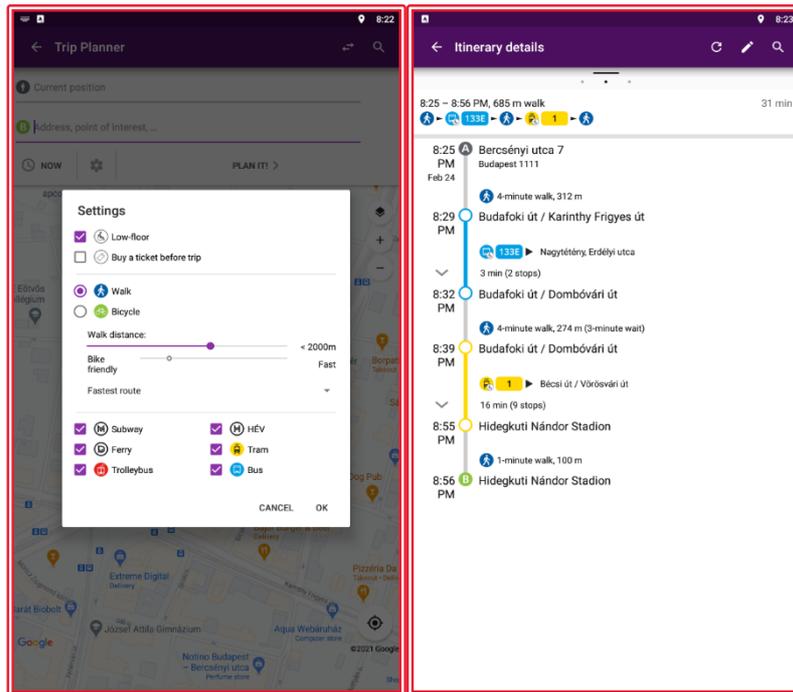


Figure 34 - Screenshots from BKK Futár application

### Romania

For Bucharest, Info Transport Bucharest application was tested. It has an accessibility option for route planning, but there is no displayed accessibility information about vehicles or stations.

### Bulgaria

In Sofia, the most popular public transport application is “Софбус 24” (Sofbus 24), which ms to be a non-official one. Unfortunately, it is not available in English, and there was not any accessibility information found. Functionality is also limited, it does not have a route planner, only departure times can be accessed. However, it has an interesting feature: for each stop, a Google Streetview image is available, which can help their localization (Figure 35).

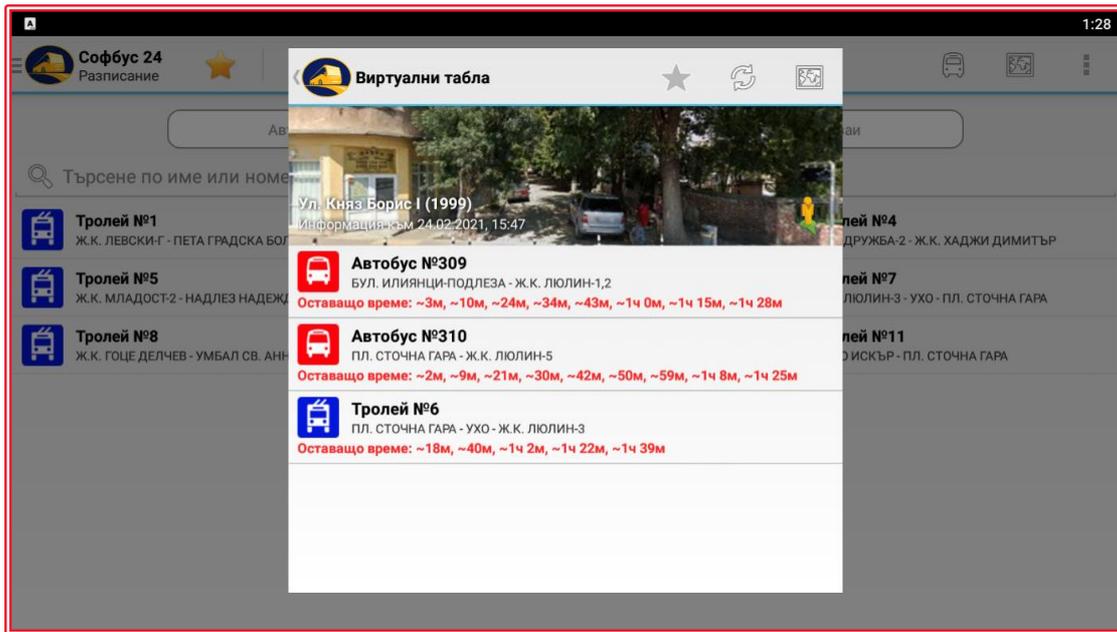


Figure 35 - Screenshot from Sofbus 24 application

### Public transport applications – USA, Canada, Oceania

The countries included in the region can be seen on Figure 36.

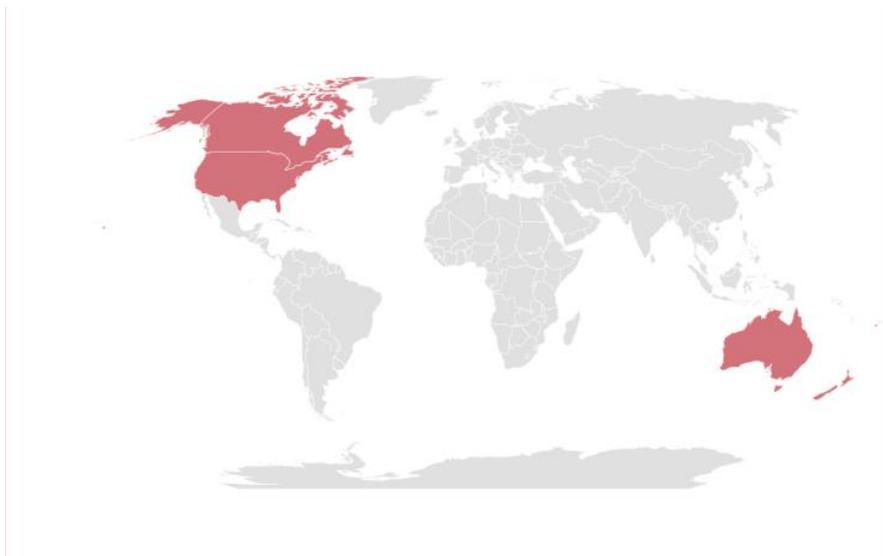


Figure 36 - countries of the USA, Canada, Oceania region

#### United States

Most of the big cities in the United States do not have city specific transport applications but offer third-party solutions instead (one of those will be presented at Canada). The New York Subway application (Figure 37) is an exception. It has some interesting features, for example it has editable service status updates, and the background map shows accessible stations.



However, it does not feature any options for accessible route planning, and many promising features are only available in the paid version (e.g., personal support, navigation on stations). The application’s opening screen also offers to upgrade to this ad-free version.

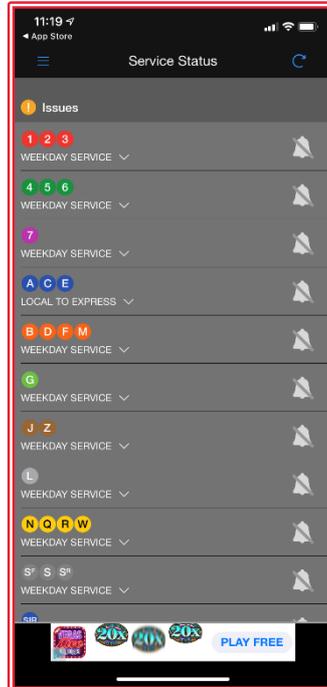


Figure 37 - Screenshot from New York Subway application

### Canada

Transit application is not specified for Canadian cities, it also offers services for many cities worldwide, including more than hundred across Canada & USA (the screenshots show Los Angeles on Figure 38). Its best feature is that it allows a step-by-step navigation throughout the planned journey, although there is no option for accessible route planning.

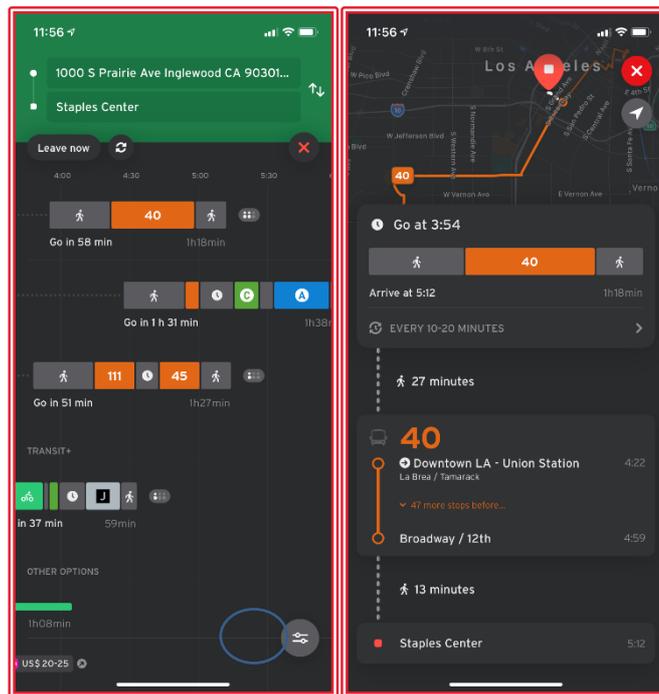


Figure 38 - Screenshots from Transit application

### Australia

Melbourne’s PTV application (Figure 39) provides information about the whole Victoria region in Australia. It offers accessibility options for route planning and also tickets can be purchased for the planned routes. Notifications will be given for the whole network if alarm setting is turned on.

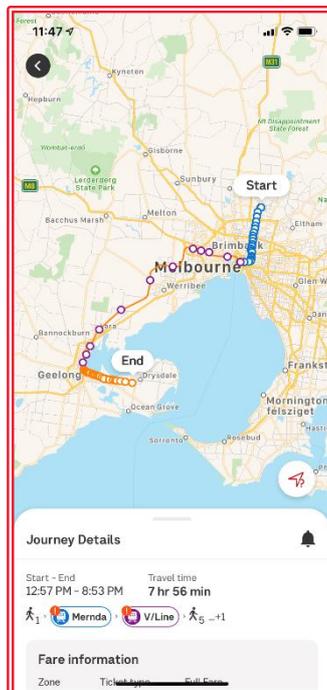
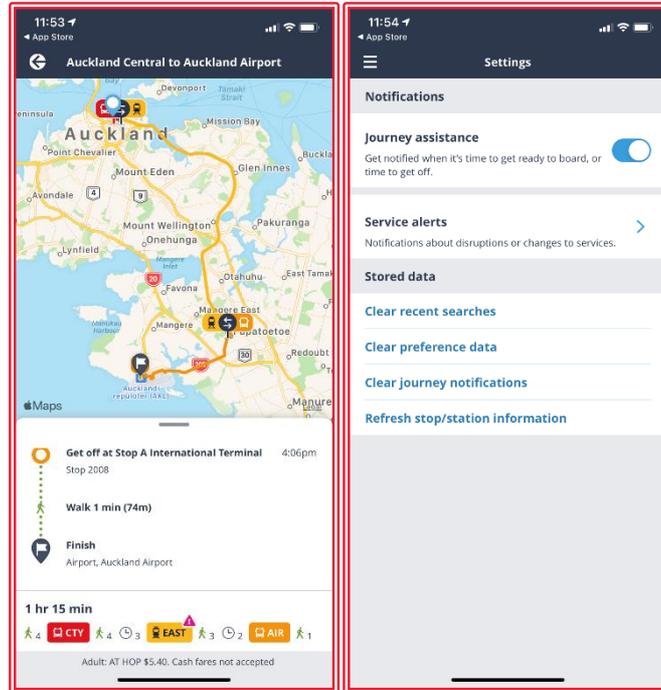


Figure 39 - Screenshot from PTV application

*New Zealand*

New Zealand’s biggest city, Auckland offers the AT mobile application (Figure 40) for its public transport users. Although it does not allow accessible route planning, it offers a virtual journey assistance throughout the trip. It features various saving options for places, stops and routes, and notifications will be based on these saved elements of interest.



**Figure 40 - Screenshot from AT mobile application**

**Public transport applications – Arabic countries and Israel**

Because of relatively different approach of public transport, Arabic countries (and Israel, shown on Figure 41) were analysed separately from the other countries on their respective continents.



**Figure 41 - Arabic countries and Israel**

*United Arab Emirates*



Dubai has a pair of application for all transport modes: RTA application and S’hail reference to each other (users can access several functions from both application) and manages private and public transport related services and information respectively (Figure 42). Altogether the two apps provide a mobility as a service solution in Dubai, where users can choose in an interactive, customizable dashboard from the different transport modes (including taxis, public transport and even Uber).

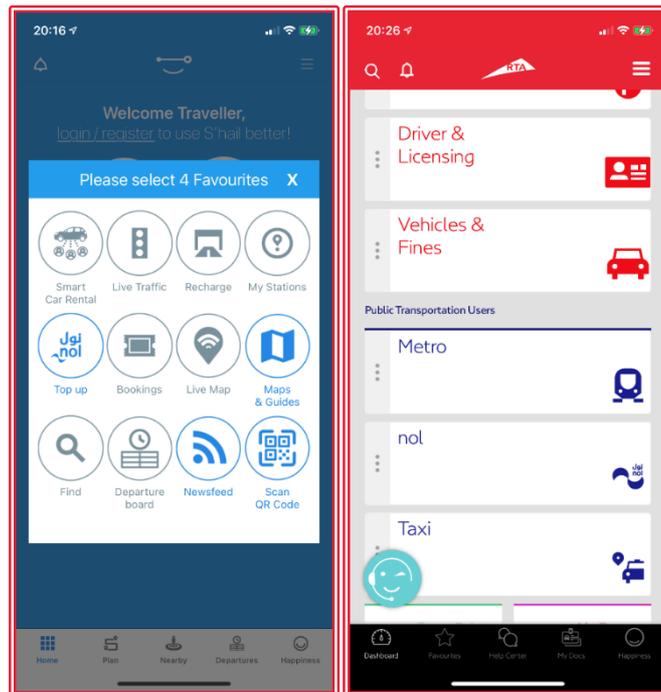


Figure 42 - Screenshots from S'hail (left) and RTA (right) applications

### Other countries

Most of the bigger cities of the Arabic world offer application for public transport users, and most of them use a dashboard as a starting point, where users can select the function what best fits for their habits (e.g., Qatar Rail App, Amman Bus App, Bahrain Bus App). Unfortunately, many of these dashboards operates with icons (Figure 43) which cannot be handled by text-to-speech software or if there are texts under the icons, these texts are not clickable (only the icons).

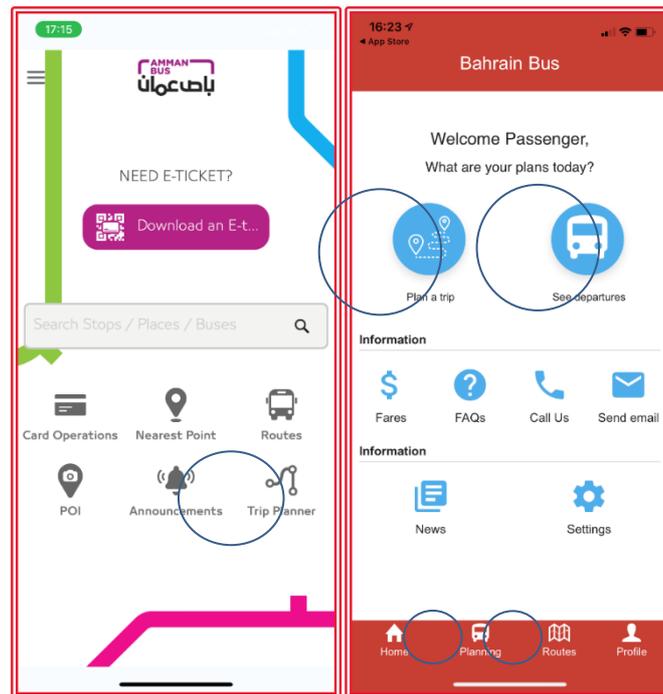


Figure 43 - Screenshots from Ammanbus (left) and Bahrain Bus (right) applications

During testing, positive approach were detected in the Bahrain Bus App, where users can set weather-based settings, if they would like to avoid long walking on the blazing sunshine and it also gives specific accessibility information for passengers with special needs. Cairo Metro application looks and works very simple with very few functions, but it can give real-time notification during travel about alighting and boarding (Figure 44).

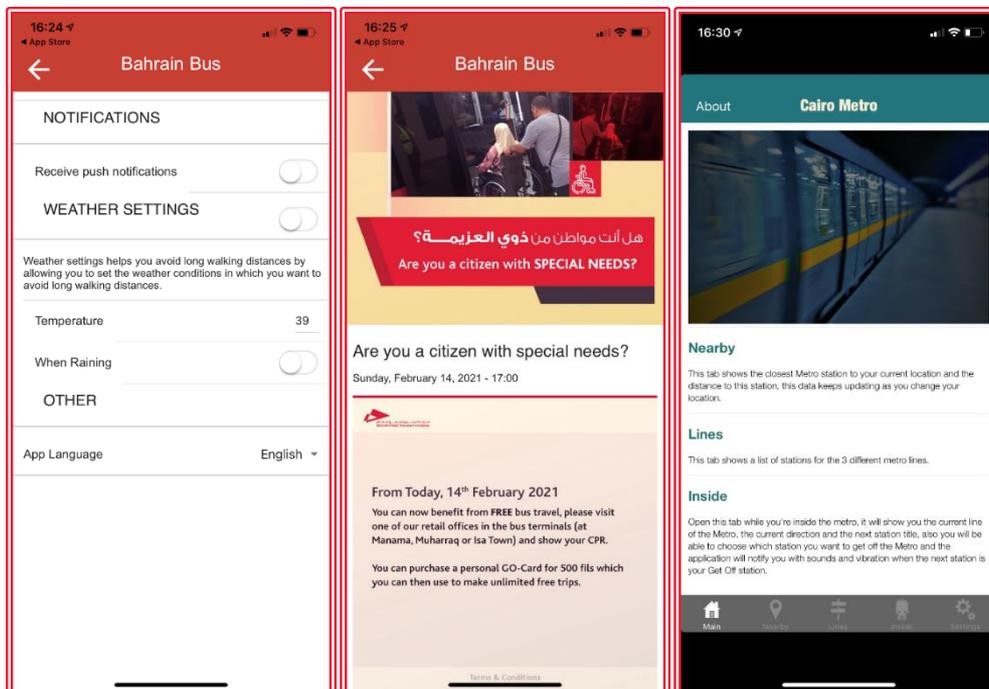


Figure 44 - Screenshots from Bahrain Bus (left & centre) and Cairo Metro (right) applications

However, negative examples were also found, like the Israeli Egged Mobile App (Figure 45), which can be very useful for passenger, but it is only available in Hebrew, therefore, no detailed testing can be made. The use of Citybus Kuwait application starts with registration, which needs a mobile phone number, unfortunately, only a handful of area codes can be selected, none which the testers would have.

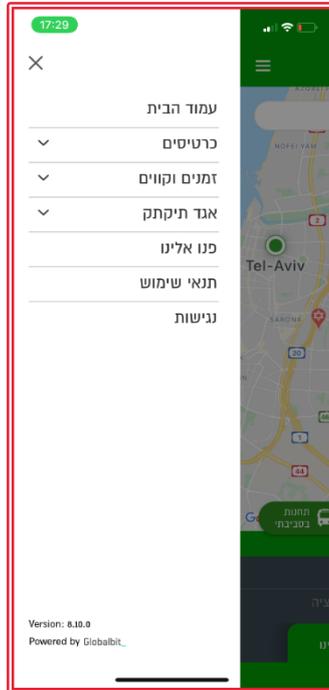


Figure 45 - Screenshot from Egged Mobile application

### Public transport applications – Asia

Asia (outside of the Arabic countries – Figure 46) shows different transport patterns in diverse cultures, however, highly populated metropolises m to use similar approach in mobility application design.

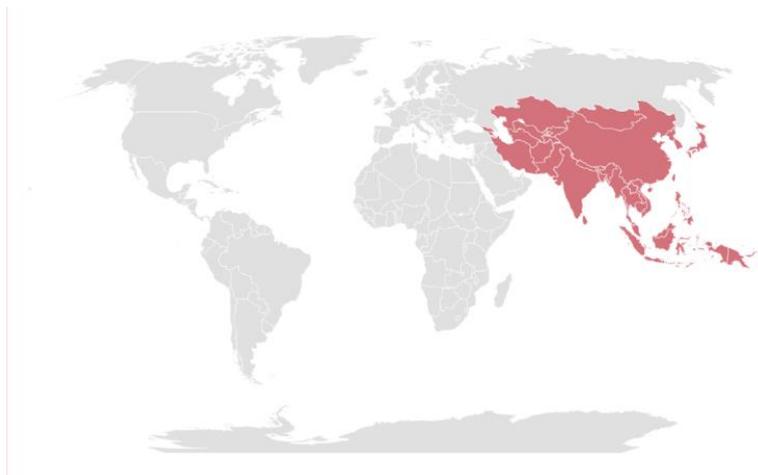


Figure 46 - countries of the Asia region

*China*

In China, a bigger need of specialized applications was expected, because many global solutions are disabled (e.g., Google). However, from Europe, only Metro Beijing/Shanghai/... Subway application were available, which is a non-official software which covers many cities with metro throughout China. It features no specific accessibility solutions but gives information from station to station during travelling by metro.

*Taiwan*

In Taiwan, passengers can use Go! Taipei Metro application (Figure 47) when travelling by metro. It provides detailed facility information about each metro station and nearby bus stops including accessibility and inclusivity related elements (e.g., escalators and elevators at exits, restrooms, breast-feeding and diaper changing opportunities).



Figure 47 - Screenshots from Go! Taipei Metro application

*South Korea*

KakaoMetro application (Figure 48) can be used throughout South Korea, as it includes many cities other than Seoul. It is published by an application developer company, not by the public transport operators and manages only the metro systems of the included cities (but there is also a similar application called KakaoBus for bus services). It provides detailed facility information about each station (e.g., on which side the vehicle’s door will open) and has an option of voice notification at arrival when passenger uses earphones.

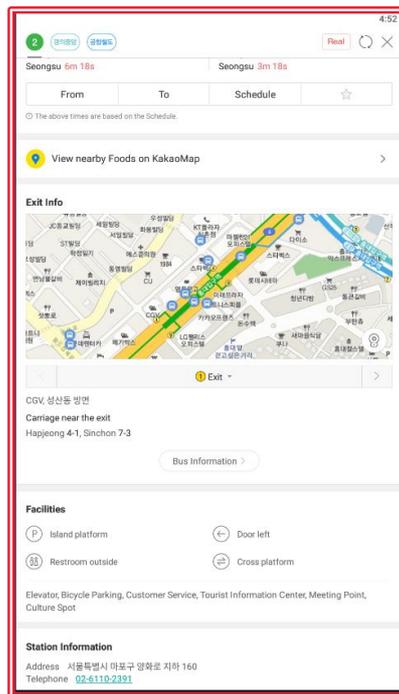


Figure 48 - Screenshot from KakaoMetro application

### Japan

JapanTaxi application covers most taxi service providers, all over Japan. Car type can be chosen, and payment is also included in the application (for most companies). It allows the use of third-party virtual assistants (e.g., Amazon Alexa).

In Tokyo, the Tokyo Subway Navigation application is the most popular, which covers the metro system, but it does not have any accessibility features. For Osaka, Osaka MetroGroup NavigationApp was tested, but unfortunately it didn't start. In Sapporo, bus services are provided mainly by Eki Bus. Their "navi" application was tested, but it neither has accessibility options (and proposes some strange questions at start about gender, age, profession, which do not m to be connected to the service).

### Malaysia

In Kuala Lumpur there are only non-official applications available.

Kuala Lumpur MRT LRT Train Map (SGAPP) is a single static map image, while Kuala Lumpur Rail Map has some basic functions (station search, route planning), but none of them have any accessibility features.

### India

Not many of the big cities of India provides easy-to-use transport applications. One exception is Delhi's Delhi-NCR Metro application (Figure 49). Its most interesting feature that it provides a handful of added information about stations (e.g., the level of stations, escalators) and also a station-specific contact phone number for each station.

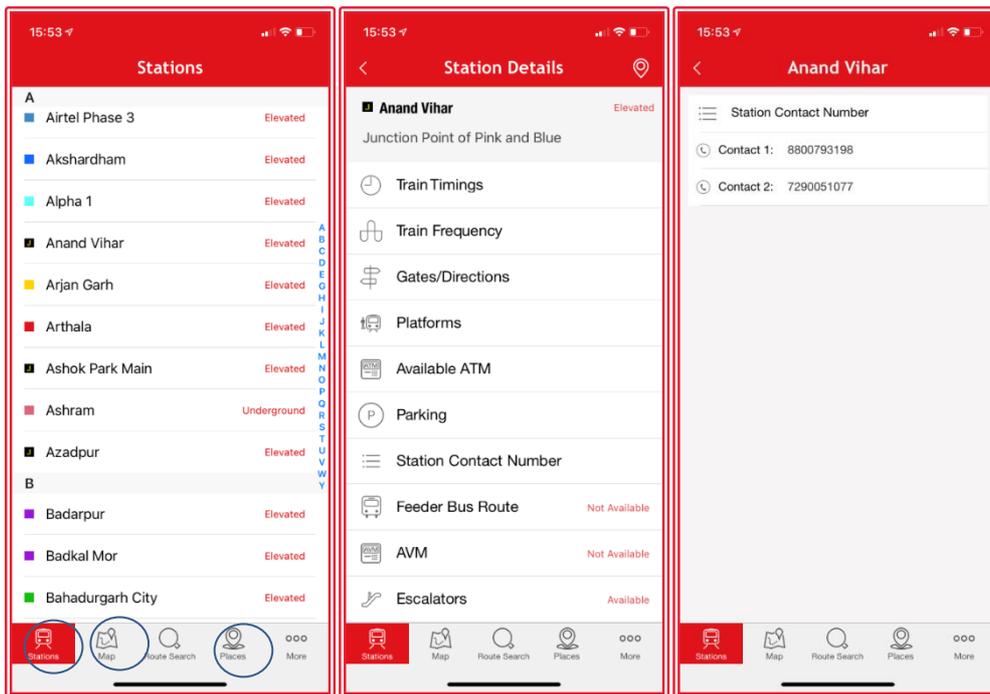


Figure 49 - Screenshots from Delhi-NCR Metro application

## Public transport applications – Central and South America

In Central and South America (Figure 50), public transport in big cities is not always as developed as needed. However, there were good practices regarding mobility applications.



Figure 50 - countries of the Central and South America region

### Brazil

Both Brazilian metropolises have their own applications for public transport. Rio de Janeiro Metro App is non-official (developed externally, not by the PT operator) and only contains a single static map image. On the other hand, although São Paulo Metro application (Figure 51) manages only the metro system of the city, it provides facility information on stations (as the only accessibility information).

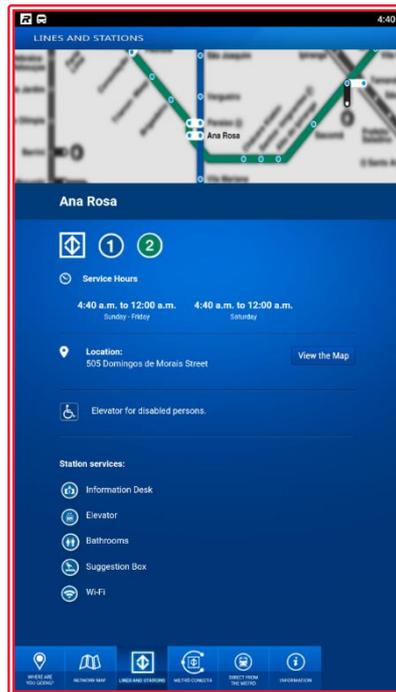


Figure 51 - Screenshot from São Paulo Metro application

*Chile*

The Chilean capital, Santiago de Chile has the most user-friendly application in the region, the Transantiago Bus Checker (Figure 52). Although, it manages only buses, there is a widget available to the home screen of the smartphones, which displays departure times and there is a speak function including alerts when arriving to a chosen bus-stop.

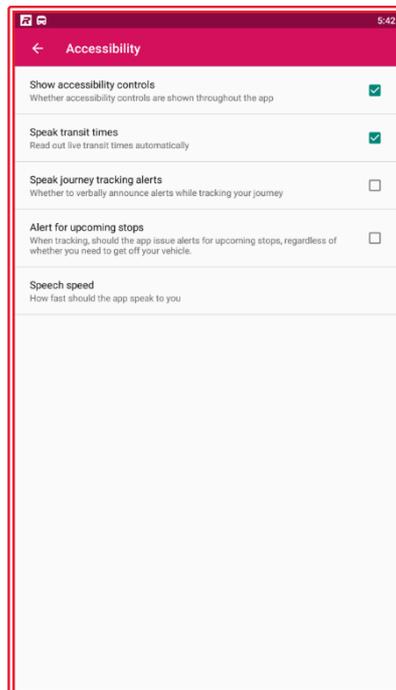


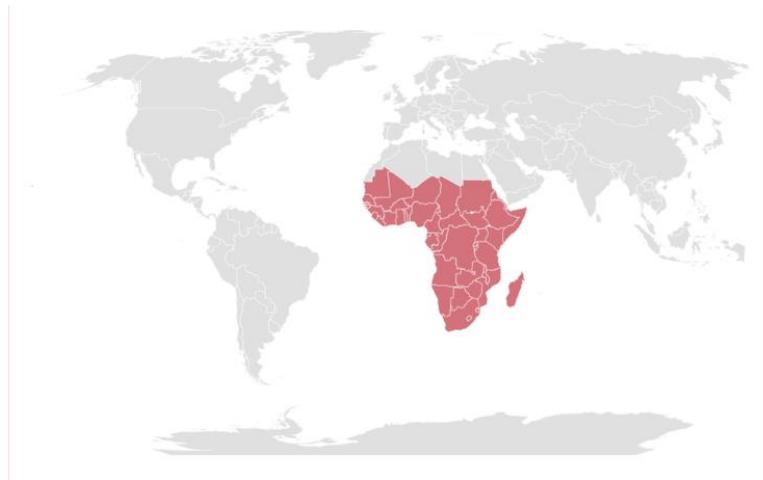
Figure 52 - Screenshot from Transantiago Bus Checker application

### *Other countries*

Other applications from South American metropolises (BA Cómo Llego – Buenos Aires, STM Montevideo) usually provides only a few useful functions for vulnerable to exclusion passengers, such as actual service info and accessibility info of the vehicles. STM Montevideo is only available in Spanish.

### **Public transport applications – Africa**

There are not too many examples of public transport services in Africa (Figure 53), therefore not many applications were developed for them.



**Figure 53 - countries of the African region**

### *Gulf of Guinea*

There are many big cities in the area, but public transport means bus service in best cases. In Lagos, Nigeria, the BRT Lagos application shows the stations of the only bus rapid transport line of the city and provides only a few static information.

Other than buses, the so-called “trotro” service is available, which is a network of minibuses with demand responsible timetables (which means they will leave the stop when they are full). In Accra, Ghana the network has also numbered routes. In the Trotro application (Figure 54), passengers can plan route by these minibuses. It counts as a very useful feature as these trotro routes are not available in global applications (e.g., Google Maps).

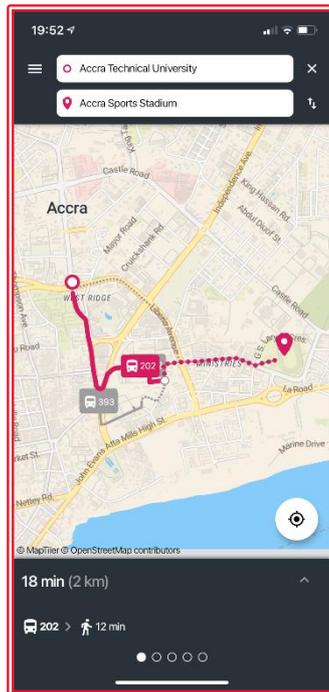


Figure 54 - Screenshot from Trotro application

### South Africa

South Africa and its public transport service are considered the most developed throughout the region, and the applications provided show the same. Both the Johannesburg/Pretoria based Gautrain and the Cape Town based MyCiTi applications (Figure 55) offer detailed route planning and vehicle tracking. Unfortunately, no accessibility options are available, but detailed service updates can be useful during the daily use.

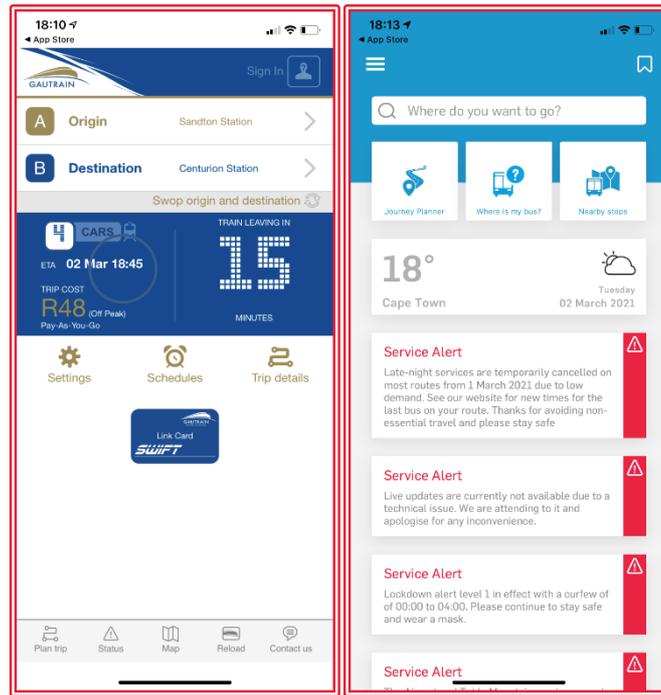


Figure 55 - Screenshots from Gautrain (left) and MyCiTi (right) applications

## Annex 2 – UIL exercise: instructions for moderators and example

### *Instructions for moderators*

#### **UIL exercise with inclusive discussion | 40 minutes**

Objective: collect end-users' feedback about accessibility of pilot apps and commercial apps, especially in terms of icon comprehensibility and the inclusivity/usability of the general interface.

#### **Description:**

5 minutes: After a short introduction to the exercise, the link to the interactive board will be shared in the meeting chat. The interactive board will be used to show participants the app screenshots and the related questions. All participants will be allowed to add sticky notes on the board, but most comments will be collected verbally by the moderator and noted down separately by the note-taker on a debriefing template and collected later in a single document (sticky notes + verbal comments).

20 minutes: three most representative screenshots of the pilot app will be analysed by asking participants questions related to the pictograms' level of comprehensibility/ambiguity and to the overall interface inclusivity/usability.

20 minutes: an identical analysis will be run testing a second (10 min) and a third (10 min) commercial application providing similar services for digital mobility or delivery.

#### **Requirements and materials:**

- Each participant will be asked to use microphone during this session. Webcam is not needed since most of the exercise will be done looking at pilot app screenshots.
- A how-to-guide, the pilot-app interactive board link (plus a power-point backup version), and a question debriefing template will be provided in advance in English. Exercise description and questions must be translated in local language. Answers will also need to be translated from local language to English before providing them Deep Blue.
- One moderator, one person handling Miro board on-screen projection, and one note-taker, also in charge of timekeeping, are needed.

#### **Follow-up survey**

A follow-up survey, quite similar to the one that will be circulated among Consortium members, will be sent individually to COPs participants, in order to integrate their informal feedback collected during the meeting, with a more systematic one. The survey will include Likert scale (1:4) questions evaluating respect of UD principles, pictograms/icons evaluation and overall pilots apps' usability.

### UIL full exercise example (Pilot 5 – Berlin)

The UIL exercise was almost identical for all pilot sites, with the only difference being the icons selected for evaluation (since every pilot service uses a different set of icons) and the screenshots of the user interfaces analysed. The debriefing templates are collected in the Annex 3 – UIL exercise: debriefings



Berlin

— **UIL exercise for COP**

**[RIDE POOLING APP]**  
(door2door)  
[description of app on three lines]

The exercise we are going to present here is intended to collect your intuitive and **immediate feedback about visual icons** (also called pictograms) used by most digital mobility applications to support fast comprehension of information and inform about available actions.

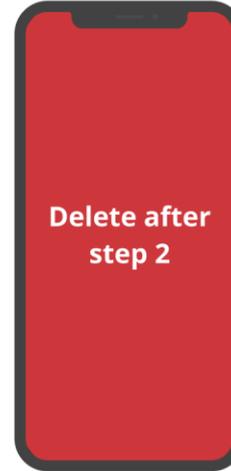
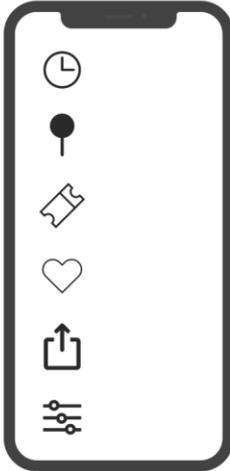
The objective is to let end-users evaluate the accessibility and inclusivity of icons' design. You will be asked to think about the meaning of pictograms that are included in this pilot app's screens.

Focus on your own experience and be bold: if you don't understand the digital world it's not your fault, it's technology that needs improvements. There are no rights or wrongs. **You are the expert!**

Let's go!

1) Icons pitch

INDIMO WP2 - UIL exercise for P5 | Berlin



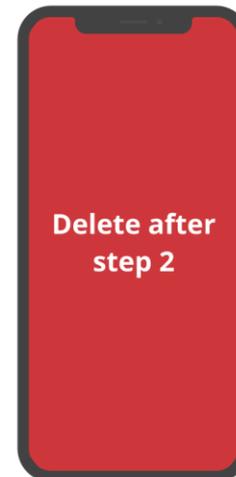
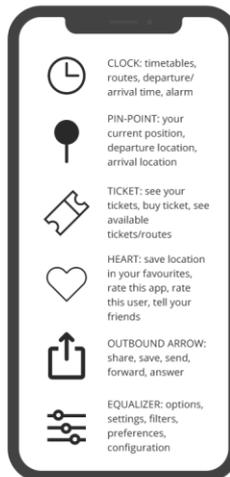
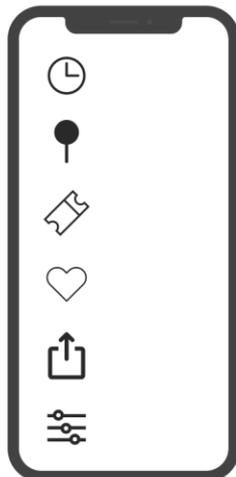
10 MINUTES – Please name and describe the meaning of each presented pictogram in your words. According to your experience, what does this icon mean or what action does it trigger in a digital application?

10 MINUTES – Your meanings have been added to the most used ones. Are there other pictograms you've seen that are used to issue the same message?

5 MINUTES – Here some examples, who would like to comment? Do you think they are equivalent?

1) Icons pitch

INDIMO WP2 - UIL exercise for P5 | Berlin

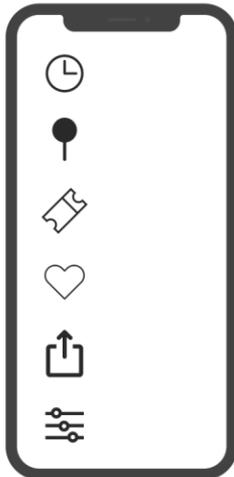


10 MINUTES – Please name and describe the meaning of each presented pictogram in your words. According to your experience, what does this icon mean or what action does it trigger in a digital application?

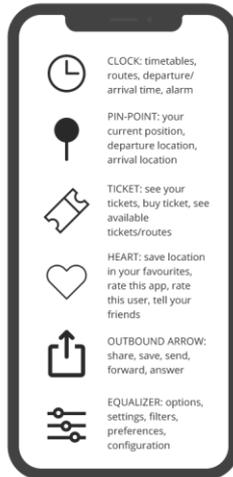
10 MINUTES – Your meanings have been added to the most used ones. Are there other pictograms you've seen that are used to issue the same message?

5 MINUTES – Here some examples, who would like to comment? Do you think they are equivalent?

1) Icons pitch

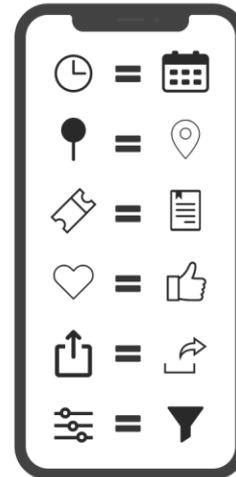


10 MINUTES – Please name and describe the meaning of each presented pictogram in your words. According to your experience, what does this icon mean or what action does it trigger in a digital application?



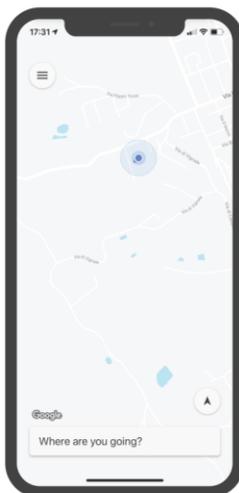
10 MINUTES – Your meanings have been added to the most used ones. Are there other pictograms you've seen that are used to issue the same message?

INDIMO WP2 - UIL exercise for P5 | Berlin



5 MINUTES – Here some examples, who would like to comment? Do you think they are equivalent?

2) Welcome screen



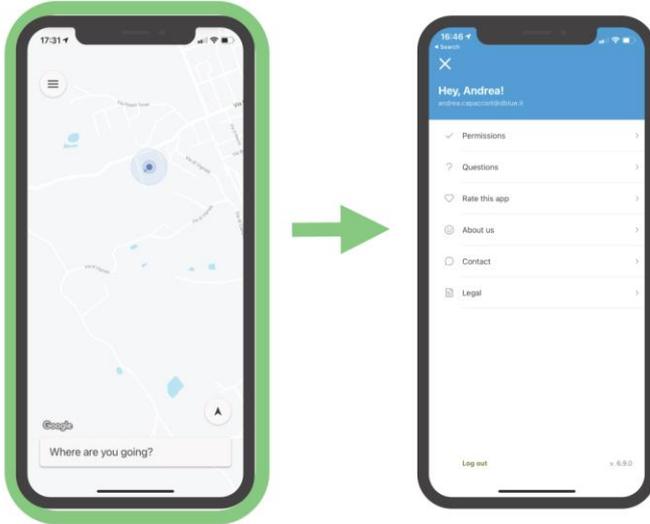
ICON 1: Sandwich ☰

5 MINUTES: In this app screen context, by clicking on this icon, what do you expect to happen?

INDIMO WP2 - UIL exercise for P5 | Berlin

3) Menu

INDIMO WP2 - UIL exercise for P5 | Berlin



ICON 1: SANDWICH 

5 MINUTES: This is the screen that appears after clicking on the sandwich icon. Please comment around your expectations and actual contents provided.

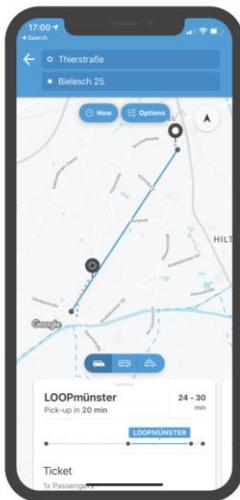
ICON 2: HEART 

5 MINUTES: In this app screen context, by clicking on this icon, what do you expect to happen?



4) Route finder

INDIMO WP2 - UIL exercise for P5 | Berlin



ICON 3: PINPOINT 

5 MINUTES: Looking at the two pinpoints on the map, can you tell which one is the departure point and which the arrival? Please comment

ICON 4: CLOCK 

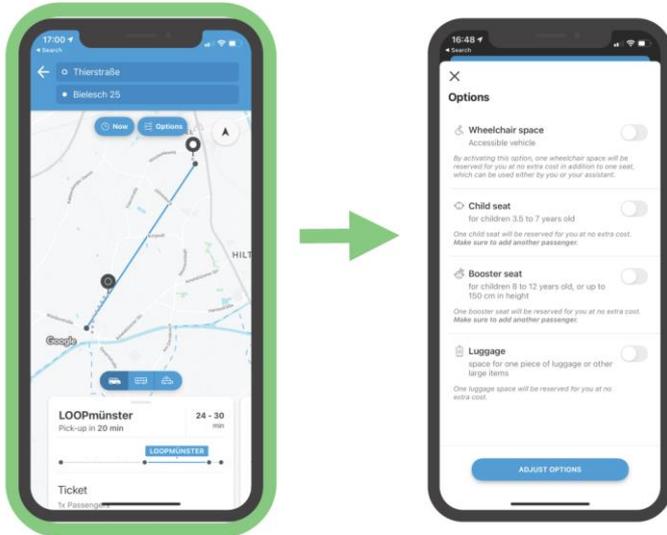
5 MINUTES: In this app screen context, by clicking on this icon, what do you expect to happen?

ICON 5: OPTIONS 

5 MINUTES: In this app screen context, by clicking on this icon, what do you expect to happen?



5) Options

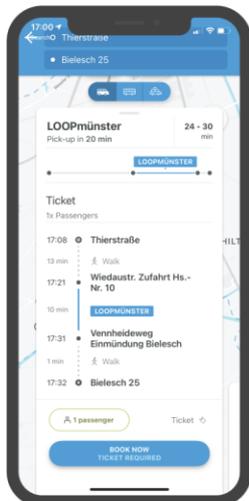


INDIMO WP2 - UIL exercise for P5 | Berlin

This is the related screen  
5 MINUTES: What other information would you like to be included here?



6) Available routes



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ICON 5: PASSENGER 

5 MINUTES: In this app screen context, by clicking on this icon, what do you expect to happen?

ICON 6: TICKET 

5 MINUTES: In this app screen context, what information is this icon providing to you?

5 MINUTES: What additional information attached to the icons is helping you or would help you in understanding their meaning?

ADDITIONAL QUESTIONS ABOUT THE WHOLE APP INTERFACE

- To what extent were you able to identify essential information?
- What is the least intuitive action you can perform?



## Annex 3 – UIL exercise: debriefings

### UIL Debriefing template – P1 MONGHIDORO

Moderators	Eleonora Tu (ITL)
Media of interview	<input type="checkbox"/> online via __ <input checked="" type="checkbox"/> in person at the Agriturismo “La Fenice” Castel D’Aiano <input type="checkbox"/> by phone



Date	29/04/2021
Recorded?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes

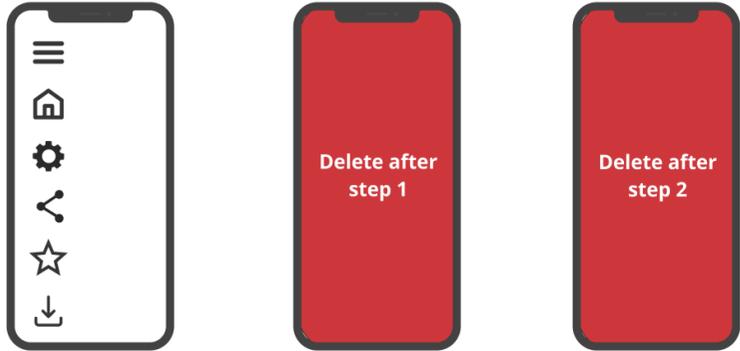
### Participants’ Data

#	Gender	Category (end-user, stakeholder, user representative <sup>29</sup> , etc...)	Age	Additional Comments
1.	M	Stakeholder	50+	Major of the Castel d’Aiano Municipality and Representative of the– Metropolitan City of Bologna
2.	M	Citizen with foreign origins (Poland)	40+	
3.	F	Citizen with foreign origins (Poland)	40+	
4.	F	Citizen with foreign origins (Poland)	40+	
5.	M	Local Citizen	60+	
6.	F	Local Citizen	60+	

<sup>29</sup> In the case of user representatives, please specify the type of stakeholders

7.	F	Local Citizen	60+	
8.	M	Local Citizen	60+	
9.		Local Citizen	60+	
10.		Local Citizen	60+	
11.		Local Citizen	60+	
12.		Local Citizen	60+	
13.		Local Citizen	20+	
14.	M	Project Partner   Moderator	30+	ITL

## Workshop questions.

Screenshot of reference	Questions and Notes
<p> 1) Icons pitch</p>  <p>10 MINUTES - Please, name and describe the meaning of each presented pictogram in your words. According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?</p> <p>5 MINUTES - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?</p> <p>5 MINUTES - Here some examples, who would like to comment? Do you think they are equivalent?</p>	<p><i>According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?</i></p> <p>R1: The first means that there is a bit of fog, the second resembles my home and the third looks like a tractor [laugh].</p> <p>R2: Ah, this gear is a sprocket [he uses the specific word in Italian to describe the gear, which is “pignone”]</p> <p>Many residents [together, at least 4, some nod their head]: I don't know what it means/we don't know the meaning.</p> <p>R1: This is used to enter the menu/setting.</p> <p>R3: I have seen this on my mobile.</p> <p>R1: On a website, usually there is this symbol... then you scroll down and go where you</p>

	<p>need to go.</p> <p>R3: I have also seen this on Facebook!</p> <p>R1: No, it's not on Facebook.</p> <p>R3: Yes, yes I've seen it myself. It's a menu!</p> <p>According to at least 4 people, the icon is not very clear. In the background, some people laughed because they feel a little uneasy to speak about digital things they don't know.</p> <p>R2: I think that if there was an "M" for menu, it would be a lot easier to understand. Or maybe they should just write "Menu". Some other residents agree with R2.</p> <p>ET: Let's look at the 2<sup>nd</sup> icon. [the house]</p> <p>R3: It means the beginning of something.</p> <p>R1: It means homepage [he says homepage while speaking Italian].</p> <p>Other residents still felt very confused because they do not use digital items/mobile phones/applications. Some other murmured to agree with R3 and R1.</p> <p>ET: The third icon is a gear.</p> <p>R1: It means "settings".</p> <p>ET: What is the difference between the first icon and the third icon? [three horizontal lines and the gear]</p> <p>R4: It is almost the same, actually.</p> <p>R1: No, in the first one you choose what you see in a website, in the third one you are more specific, to see for example the settings of the phone.</p> <p>R5: The first is the menu, the second is the homepage, the third you can change the language.</p>
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ET: All right, let's move on and look at the fourth symbol...

They all agree that it means "to share".

R1: We all know this one!

R2: I think this is one of the most intuitive, because it shows a triangle...I understand that it unites different dots...am I right?

A lot say that they share items on Whatsapp.

ET: And what do you think about the star icon?

R3: I think this means "Favourites".

All the other participants agreed.

ET: What about the last icon?

R3: It means "To download".

ET: Is there anyone who would not understand what it means?

At least 3 participants raised their hand.

R1: I wouldn't know what it means.

R4 (probably the wife of R1): You always use it but you don't know!

R1: It could be, but sometimes you are so used to do something that you don't notice how you do it. You don't even look at it.

R2: So what does this symbol mean?

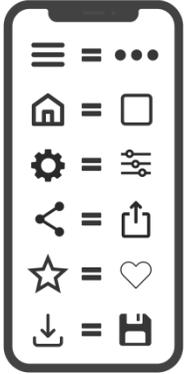
R1: *Scaricare* (to download)...

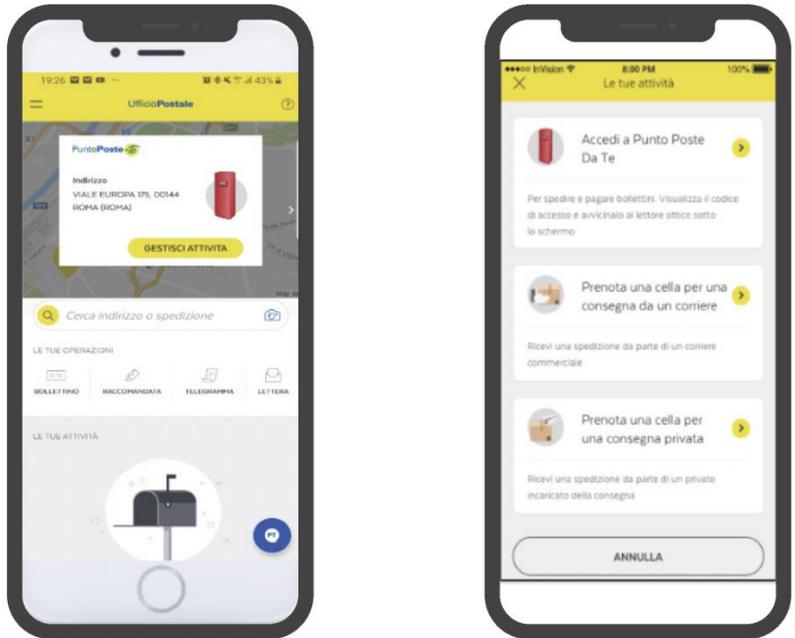
R2: *Scaricare che cosa? Un camion?* (this is a pun in Italian, because download also means "to unload")

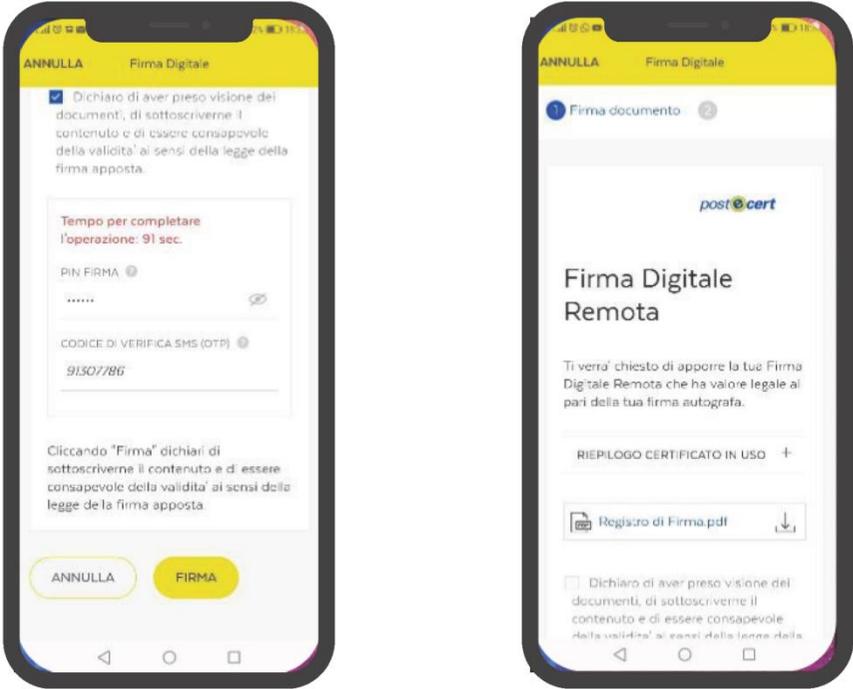
They laughed at the joke.

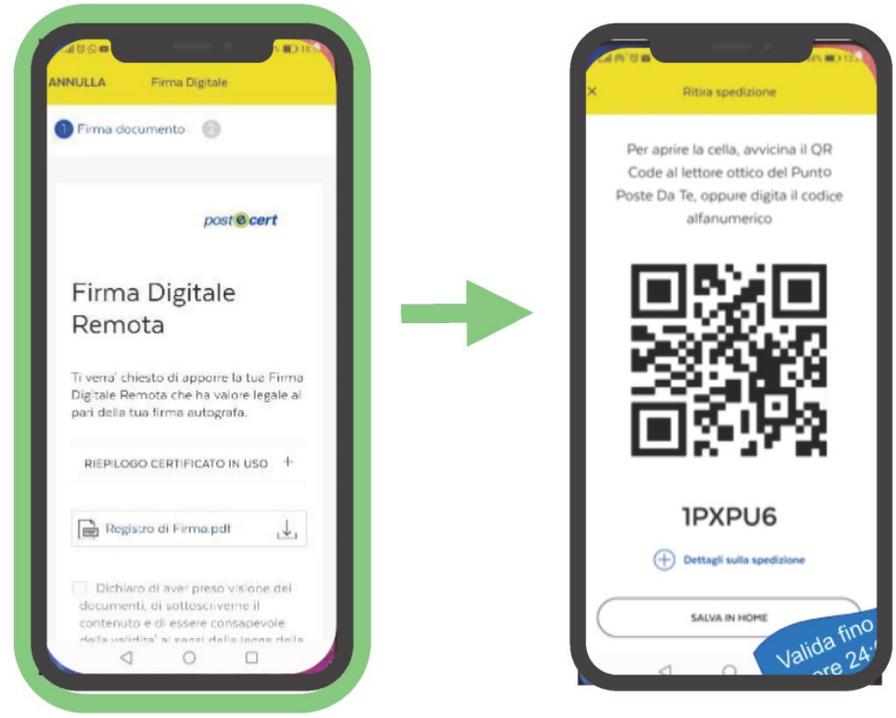
R2: I actually thought it meant "to look down".

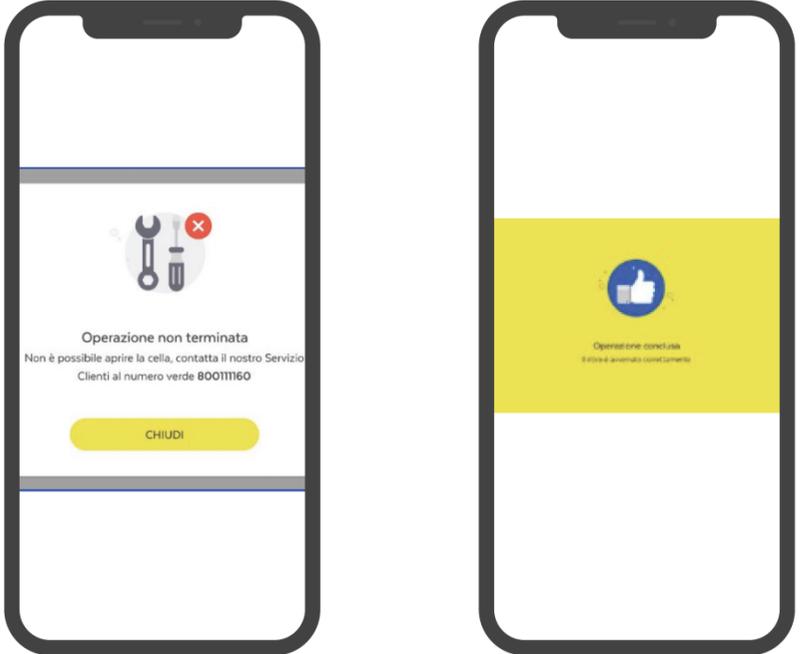
None of them mentioned the meaning "to save", ET then went through slide 4,

	<p>explaining the meaning of each symbols/icons</p>
<p>1) Icons pitch</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="161 341 344 715">  </div> <div data-bbox="468 341 651 715">  </div> <div data-bbox="768 341 952 715">  </div> </div> <p>10 MINUTES - Please, name and describe the meaning of each presented pictogram in your words. According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?</p> <p>5 MINUTES - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?</p> <p>5 MINUTES - Here some examples, who would like to comment? Do you think they are equivalent?</p>	<p>5 MINUTES - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?</p> <p>R1: The star can be replaced by a heart, or a fist with the finger pointing up.</p> <p>R2: "To save" sometimes it is also an icon of a TV...or a floppy disk.</p> <p>R3: Not a TV, a floppy! But honestly, we don't know because we didn't go to the school of computers [literal translation from Italian].</p> <p>ET went through slide 5 with the icons/symbols that have the same meaning.</p> <p>R1: Now it comes to mind...sometimes the gear is also replaced by a wrench. This is probably the most intuitive one</p>

	<p><b>Welcome Screen:</b>          Many residents complained that they couldn't see very well what was on the slide (although one slide takes an A4). The images were a bit blurred. They put on their glasses. ET described what is one the images.</p> <p>ET: What do you expect from these screens? What kind of services could you perform?</p> <p>R2: If I click on the red icon [the digital locker] I expect nothing would happen. What could it mean? I think the icon is not used for something specific. This is the problem: why do you make this icon if it means nothing? Either you do it or you don't.</p> <p>R5: Yes but I think you should click on "gestisci attività", the yellow bottom.</p> <p>R2: Probably, but this is not intuitive at all.</p> <p>R5: Yes, probably the layout is in line with the other products of Poste Italiane. I think this is all very clear.</p> <p>R5 explained the operations that can be performed.</p> <p>R3: By looking at the screens I don't understand how to get my parcel.</p> <p>R2: If I read what is written is a lot clearer.</p> <p>ET: What do you think of the possibility to leave a parcel/package to another person (C2C)?</p> <p>R3: Great for drug dealer! [joking] But actually, I'm concerned that it could be a mean for some illegal activities.</p> <p>R1: Regarding the icons, I think most of them are not very intuitive. Recently I have worked to set up a website, I had some consultants that helped me. But if it wasn't for them, I wouldn't have known many icons!</p>
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	<p><i>ET: Let's look at the next page (slide 7).</i></p> <p>R3: This is used to get your package! You need a code to retrieve your package. There was a chat about the code, how to get it from the phone.</p> <p>ET: What do you think the icon of a box means?</p> <p>They all answered "I understand that there is a package".</p> <p>R3: But when I see the red cross next to the box, it means that there is a problem. I cannot get the parcel because there is an error.</p> <p>ET: Great, let's look at slide 8 "Firma".</p> <p>As participants pointed out that the pictures of the screens were not very visible, ET read the screens out loud for the participants. The conversation revolved around the concept of "signature"</p> <p>R1: So... I need a digital signature to use this app? What is it?</p> <p>R3: No, it's ok when you just have a code!</p> <p>R5: The signature is the OTP, the code that you receive by SMS, like when you use the home banking.</p> <p>R4: This is too complicated. If it was up to me, I would never be able to get the package/parcel out! I even have troubles to write a text!</p> <p>ET: Let's look at the icon "down arrow". What happens when I click on it?</p> <p>R6: Somewhere a screen will pop up saying you have signed.</p> <p>ET: Let's see slide 9.</p> <p>R1: What does "Firma Digitale Remota" means? Why is it remote?</p> <p>R5: It is made from another device.</p> <p>R1: I know, but why do we use "remote"? It is not clear at all, not very intuitive.</p>
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	<p><i>ET: What about the QR code?</i></p> <p>R3: I don't know what a QR code is.</p> <p>None of the participants could explain it, just R5 (the youngest). He went ahead and explained it.</p> <p>R1: So, if you read a number or a QR code is the same!</p> <p>Most of them never used a QR code, some mentioned Ryanair when they travelled, or in museums or restaurants. In fact, during the pandemic, many restaurants asked you to scan a QR code instead of giving you the menu. Many were a bit unsure about the QR code.</p> <p>R1: Anyway, now you cannot even go to the restaurant! [In April 2021, there was a lockdown]</p> <p>ET: Do you think the functions of these screens are clear?</p> <p>They agreed that now that once they know what a QR code is, the screens were somewhat clear. The participants discussed whether the digital locker may be installed in Castel D'Aiano. Some of them were concerned that there would be less service for the citizens at the post office (e.g. reduced hours).</p>
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	<p><i>ET: Let's have a look at the final slide. Can you tell me what do these screens mean?</i></p> <p>R1: Something is wrong!</p> <p>R6: Oh well, it says that there is a problem but with the wrench you can't open it [the digital locker]. Maybe you should take a screwdriver and force it open! This is why I always carry a wrench or screwdriver with me!</p> <p>R2: It means that there is the need of assistance.</p> <p>They generally understood from the screen that it was not possible to open the box.</p> <p>R2: I think this icon [screwdriver and wrench] is not clear at all. Why is there a wrench? Do you need to fix something? Maybe a better icon, such a locker, would work better! Just like the carkeys. I understand there is a problem, but I don't understand much else.</p> <p>R1: Then they tell you to contact the assistance...but maybe another icon (es. contact) it would be better.</p> <p>R2: Ok, but they cannot tell you everything (both the locker that is closed and to contact the assistance).</p> <p>R5: I think the icons should be changed with easier-to-understand icons.</p> <p>R3: It's ok when it's written [what you need to do], no need of icons.</p> <p>R2: Yes, but we are talking about icons. Of course, if it was written it would be easier! I think a small locker [instead of the wrench and screwdriver] would be great.</p> <p>R1: ...and maybe an icon of a "telephone" to contact them [the assistance]. Some other ideas...a balloon, for example, to give the idea "to call" "to talk to someone" or maybe a mouth.</p> <p>R5: Anyway the Poste Italiane app never works!</p> <p>They argued that the two tools are not intuitive to understand. It is clear that there are two actions that are prompted (that there is a problem/error and to contact the assistance) but the icon only refers to one. Also it is not clear whether the process can be restarted or not: if there is a problem, can the user go back and try again?</p>
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	<p>R5 thinks that sometimes it is not so easy because of security protocols, so maybe you are not able to go back.</p> <p>Concerning the final screen all participants agreed about it being “operation successfully completed”</p>
	<p><b>Main lessons of the UIL-session:</b></p> <p>Looking back at all the screens of the app, they all agreed that most of screens were quite unclear, not so intuitive. They said that probably they would not be able to use the app by themselves. Only one person of foreign origin (R3) joined the conversation, all the others did not say much. Many people were not comfortable talking about “digital stuff”.</p>

Moderators	Wim Vanobberghen (imec- SMIT -VUB)
Media of interview	<input checked="" type="checkbox"/> online via _____Microsoft Teams meeting_____ <input type="checkbox"/> in person <input type="checkbox"/> by phone

Date	30/3/2021
Recorded?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes

### Participants' Data

#	Gender	Category (end-user, stakeholder, user representative <sup>30</sup> , etc...)	Age	Additional Comments
1	M	Stakeholder		Public Transport
2	M	Stakeholder	60+	Accessibility Council Antwerp
3	M	Stakeholder		Agency of Accessibility Flanders
4	F	User representative		Blind persons organization
5	F	User representative		Blind person organization
6	M	End user	30	Imec developer/designer
7	F	Project partner		EPF
8	F	Project partner		DBL
9	M	Project Partner		CambiaMO
10	M	Project Partner   moderator		Imec-SMIT-VUB

<sup>30</sup> In the case of user representatives, please specify the type of stakeholders

## Workshop questions.

Screenshot of reference	Questions and Notes
	<p><i>15 MINUTES - Please, name and describe the meaning of each presented pictogram in your words.</i></p> <p><i>According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?</i></p> <ul style="list-style-type: none"> <li>- <b>Welcome Screen:</b> <b>How do we best represent the welcome screen. How to organise it?</b></li> </ul> <p>General observation: Not only thinking about the blind people, but also look at people with bad sights (visual impaired). In that case contrast is very important. Both categories have their own needs and it will be important to take their needs into account from the start. For example: a blind person will relate more to auditive messages while a person with bad sight in most of the cases has been raised in a literate culture, so he will focus more to text and images.</p> <p>Main focus of the welcome screen: contrast and simplicity for both categories.</p> <p>Blind persons: Name application itself is alright for blind persons. The picture as such won't matter much given that they are blind. In current screen, a blind person still must click on 'routes' in order to go the start screen with the menu. This is not as such a problem.</p> <p>Capital letters: one should be careful! It is better to use a Capital letter in the beginning and small afterwards.</p> <p>Visual impaired: colours for persons with visual impairments, one should be aware of the red colours (and others)! If one is colour-blind he sees everything grey and the red circle will be seen as a shadow instead of location. Best to use are normal colours and usage of contrasts! Also mind that colour-blind people are mostly not seeing red or green.</p> <ul style="list-style-type: none"> <li>- <b>Screen Menu :</b> <b>How do we best structure the screen with the menu and structure the interaction after pressed on routes?</b></li> </ul> <p>Blind people work all the time with voice over, so the best is to be able to swipe from block to block. If we look at this screen: this is smart traffic light (welcome) -&gt; swipe (route) -&gt; menu screen: swipe from block to block. So</p>

also everything is best fit in one screen so it is avoided that blind people have to go to another screen.

Concerning visual impaired: It all will depend on the person if he works or not with voice over. If he does not, he will work with the enlargement of the image. In that case it is important that it is big enough, that there is not too much information. For example, the picture used here is too busy. So clear blocks, not too much information. If there is no voice – over, the press button is sufficient.

*5 MINUTES - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?*

**Fragment 1: Selecting the route one is following to get information about the status of the traffic light from the menu of available routes and then crossing one street with instructions. In the middle of the street there is one stop place. (see map below: this is the trajectory (route) that has been chosen and what has been heard by the members of the CoP/purple dots: traffic lights) (5 MIN)**

**We first let them hear the whole flow. These were the reactions/thoughts**

Signal of the traffic light: did it come from the application? Yes, all info you are hearing comes from the application

Can each traffic light be heard? Is it via a certain signal that the mobile app is capturing? There will be a connection between the traffic light and the mobile application, but the light should be able to broadcast its data.

Is there a recognizable signal between red and green? Yes

**Then we divided the tape in three major actions:**

***Selecting the trajectory (sec 00 to sec 21) (5 MIN)***

Very clear for a blind persons. Voice over is clear, tone is good; Text is short and clear.

You should not forget that they are on the street, so reduce the information to what is really needed.

Visual impaired: it is nice build one under the other, so a nice column with options here. The use of black and white is good to give a certain feeling of tranquillity for the user. You will have to be careful if the person will



<p>enlarge the screen, that it will be of good quality.</p> <p><b><i>Standing at the crossroad and make a choice to select it (Sec 22 to 35) (5 MIN)</i></b></p> <p>If the blind person is following the route, a logical order of the crossroads should be built in the app. So no choice of crossing needed, but a kind of automatic detection of the crossroad.</p> <p>What if the application does not know which direction will be taken at a crossroad? In this case: best to reduce choice to the relevant options. The stop in the middle of the road can be a problem. In reality the person can cross the street in one time without having to stop at the spot in the middle, unless the traffic lights have changed.</p> <p>Most important: blind person should keep his focus on traffic, not the application, so automatic detection and only relevant information needed</p> <p><b>Information about the status of the light (sec 40 to 51) (5 MIN)</b></p> <p>Signal was clear and good to hear on the street (worker of centre Marckgraeve).</p> <p>When is the signal actually stopping: when you have crossed the street, or do you need as a user turn down the light yourself once you have reached the other side? You should avoid that the green light signal is still beeping or at crossroads with many lights, that you still get the information from the light you just crossed while you are already looking to the next light.</p> <p>For me the distinction between the green and red light was not clear (Licht &amp; Liefde, Blind people organization). Second attempt to listen to it? Person of Licht and Liefde ask that the frequency or hight of the tone should be more diverse. It sounds the same, apart from the rhythm. She would also open the possibility of incorporating a buzz function on the app (vibration).</p> <p>Better distinguish the name of the light (e.g. Camille Huysmanslaan velo) from the activation button of the light (knowing the status)</p> <p>Licht &amp; Liefde: thinking of the context of a traffic light, the sound can give also a certain impression. Avoid that the sound will irritate users.</p> <p><b>Main lessons of the UIL-session:</b></p> <p>Focus on blind persons is ok, but take also persons with visual impairment on board</p> <p>Keep it simple, pay attention to contrast, work with small letters instead of capitals, pay attention to colours</p>
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Make logical lists

Signal: re-investigate the rhythm and the height of the tone

Signal of activation of the status of a light should be more user friendly

**Final Recommendations: (5 MIN)**

Test and test thoroughly with the focus groups as the solution has many dimensions to take into account (context, balance focus during usage on app – traffic, interface, amount of information and presentation of the information, ...)

Sometimes blind person select to read text very fast in order to save time -> how does that impact the user experience? In what context can they do this, in what not?

**Usage constraints: (8 MIN)**

All: Context important and avoid distractions

All: Support or rather a back-up in case of particular situations

Licht & Liefde: main concern is that the signal of green light is coming from the application and no longer from the other side of the street as is currently the case with a normal “rateltikker”. Consequently, the sound in the app loses its capacity to be an orientation point.

Council of Accessibility: how to pick up the signal of lights that are not part of your route? Answer of consortium: So far the focus is on usage with trajectories you as a blind person know. It is therefore designed to support you, it is not meant to be in this stage a tool that you can use to explore new unknown routes.

INTER (Agency of Accessibility): If it is only for routes they know, do people need this? Answer: the application is now in design phase, so we need to restrict in order to develop. Secondly we design at this stage from the situation that a blind person has no support (no dog, no other person ‘available). In this case we know from feedback of blind persons that they probably don’t use it all the time during a trajectory, but it is seen as a support tool in case that there is no assistance available. Thirdly, so far rateltikkers are not present everywhere in the city. If this mobile rateltikker system works and can be rolled out easier, we can improve the accessibility for blind persons of the city.

**UIL Debriefing template – P3 Galilee**

Moderators	Flrodia Di Ciommo (CambiaMO)
Media of interview	<input checked="" type="checkbox"/> online via ZOOM <input type="checkbox"/> in person <input type="checkbox"/> by phone

Date	5/4/2021
Recorded?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes

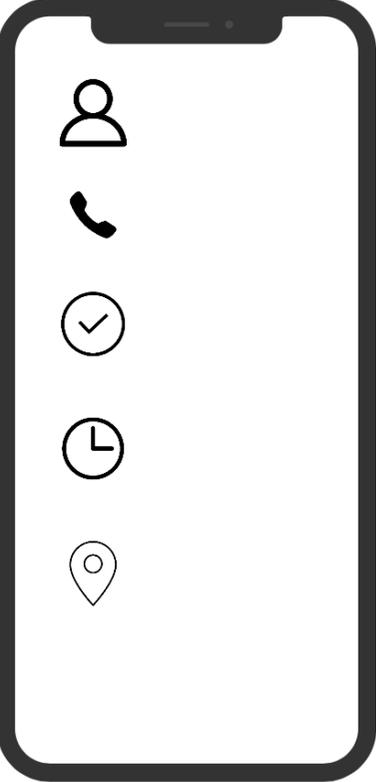
**Participants' Data**

#	Gender	Category (end-user, stakeholder, user representative <sup>31</sup> , etc...)	Age group	Additional Comments
1	Female	User representative	40-45	Policymaker org
2	Female	User representative	35-40	Policymaker org
3	Male	Developer	30-35	Safarcon
4	Male	Stakeholder	35-40	City of Jerusalem
5	Male	Project partner   Note taker	60-65	Technion
6	Female	Project partner   Moderator	50-55	Technion
7	Female	Project partner   Listener	50-55	CambiaMO

<sup>31</sup> In the case of user representatives, please specify the type of stakeholders

## Workshop questions.

Please, include notes concerning how the workshop has been carried out, pointing out difficulties, misunderstanding, notes “on the margins”...

Screenshot of reference	Questions and Notes
	<p><i>10 MINUTES - Please, name and describe the meaning of each presented pictogram in your words. According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?</i></p> <p><u>First icon:</u>            Limor: “user profile”            Ravid: indication of “uncompleted profile”            Sivan: “contact person”            Aamer (developer): “user profile”. User usually uploads photo, if not then you see this icon, so this could indicate an uncompleted user profile in the system.            Sivan: so maybe it is a “user profile” rather than “contact person”... not sure.            Limor: agrees, it looks like uncompleted            Yoram (Technion): “contact info”            Michelle (Technion): “contact info” or “user profile”</p> <p><u>Second icon:</u>            Ravid: option to make phone call or contact details            Sivan: dialing option            Aamer: option to see contact phone number and other contact info</p> <p><u>Third icon:</u>            Limor: “have no idea, trying to think”</p>

Sivan: maybe confirmation/completion/acceptance

Aamer: indication of completion of tasks

Fourth icon:

Sivan: something to do with time. Not sure about it. Maybe time remaining for using app, or clock/time/schedule/calendar, or maybe availability of something

Aamer: open hours, availability

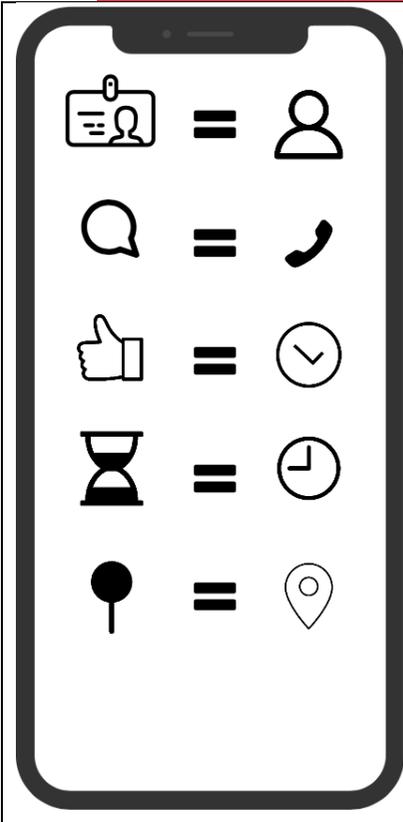
Fifth icon:

Limor: something geographical, like Google's location icon.

Sivan: location

Aamer: location

 <p><b>USER:</b> add user details, see user details, number of passengers,</p> <p><b>PHONE:</b> call, add to contacts, reserve, see contact details,</p> <p><b>CHECK SIGN:</b> accept/ed, approve/ed, enable/ed, activate/ed, confirm/ed, online, ok, yes,</p> <p><b>CLOCK:</b> timetables, routes, departure/arrival time, alarm</p> <p><b>PIN-POINT:</b> your current position, departure location, arrival location</p>	<p><i>5 MINUTES - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?</i></p> <p><u>First icon:</u> not clear if contact info or user profile; Ravid: recommends to add eyes and mouth, add one word of text to icon itself.</p> <p><u>Second icon:</u> make phone call or see contact details</p> <p><u>Third icon:</u> check mark/accomplished/done; preferably in green</p> <p><u>Fourth icon:</u> Sivan: the clock is the one most unclear. Maybe has multiple uses in different contexts clock/time/schedule/calendar; Limor: need to add numbers to make it look like a clock Michelle: very confusing, too similar to check mark. To distinguish from v-tag mark need different colours, or other time maybe 4 (instead of 3), or add the seconds hand to clock.</p> <p><u>Fifth icon:</u> Limor: Google's location mark; older people and digital illiterate don't understand it. Maybe need a map or small globe.</p>
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*5 MINUTES - Here some examples, who would like to comment? Do you think they are equivalent?*

First icon: profile card, still not clear if of contact info or user profile; recommend to add eyes and mouth

Second icon: chat icon, not familiar to all. Related to specific digital app such as WhatsApp.

Limor: Being a lawyer I was thinking of intellectual property (IP) / copyright claims. These might suggest that google/whatsapp are involved in this app in some way...

Michelle: cloud callouts could be a better fit.

Third icon: check mark is better than the “like” icon.

Again might be too specific to Facebook. May raise intellectual property (IP) / copyright claims.

Fourth icon:

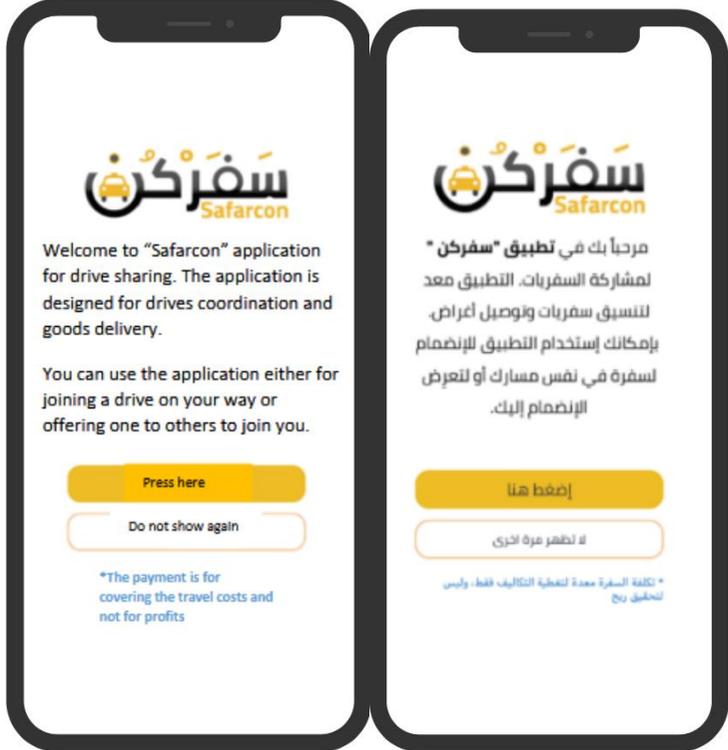
Aamer: thought of send clock before, but this represents something is happening. Not a good way to represent time.

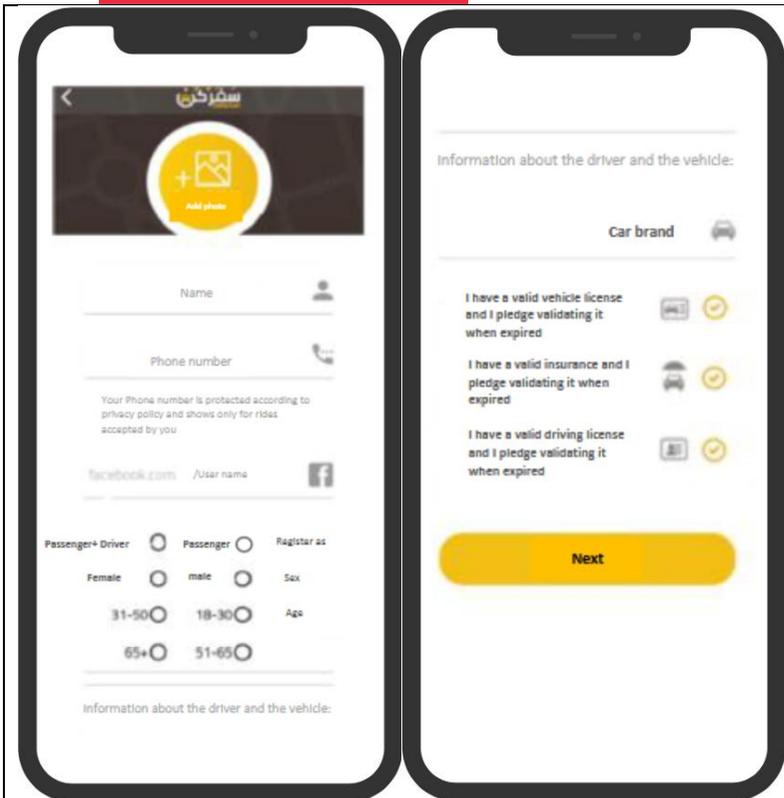
Michelle: sand clock is more a “timer” than clock/time/schedule/calendar; not appropriate.

Sivan: not a good fit.

Fifth icon:

Limor: pin without google location mark would not mean anything to me. Pin over map is preferable. Google’s location mark is better than the “black pin”; pin not good. Maybe need a small map with it.

Screenshot of reference	Questions and Notes
	<p><b>WELCOME SCREEN</b></p> <p><i>5 MINUTES: From the Safarcon welcome screen, what service do you think the app could provide?</i></p> <p>Ravid: Safarcon app’s welcome screen indication for mobility is the small car in logo, would add something to make it more dominate.</p> <p>Sivan: agree with Ravid and colours remind me of yellow Cap/Taxi service (maybe contour dependent).</p> <p>Limor: Car is too small and absorbed in logo. Would add something about delivery (package/envelope) and something about it being a shared ride service.</p> <p>Developer (Aamer): Safarcon – “your (her) travel” - the App name in Arabic is in female tense and incorporates both goods delivery and personal travel services dedicated for women. The original design was yellow-black colour scheme across all app screens.</p> <p>Sivan: Iconography recommendations: enlarge car and change its colour.</p>



**ICON 1: USER**

5 MINUTES: In this app context, what information is this icon providing to you?

**ICON 2: PHONE**

Limor: first icon could stand for enter your name

5 MINUTES: In this app context, what information is this icon providing to you?

**ICON 3: CHECK SIGN**

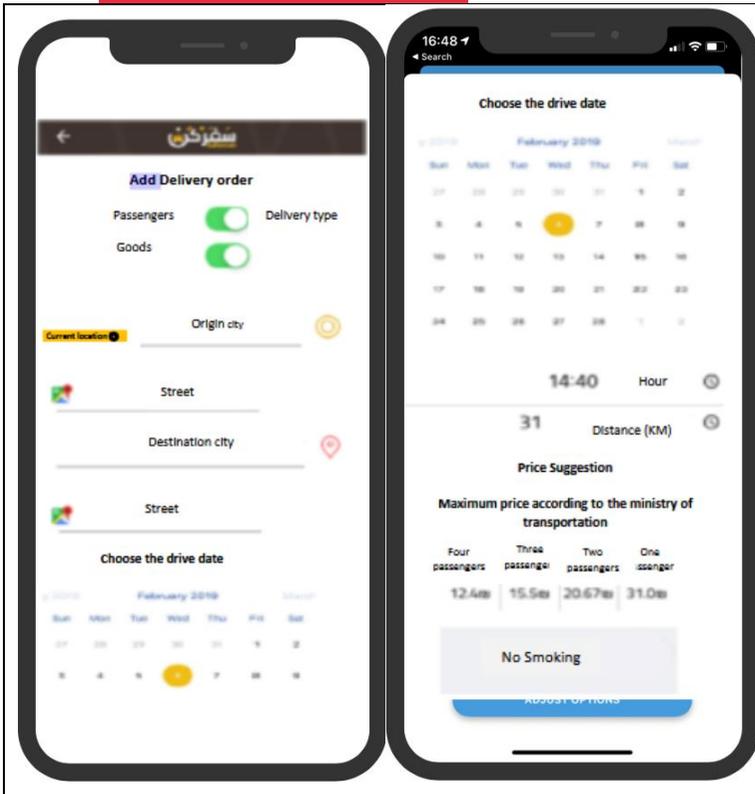
Sivan: represents a number and not an actual dialling... a little misleading

5 MINUTES: In this app's screen context, what information is this icon providing to you?

Ravid: sign of conformation, trusted.

Aamer (developer): the thought behind this was to keep simple and use few "generic" icons. User sees not only icon but also text next to it. This can be changed to achieve better understanding. Colors chosen like the logo.

Sivan: better to use green color for check sign.



**ICON 4: PIN POINT**

**5 MINUTES:** In this app context, what information is this icon providing to you?

Limor: very small... it looks like pin point on map, makes it more convincing that it is location. the use of Google location icon is not clear for elderly.

Sivan: not clear if actual hour to get service, or scheduled time... not sure what it means here.

Ravid: Google map looks like taken form other App.

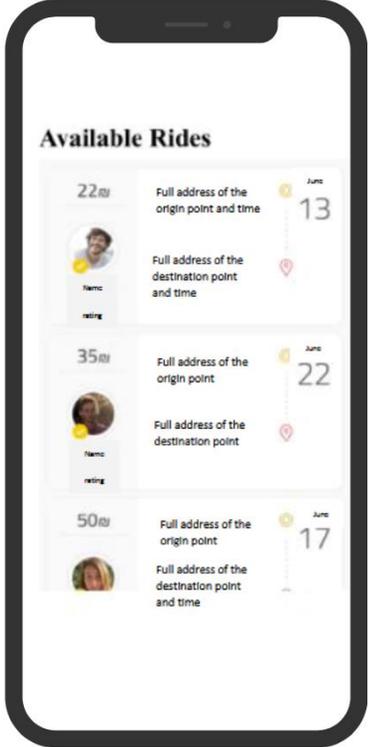
**ICON 5: CLOCK**

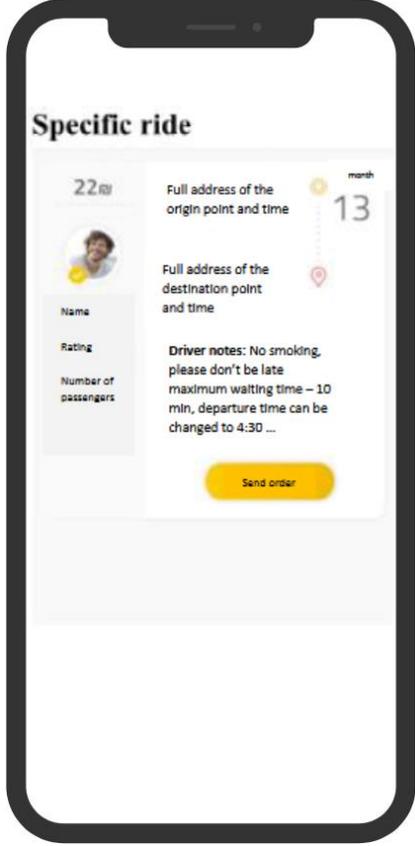
**5 MINUTES:** In this app's screen context, what information is this icon providing to you?

Aamer: clock on top of page you have a topic that tells you need to choose the date of drive. Action in steps to chose date followed by hour.

Sivan: use "time" instead of "hour"

Aamer: time/hour - semantics of language

	<p><b>ICON 3*: CHECK SIGN</b></p> <p><b>5 MINUTES:</b> In this app context, what information is this icon providing to you?</p> <p>Limor: check sign next to driver, is a “confirmed ride” between rider and driver. Order was accepted.</p> <p><b>ICON 4*: PIN POINT</b></p> <p><b>5 MINUTES:</b> In this app context, how are the different pictograms used for departure and arrival supporting comprehension?</p> <p>Ravid: yellow –origin, orange – destination.</p>
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	<p><i>5 MINUTES: Considering the whole digital application interface, what additional information attached to the icons is helping you or would help you in understanding their meaning?</i></p> <p><i>What additional information does the icons' colour provide to you ?</i></p> <p>Sivan: pin point on small map. Accept sign, should be in green, much more clear even though not confirms the visual scheme of app.</p> <p>Limor: red – feel like something is wrong. If green – OK.</p> <p>Aamer: red represents also love.</p> <p>Limor: all interpretations in the eye of the beholder.</p> <p>Ravid: text is helpful.</p> <p>Sivan: the writing on icon is helpful and provides confirmation I understood icon correctly.</p> <p>Limor: yellow bubble – could be add to my calendar</p>
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## UIL Debriefing template – P4 Madrid

Moderators	Floriea Di Ciommo, Gianni Rondinella, Miguel Jaenicke
Media of interview	x online via _____ Zoom _____ <input type="checkbox"/> in person <input type="checkbox"/> by phone



Date	13/04/2021
Recorded?	<input type="checkbox"/> No <input type="checkbox"/> Yes

## Participants' Data

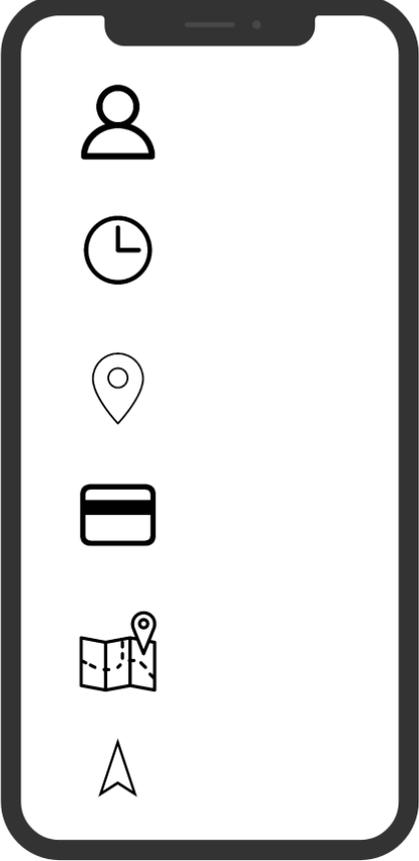
#	Gender	Category (end-user, stakeholder, user representative <sup>32</sup> , etc...)	Age	Additional Comments
1	F	Researcher	50	Facilitator/moderator
2	M	Researcher	50	Notetaker
3	M	Operator from La Pajara Madrid	40	OP
4	F	User representative	60	UR
5	F	User representative	60	UR
6	F	Public officer	50	PM
7	M	Open software specialist	45	EU
8	M	Representative from VIC	45	Time keeper
9	M	Developer of Coopcycle	40	DEV

<sup>32</sup> In the case of user representatives, please specify the type of stakeholders

10	F	Food store owner	50	OU
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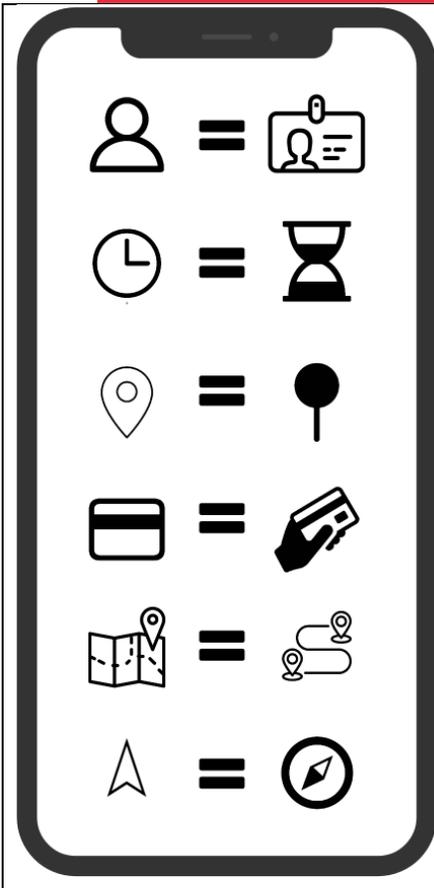
## Workshop questions.

Please, include notes concerning how the workshop has been carried out, pointing out difficulties, misunderstanding, notes “on the margins”...

Screenshot of reference	Questions and Notes
	<p><i>10 MINUTES - Please, name and describe the meaning of each presented pictogram in your words.</i></p> <p><i>According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?</i></p> <p>Acronyms: UR, User representative - EU, end-user - PM, policy maker - OU, operator user (restaurant) – OP, service operator - DEV, developer</p> <p>The first one represents: myself (UR), a profile (PM), the user (EU), the client (UR).</p> <p>The second one represents: time of delivery (PM), waiting time (EU), opening hours (OU).</p> <p>The third: location, where the ordering user is (UR), where it should be delivered (UR). No more ideas, consensus</p> <p>The fourth: the payment (OU), method of payment (UR). No more ideas, consensus</p> <p>The fifth: itinerary, how to reach a place (UR); a map (EU); suggestions of where to move (PM), where the rider starts, where the rider is now and where they should go (OU).</p> <p>The sixth: the route (EU), others agree but it is not so clear because if the previous one is the rout what is this</p>



	<p>one? (PM+UR), it is the symbol that appears when you move along a given route, but it is not straightforward (consensus on this).</p>
	<p><i>5 MINUTES - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?</i></p> <p>The credit card could be replaced by a Euro sign (DEV).</p> <p>The clock could be replaced by a symbol of a sand clock (DEV).</p> <p>The map could be replaced by a rounded globe (EU).</p> <p>The location could also be indicated by a pin (EU).</p>



*5 MINUTES - Here some examples, who would like to comment? Do you think they are equivalent?*

The ones on the left-hand are more universal (PM+EU). The one on the left-hand are simpler (almost all, except UR which thinks that the credit card with the hand is clearer)

The most controversial and source of discussion is the ones about time:

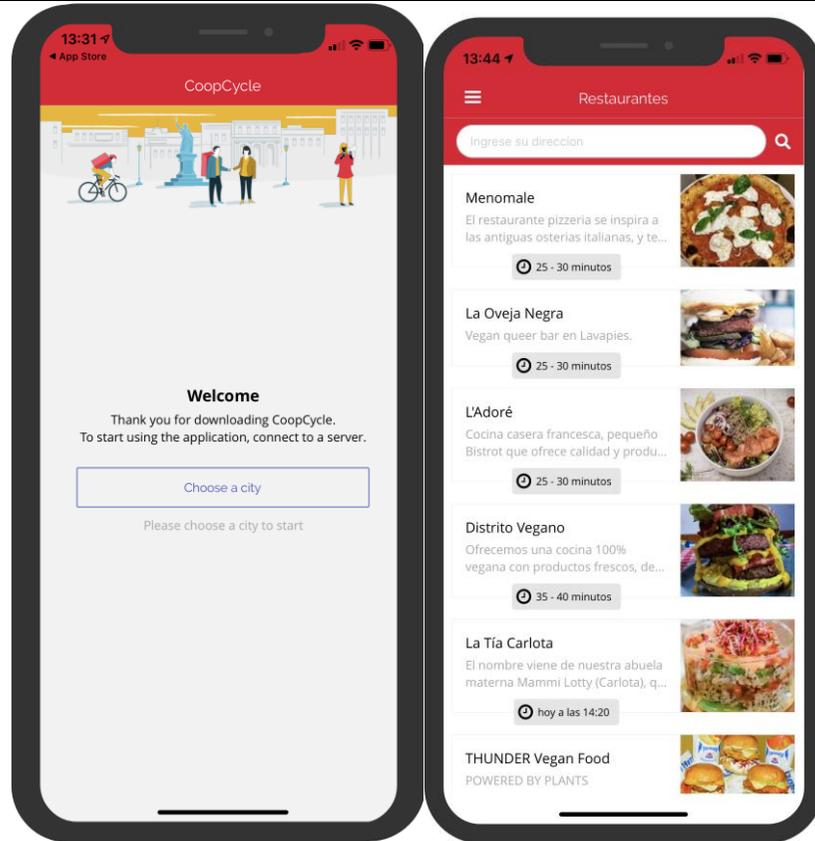
One participant says “I would put the analogical clock with more clear hands, the sand clock means waiting” (UR).

Another person prefers the ones on the left (UR). The sand clock is a concept of waiting time and not opening hours or service hours (OU+EU).

The ID card on the right-hand might be beautiful but may not be useful to refer to profile/account.

The pin is not so recognizable. It depends if you use an I-phone or Android. The one on the left is from Google (DEV).

The meaning depends also in the type of user: it may indicate something different for the end-user or for the rider (OP)

**Screenshot of reference**

**Questions and Notes**
**WELCOME SCREEN**

5 MINUTES: From the CoopCycle welcome screen, what service do you think the app could provide?

Please comment

The bike is on the front and the food is not visible, there should be an icon associated with food. Now it could be delivery of anything, the fact that the service delivers food is not clear (PM+UR+EU, consensus).

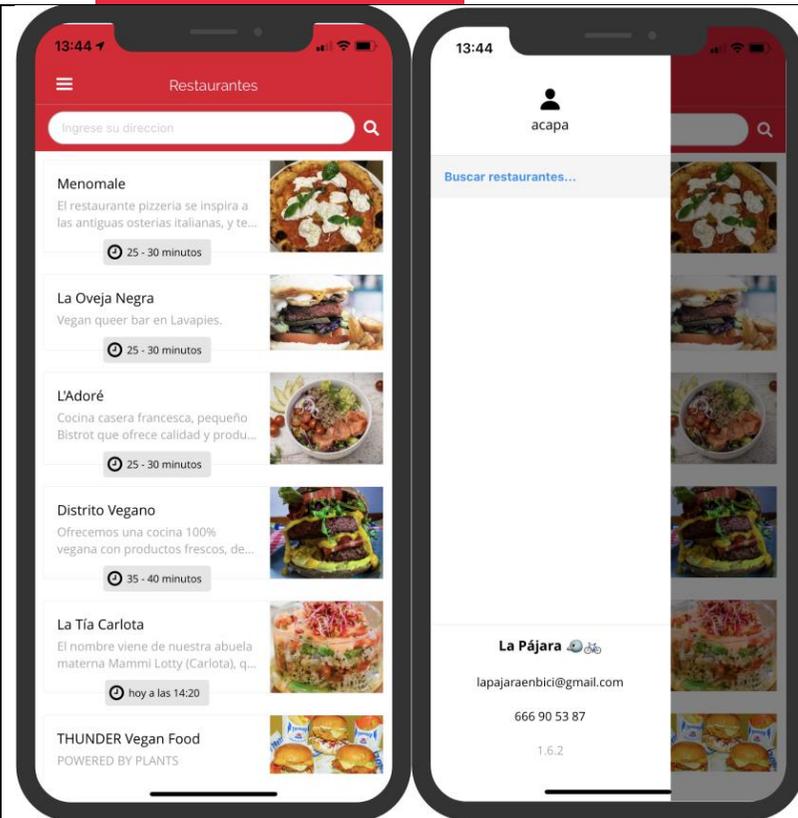
**ICON 1: THREE LINES**

5 MINUTES: In this app context, by clicking on this icon, what do you expect to happen?

To set further options, to find more information, to search for more restaurants, to close the session, to introduce data of a user or profile (PM+UR+EU).

Close the session should be more visible (UR).

Lack of orientation where to introduce the address for delivery (PM).



### ICON 2: CLOCK

*5 MINUTES: In this app context, what additional information is this icon providing to you?*

Different and divergent answers (uncertainty among all participants):

- How long will it take to be delivered? It may be, but not clear (PM)
- From what time on, you will have your order delivered (EU)
- Opening hours of the store? (PM)
- At what time the delivery could be made (UR+EU)
- 

If it is waiting time, the sand clock would be better, but otherwise it indicates the time you could order.

In any case there is an ambiguity between: waiting time to initiate an order vs. waiting time once the order has been placed, so to receive the order (consensus).

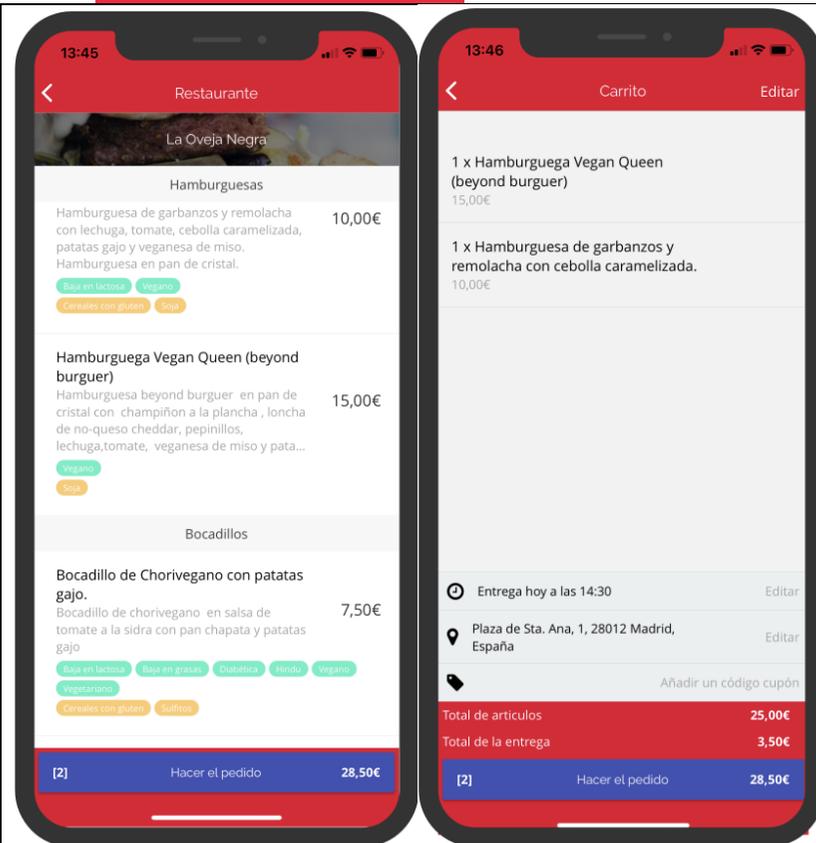
It is different in every menu, so it creates confusion and doubts (consensus).

### ICON 1: USER

*5 MINUTES: In this app context, by clicking on this icon, what do you expect to happen?*

Personal data (UR). If you have registered, supposedly your data should be already entered. It is not clear why the data are not stored from previous orders; the reason is not explained (PM+EU+UR). In the history of my account the fact the “previous orders” and “my address” are missing info is something that should be explained (PM).

Great differences between mobile app and web app creates confusion (UR)



**ICON 3: CLOCK**

*5 MINUTES: In this app context, by clicking on this icon's editable field, what do you expect to happen?*

The option to choose another day and time (everybody agree)

**ICON 4: PINPOINT**

*5 MINUTES: In this app context, by clicking on this icon's editable field, what do you expect to happen?*

It indicates the option to change your address (PM).

To confirm your address, to make sure that your address is correct (EU, UR).

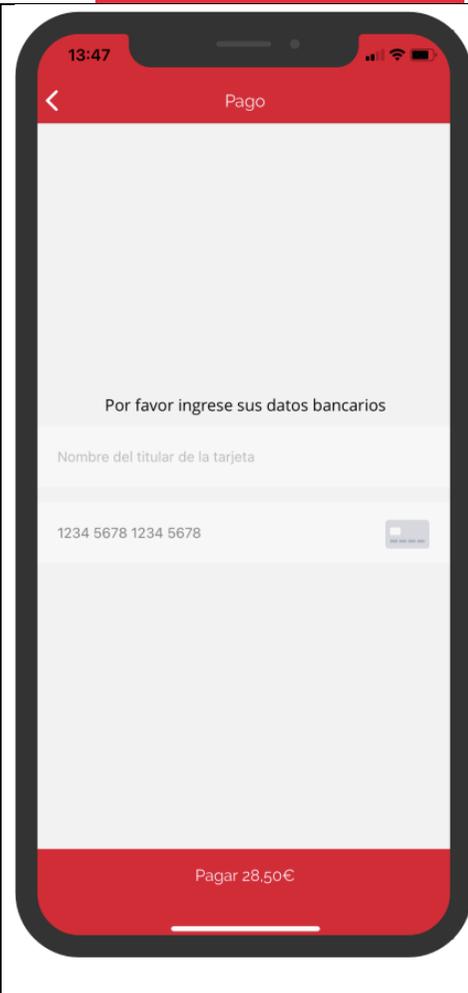
To see the address so to find any possible error, to make sure (consensus).

**ICON 5: TAG**

*5 MINUTES: In this app context, by clicking on this icon's editable field, what do you expect to happen?*

A blank to insert a comment, such as conditions to deliver, or any additional indication for the rider or to the restaurant (e.g. do not deliver cold, the last time it was delicious, etc.)... consensus

To comment when there is a workflow mistake.

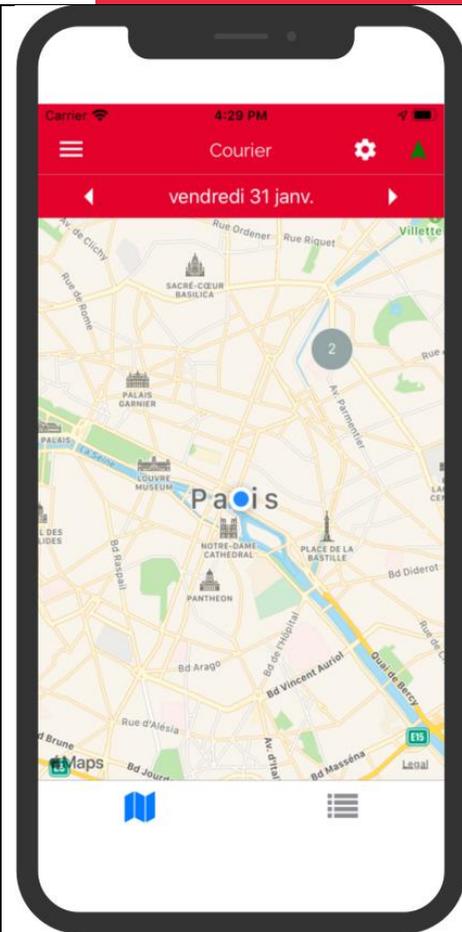


**ICON 6: CARD**

**5 MINUTES:** *In this app context, what additional information is this icon providing to you?*

I would put the icon of the card very large, for people who are not familiar, or people with cognitive impairment. And not shaded as it is now (consensus)

I would add the Euro symbol (UR). Both icons should be included (consensus)



*5 MINUTES: This one is a courier screenshot. Please comment on the use of icons.*

*5 MINUTES: What additional information attached to the icons is helping you or would help you in understanding their meaning?*

This is a screen that only the rider sees. The user does not see it. The user has a view about the status of the delivery.

Distribution of tasks for the rider, that could be clearer. Not well distributed to find it. You need the number of the order, the code assigned to it. If you have more than one order, you need to write it with a marker. (OP)

The control to finalize the action, notifying that the product was delivered could be improved. It was copied from other platforms, because people are used to these platforms, even when it is not intuitive. Restaurants have the same function to accept an order. (OP)

The clock generates doubts: the restaurant opens at that time? my order is delivered? Is it the waiting time? Not clear for the user. (OP)

I don't understand the order in which the restaurants are shown (OU). A filter would be a good idea. The most intuitive criteria is the closest to you, maybe a criteria of listing options could be rating, price, alphabet. Another person: the ones that are available for today should be listed before. Once, the first restaurants that appeared listed were not available until the following day. That was strange.

	<p>Web and app are different kinds of programming. The order of listing is the order of creation. Availability is not as simple to put into a formula, a code to do it. (OP)</p> <p>The Home should indicate something else, maybe asking the address, because it is the most important step. (consensus)</p>
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**Final comments:**

This was the 8<sup>th</sup> CoP of P4 and relationships among participants are friendly and relaxed. Users and non -users, developers, operators, policy makers know each other and are happy to stay there and share the CoP discussions, knowledge and express their doubts. One thing to stress is related with the strong interest of the developer to be there and listen what the other participants say about general apps and specific Coopcycle icons.

Thinking in colour blind people. It is required to generate contrasts, labels that may be difficult to distinguish, mainly the interface as users. For instance, labels for indicating allergies. Difficulty in the contrast of red and green, for instance.

Participants make often comment on the (in)stability of the app, the fact that freezes, that you have to close it and start it again.

Many comments of the errors in inserting the address.

Moderators	Thais Lamoza and Floridea Di Ciommo
Media of interview	<input checked="" type="checkbox"/> online via Zoom <input type="checkbox"/> in person <input type="checkbox"/> by phone



Date	26.03.2021
Recorded?	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes

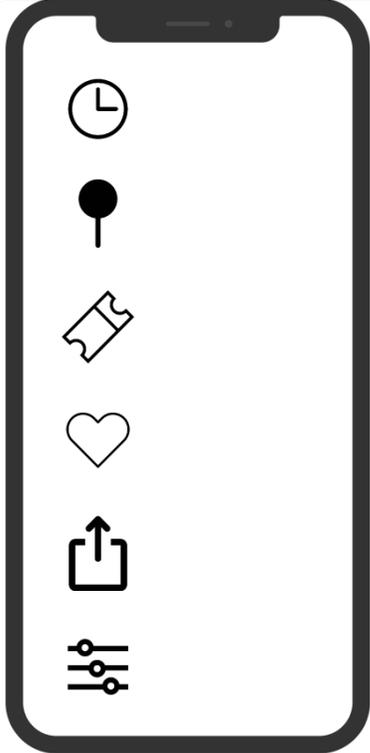
## Participants' Data

#	Gender	Category (end-user, stakeholder, user representative <sup>33</sup> , etc...)	Age	Additional Comments
1	Female	Researcher		
2	Male	Civil society representative		
3	Male	Civil society representative		
4	Female	Project partner   Moderator		Door2Door
5	Female	Project partner		CambiaMO

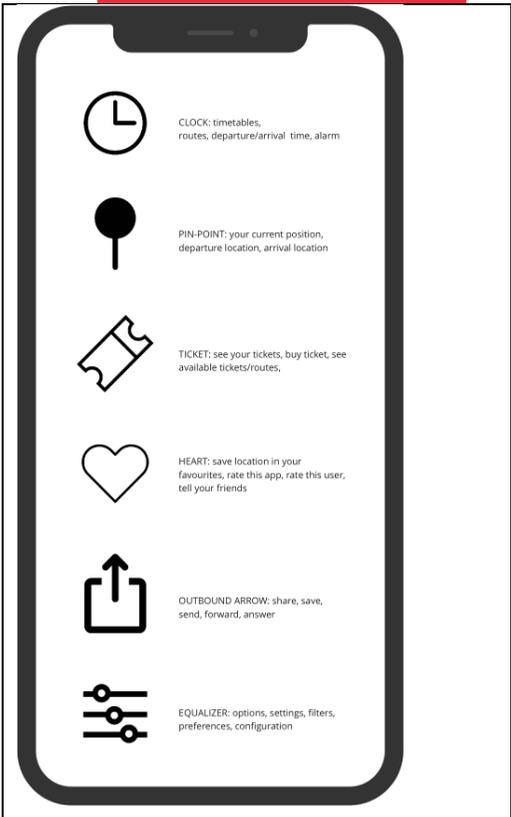
<sup>33</sup> In the case of user representatives, please specify the type of stakeholders

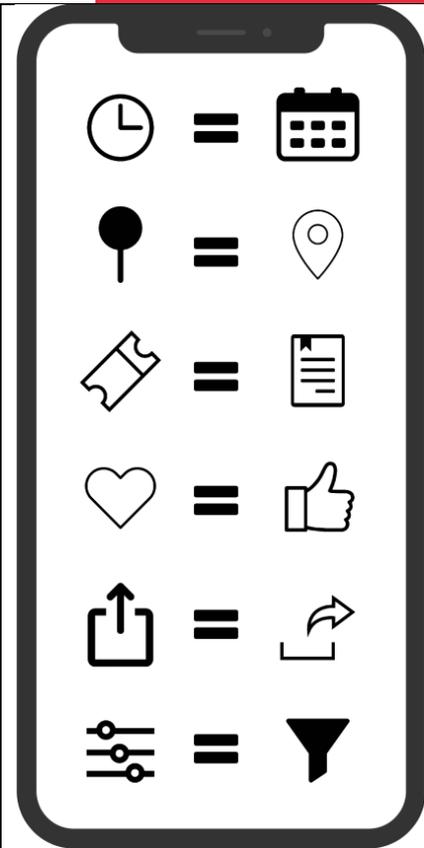
## Workshop questions.

Please, include notes concerning how the workshop has been carried out, pointing out difficulties, misunderstanding, notes “on the margins”...

Screenshot of reference	Questions and Notes
	<p><b>10 MINUTES</b> - Please, name and describe the meaning of each presented pictogram in your words.</p> <p>According to your experience, what does this symbol/icon mean or what actions does it trigger in a digital application?</p> <p>clock:</p> <ul style="list-style-type: none"> <li>- has been struggling with it in the beginning</li> <li>- looking up the schedule</li> <li>- timetable of the vehicle</li> <li>- Is the ordered or requested vehicle arriving on time? - can get the info with it, if it's on time.</li> </ul> <p>pin:</p> <ul style="list-style-type: none"> <li>- not sure or clear - could mean it stops at my place</li> <li>- on the other side, if I have given an order for a requested vehicle: GPS location maybe</li> <li>- looks like a lollipop - should be the pin of location of a stop but it's not evident</li> <li>- not sure whether the stop and the vehicle have the same pin or have some kind of characteristics that differ (form o.a.)</li> <li>- not sure what this function shall do at all</li> <li>- not sure what to expect at the pin: stop?</li> <li>- highly dependent on the use case and situation probably - might have different meanings <ul style="list-style-type: none"> <li>- where I stand at the moment or could mean where is the vehicle at the moment</li> </ul> </li> </ul> <p>ticket:</p> <ul style="list-style-type: none"> <li>- ticketing - buy a ticket and according functions such as tickets for short trips, how many tickets etc.</li> </ul>

	<p>heart:</p> <ul style="list-style-type: none"><li>- not sure - 'like' thumb function from facebook ?</li><li>- unclear function for the app: like app? like specific function in ticketing?</li></ul> <p>box:</p> <ul style="list-style-type: none"><li>- understanding of leaving something</li><li>- in connection of vehicle ordering: no connection what we understand there</li><li>- not connection to what it should support</li><li>- maybe sharing something, like in teams a screen o.a.</li><li>- doesn't have the envelop like sharing something, so unclear</li><li>- maybe share the route or something</li></ul> <p>bars:</p> <ul style="list-style-type: none"><li>- maybe connections 'Verbindungen'</li><li>- preferences maybe</li><li>- not clear</li></ul>
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 <p><b>CLOCK:</b> timetables, routes, departure/arrival time, alarm</p> <p><b>PIN-POINT:</b> your current position, departure location, arrival location</p> <p><b>TICKET:</b> see your tickets, buy ticket, see available tickets/routes,</p> <p><b>HEART:</b> save location in your favourites, rate this app, rate this user, tell your friends</p> <p><b>OUTBOUND ARROW:</b> share, save, send, forward, answer</p> <p><b>EQUALIZER:</b> options, settings, filters, preferences, configuration</p>	<p><b>5 MINUTES</b> - Your meanings have been added to the most used ones. Are there other pictograms you've seen used to issue the same message?</p> <p><b>pin:</b></p> <ul style="list-style-type: none"> <li>- there is a map missing to understand what the pin point is for</li> <li>- look at google maps or streets maps: see how they pin point the locations - different pins             <ul style="list-style-type: none"> <li>- you should take a form that people are familiar with in regards to shape and colour to get the idea what it's about</li> </ul> </li> </ul> <p><b>outbound arrow:</b></p> <ul style="list-style-type: none"> <li>- give letters to give hint of information sending</li> <li>- give more hint of the issue of information sending or sharing</li> <li>- maybe include some sort of letter to create a better understanding</li> </ul>
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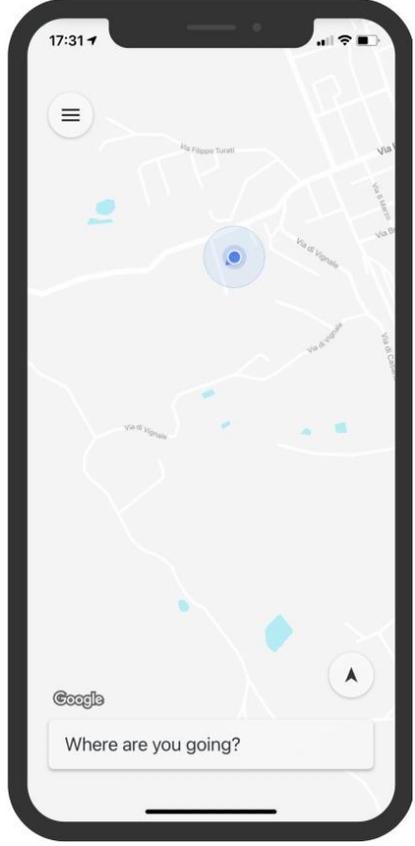
5 MINUTES - Here some examples, who would like to comment? Do you think they are equivalent?

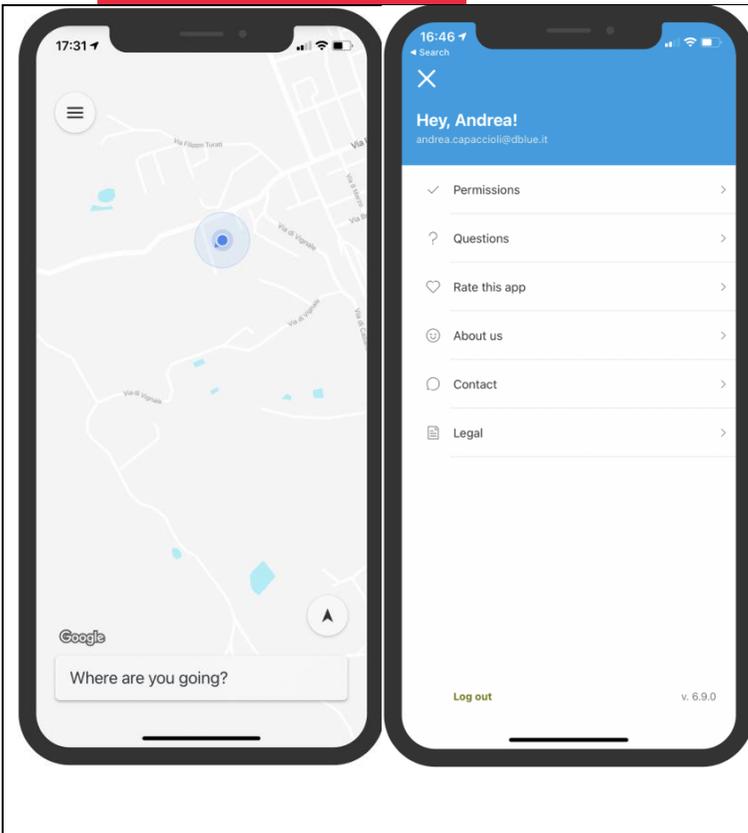
symbol:

1. clock is more clear
  - right one is calendar not time
2. pins are both unclear without map
3. ticket - don't see any connections to the INDIMO project
  - the icon on the right refers to a document
  - ticket is more clear, the right icon not understandable - no connection to ticket
4. heart more used; thumb is referring to facebook
  - heart icon is rather understandable as saving something or favourite
  - thumbs up is more 'like'

→ not the same meaning
5. not clear at all
6. the icon on the right is the more used for filter



Screenshot of reference	Questions and Notes
	<p><b>ICON 1: SANDWICH</b></p> <p><b>5 MINUTES:</b> In this app context, by clicking on this icon, what do you expect to happen? What information do you expect to appear?</p> <ul style="list-style-type: none"> <li>- perhaps the possible selections</li> <li>- expect to pop up something where I can put in the location, or info on the routing, second location where I am or want to got</li> <li>- to get some board or more options in the app</li> <li>- context menu opens maybe previous icons open maybe</li> <li>- everything I can do in the app</li> </ul>



### ICON 1: SANDWICH

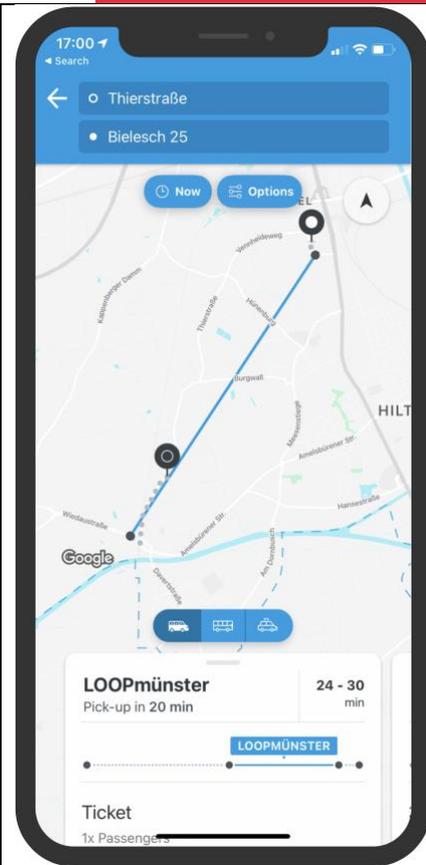
5 MINUTES: This is the screenshot that appears after clicking on the sandwich icon. Please comment around your expectations and actual contents provided.

- was expecting more the possibilities of the app instead of the legal background situation
- would have expected to be able to 'do' something and not just get information
- is fulfilling most of what is expected as it seems to be a navigator app
  - is missing restrictions: by bike? by car? etc.
  - Want to go the direct way? motorway? - preferences of the function
  - not clear if its a transportation connection or just on demand

### ICON 2: HEART

5 MINUTES: In this app context, by clicking on this icon, what do you expect to happen?

*(not asked due to time)*



### ICON 3: PINPOINT

5 MINUTES: Looking at the two pinpoint icons on the map, can you tell which one is the departure point and which the arrival?

- by just looking at it, it is not clear which point is what
- need to started thinking and interpret the usage, which is never a good sign - with the white point my location
- lower pin point is not the starting point
  - probably while the going
- pin points need to be clearer
- thought they are connected to the info of the top bar where we type in our location/ destination data - pin points should be aligned in the pinpoint
  - makes it unclear if they are connected or not
- pin with white point is destination and with black is location

### ICON 4: CLOCK

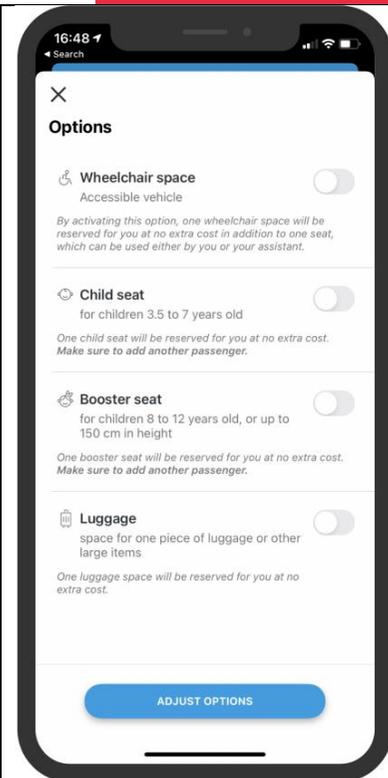
5 MINUTES: In this app context, by clicking on this icon, what do you expect to happen?

- clear - timing aspect

### ICON 5: OPTIONS

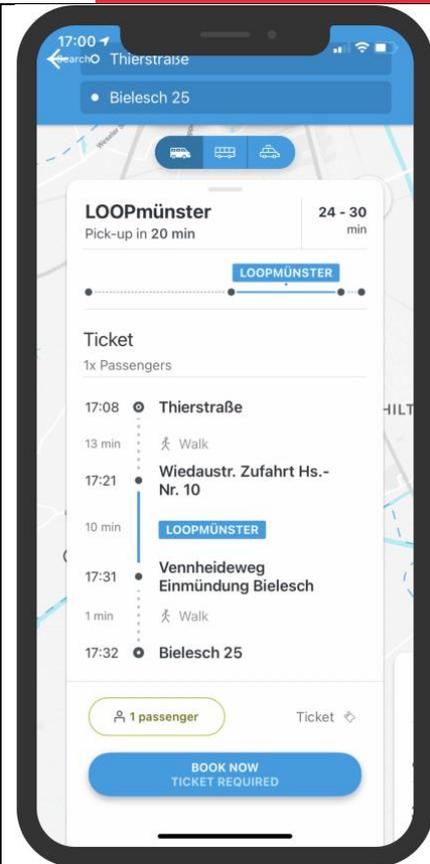
5 MINUTES: In this app context, by clicking on this icon, what do you expect to happen?

- whether I want to drive alone o.a.
- luggage, or child option needs to be added
- wheelchair
- number of passengers
- size of vehicle
- unsure at what point at the process we are



**5 MINUTES: What other information would you like to be included here?**

- option could be renamed in special needs
  - more accurate
- missing: time issue with the pick-up time: expected time to go to pick-up point might differ from the time people actually need
  - people might be slow walkers o.a.
- orientation problems could occur
- question of servicing - orientation and option of pre-booking?!
- pre-booking time is crucial especially in more rural areas
- app should be connected to google maps for example for getting a voice output of how to walk from current location to pick-up point
  - routing with vocal guidance
  - in several languages maybe
- baby seats are missing at all
- another info: do I need help to get into the vehicle? - so far unclear info
- app should indicate on which side of the road the vehicle is picking me up



### ICON 5: PASSENGER

**5 MINUTES:** In this app context, by clicking on this icon, what do you expect to happen?

- 13 min - would be important to know distance in km
- 1 passenger: standard/ normal option
  - are there different options, such as mother with child, more passengers? not clear
- amount of passengers

### ICON 6: TICKET

**5 MINUTES:** In this app context, what additional information is this icon providing?

- age of passengers?
  - reductions for certain age groups maybe
- yearly ticketing?
- discounts on ticketing
- registered user or new passenger?
  - which way of paying a ticket
- one time ticket for a short ride or long ride etc.
- Do I purchase the ticket directly via the app? unclear buying process
- How do I handle ticketing when riding with a young child who doesn't need a ticket? unclear process for new users

**5 MINUTES:** What additional information attached to the icons is helping you or would help you in understanding their meaning?

## Annex 4 – UIL online survey



INDIMO - *Inclusive digital mobility solutions* - Universal Interface Language Icons survey

### 1. Intro to the survey

Hello,

This survey is part of the INDIMO project, an EU-funded Horizon 2020 project that aims to extend the benefits of digitally interconnected transport systems to people that currently face barriers in using or accessing such solutions.

Many digital tools have emerged the past years offering personalized services at every stage of a journey and home deliveries have become very popular. INDIMO believes that it is important that all people can benefit from these digital solutions. This is why we need your help to understand the needs and attitudes you have towards the digitalisation of mobility and delivery services. By completing our survey, the INDIMO researcher will be able to better understand your requirements towards these tools and make them easier to use and more inclusive.

It will take you around 20 minutes to complete this survey. For some questions you have to select an option from a list, for other questions the answer is more open-ended and we kindly ask you to write down your opinion or experience. There are no wrong answers. If you don't want to answer a particular question, please select "I prefer not to say".

Participants' personal data (email address, background information) will only be stored by the INDIMO Consortium for the purposes of the project. Only under specific consent provided at the end of this survey, participants may agree to be invited to take part in future research activities and initiatives beyond the project end.

Read more information about the INDIMO project at [www.indimoproject.eu](http://www.indimoproject.eu)

If you have a question, don't hesitate to contact our research team:  
[rebecca.hueting@dblue.it](mailto:rebecca.hueting@dblue.it)

Thanks in advance



## INDIMO - *Inclusive digital mobility solutions* - Universal Interface Language Icons survey

### 2. Consent form

The INDIMO Team

The INDIMO research does not have any commercial purpose. As involved participant, you accept that you participate on a voluntary basis and can withdraw from the activities at any time. Your contribution may be published in project reports, journal articles, conference presentations, and via any other mode of scientific exchange and dissemination considered appropriate, while protecting your anonymity. Results will be published in aggregated form and personal data will never be published without your previous consent.

Your personal data (e-mail address) will be collected, processed and protected according to the General Data Protection Regulation (GDPR) (EU) 2016/679. You have the right to request access to and rectification or erasure of your personal data just sending an email to the responsible of data treatment listed hereafter. You will also have the right to lodge a complaint with any European supervisory authority.

The full project privacy policy is available at [www.indimoproject.eu/privacy-policy](http://www.indimoproject.eu/privacy-policy)

RESPONSIBLE FOR DATA TREATMENT IN ACCORDANCE TO THE GDPR (DATA CONTROLLER)

Deep Blue, Piazza Buenos Aires 20, 00198 Rome (Italy) – [info@dblue.it](mailto:info@dblue.it)

CONTROLLER'S REPRESENTATIVE IN THE SPECIFIC PROJECT

Rebecca Hueting, Deep Blue: [rebecca.hueting@dblue.it](mailto:rebecca.hueting@dblue.it)

After reading the information sheet above, by proceeding with the survey you consent voluntarily to participate in the current INDIMO survey and understand that you can refuse to answer questions and withdraw from it at any time, without any reason.





INDIMO - *Inclusive digital mobility solutions* - Universal Interface Language Icons survey

### 3. The use of pictograms in the digital mobility and goods delivery services

In this section we explore the use of pictograms in the digital mobility and goods delivery services. A pictogram is a picture, symbol or icon that represents a word or a phrase. In a digital context, you can point, press or click on pictograms to give instructions and/or access specific functions. Other times pictograms are only used to provide useful information.

Please leave us your answer focusing on your personal experience with mobility, transport and/or goods delivery applications for smartphones and mobile devices. Proceed also if your experience is very limited, your answers are very important for the European research!

1. Imagine you are using a mobile app and there are several pictograms you can interact with. For each proposed pictogram, how certain do you feel about the outcome when clicking on it?

Very certain

Certain

Slightly uncertain

Extremely uncertain

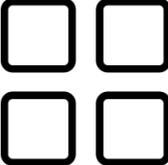
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Based on your experience, shortly describe the meaning of each pictogram

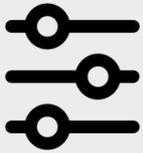




3. Please evaluate how clearly the pictograms represent the function **"OPEN MENU"**.

	Extremely clearly	Clearly	Somewhat clearly	Not at all clearly
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Please evaluate how clearly the pictograms represent the function "GO TO SETTINGS".

	Extremely clearly	Clearly	Somewhat clearly	Not at all clearly
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. Please evaluate how clearly the pictograms represent the function "RATE CONTENT/APP/USER".

Extremely clearly

Clearly

Somewhat clearly

Not at all clearly

	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

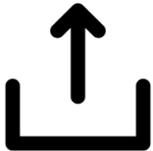
6. Please evaluate how clearly the pictograms represent the function "SHARE CONTENT".

Extremely clearly

Clearly

Somewhat clearly

Not at all clearly



7. Please evaluate how clearly the pictograms represent the function **"SAVE OR DOWNLOAD"**.

Extremely clearly

Clearly

Somewhat clearly

Not at all clearly

	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
---	-----------------------	-----------------------	-----------------------	-----------------------



<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------

8. Please evaluate how clearly the pictograms represent the function **"VISUALISE TRAVEL DOCUMENTS/TICKETS"**.

Extremely clearly

Clearly

Somewhat clearly

Not at all clearly

	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
--	-----------------------	-----------------------	-----------------------	-----------------------



<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------



<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------



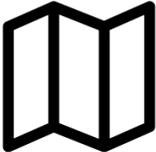
10. Please evaluate how clearly the pictograms represent the function "**CONTACT SUPPORT**".

	Extremely clearly	Clearly	Somewhat clearly	Not at all clearly
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

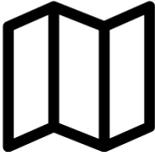
11. Please evaluate how clearly the pictograms represent the function "GO TO PAYMENT".

	Extremely clearly	Clearly	Somewhat clearly	Not at all clearly
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. Please evaluate how clearly the pictograms represent the function "VISUALIZE MAP".

	Extremely clearly	Clearly	Somewhat clearly	Not at all clearly
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. Please evaluate how clearly the pictograms represent the function "PLAN TRIP".

	Extremely clearly	Clearly	Somewhat clearly	Not at all clearly
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. Please match each pictogram with the function they better represent, based on your personal experience (select all that apply)

- View timetables
- Schedule travel
- View expected date/time of arrival/delivery
- View remaining time to arrival/delivery
- Find a date
- View current timing
- Set alarm
- None of the proposed ones




















































Other (please specify)

INDIMO - *Inclusive digital mobility solutions* - Universal Interface Language Icons survey**4. General questions on accessibility of digital services**

**How often do you use digital mobility or goods delivery services?**

- Every day
- A few times a week
- A few times a month
- Once a month
- Less than once a month

**How confident do you consider yourself when using digital mobility or goods delivery services?**

- Extremely confident
- Confident
- Somewhat confident
- Not at all confident

**15. Think about the digital application you use more often to access mobility or goods delivery services.**

Please tell us what you use it for and shortly describe in your words the content of the first screen that appears when you open the app (*it is not necessary to mention the name of the application*).

16. How often have you encountered the following barriers, due to the poor accessibility of the digital mobility or delivery services you use or would have liked to use?

Never	Rarely	Often	Always	
I could not use a digital app due to scarce readability of objects, texts or images	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I could not use a digital app due to physical limitations that prevented me providing the input required	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I had limited access to the services provided by a digital app since, from a gender perspective, I felt unsafe or unsupported	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experienced difficulties using a digital app due to situational or temporary impairments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Covid-19 provisions scared me from using touchscreen terminals or asking for help to other people while using a digital app	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experienced lack of support in using a digital app from other people due to Covid-19 confinement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have low familiarity with digital services in general	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I cannot understand the terminology used by digital apps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experience lack of support in using a digital app from other people due to the fact I do not have contacts with anyone who can offer it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not speak/understand the language used by	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



localdigital apps

Other (please specify)

17. How often did you experience situations similar to the ones described by the following statements, while using digital applications?

Never

Rarely

Often

Always

In my experience pictograms and/or descriptions of available functions are appropriately sized and well spaced





Available commands are simple and intuitive and/or I can customise them depending on my specific needs





The information provided in-app is helpful enough to allow me an intuitive use of the service





I can easily read all textual information and/or customise text size settings





It takes me too long to identify essential information

18. How often did you experience situations similar to the ones described by the following statements, while using digital applications?

	Never	Rarely	Often	Always
Thanks to the Terms and Conditions of the service I can easily retrieve and modify my personal data and decide how the service provider is collecting and using them	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If an error occurs, most applications I use provide me with appropriate error handling services and error prevention tips	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I click on an icon/pictogram and what happens next is not what I expect	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
While using an application I know how long it will take me to finalise the desired process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
After a new registration/installation, the application provides me with tips or tutorials to learn how to use the service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can easily understand how to contact the support center when needed, either through a chat, phone number or e-mail address	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. Can you recall and shortly describe one direct experience you had with any digital service or tool that you were not able to use?

20. What is your gender?

- Female  Male
- Non binary
- I prefer not to answer

**21. What is your age?**

- 18 to 24
- 25 to 34
- 35 to 44
- 45 to 54
- 55 to 64
- 65 to 74
- 75 or older

**22. How would you describe the context you currently live in?**

- Urban
- Peri-urban
- Rural

**23. What is your occupation? Please select all that apply**

- I work 35 hours or more
- I work 25-34 hours
- I work 24 hours or less
- I am a full Time student
- I am a part time student (less than 50% of my time)
- I am unemployed
- I am retired
- I prefer not to answer
- Other (please specify)

- None of the above

24. How often are you busy with care giving activities (e.g. children, elders, people with special needs, other...)?

- Every day
- A few times a week
- About once a week
- A few times a month
- Once a month
- Less than once a month

25. What is your approximate average household income?

- Under €15,000
- Between €15,000 and €29,999
- Between €30,000 and €49,999
- Between €50,000 and €74,999
- Between €75,000 and €99,999
- Between €100,000 and €150,000
- Over €150,000
- I prefer not to answer

26. What is the highest level of education you have completed?

You arrived at the end of the survey. We thank you for your effort and your contribution to our research project. Your answers will help us in improving the digital mobility system and make them more accessible to all.

The INDIMO project fores other surveys to assess and evaluate the improvements of the digital mobility apps. Read more information about the INDIMO project at [www.indimoproject.eu](http://www.indimoproject.eu)

If you have a question, don't hesitate to contact our research team: [rebecca.hueting@dblue.it](mailto:rebecca.hueting@dblue.it)

The Indimo Team

**27. Please leave us your email if you are available to be contacted for further INDIMO project activities (invitation to participate in further inquiries, interviews, events and workshops)**

Email Address

**28. Would you be available for us to contact you to involve you in other European funded projects research activities?**

Yes

No

**31. Would you like to receive INDIMO bi-annual newsletter?**

Yes

No



## Annex 5 - Icons' and application interfaces usability questions template

In this Annex we suggest a tentative adaptation of the usability heuristics and of the Universal Design principles to the contexts of digital mobility user interfaces. It is a first step into the accessibility analysis of DMS and DDS applications and it can be used during user-testing by professionals, designers and developers to collect initial insights and enhance inclusivity of their products.

### Norman Nielsen's adapted usability heuristics

**Visibility Of Status** - is the application providing you with enough information about where you are in a process, what you are doing and what you can expect as result?

**Match Between App And Real World** - is the application using familiar words, concepts and phrases?

**Consistency And Standards** - are the overall interface and the icons used consistent with others you have used before for your services? Are they consistent enough with the signage in the local area/s and physical environment where customers will most likely use the service?

**Recognition Rather Than Recall** - do icons come with other multiple cues to increase comprehension of their meaning? To what extent is the combination of visual icons, text (and auditory) cues increasing your comprehension about the actions you can perform while using the app? What are the most useful combination of cues in your personal experience?

**Minimalist Design - Aesthetic Avoids Information Overload** - is the app clear enough? do you think its appearance is supporting faster decisions?

**User Control/Freedom/Customisation** - are you allowed to decline or interrupt a procedure without consequences? Are you allowed to go some steps back in a process without losing the data already provided?

**Recognize, Diagnose And Recover From Errors** - is the app providing you with information about ongoing issues or problems?

**Error Prevention** - is the application preventing format or user input errors? can you easily change/modify/review your input without losing the work?

**Flexibility** (for beginners) and **Efficiency** (for experienced users) - is the application providing tips and guided step-by-step procedures at its first use? As an experienced user, are you able to skip or shortcut directly to the intended content/function?

**Help And Documentation** - is the application providing appropriate help or support documentation? Is this documentation easy to find and to read?

## Adapted Universal Design Principles

**Equitable Use** - are privacy, security and safety measures available to you? Can you easily find, read and navigate such contents?

**Flexibility In Use** - are different methods/modes of use available? Can you use different input devices to use available functions? Is the application providing you enough time to make savvy choices? is it adaptable to your pace?

**Simple And Intuitive Use** - is the complexity of the application appropriate for you? is it intuitive and consistent with your expectations? What is the least intuitive step or action you can perform?

**Perceptible Information** - how do you identify essential information? can you tell how they are differentiated from others?

**Tolerance For Errors** - are warnings of errors and hazards provided? are there fails-safe features?

**Low Physical Effort**- can you use the application with an acceptable cognitive and/or physical effort? what is the least sustainable effort for you while using this application? How do you feel when you have successfully completed a full procedure (e.g. order, payment)?

**Size And Space For Approach And Use** - are the different processes/functions comfortable to you? How do you feel while you navigate the app contents?

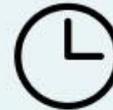
## Annex 6 - Preview of an icon usability and accessibility template

The icon card usability and accessibility template has been developed to offer an easy-to-use digital or printable document that can be used by professionals to report results of an icon's accessibility and usability evaluation, taking into consideration its specific user interface and the needs of people with diverse characteristics and needs.

In this first UIL version Annex we included the empty template and an example of its use with the clock icon evaluation.



## ICON NAME: CLOCK Analysis



### Application screens



Welcome screen



Home screen



#1 icon screen



### Intrinsic characteristics of icon

Colour	black, monochromatic
Contrast	1
Style	Wireframe 2D
Animation	/
File format	raster
Type	Control icon

### Characteristics of icon dependent on their use in the UI

Name	Clock
Label	/
Textual description	a wireframe minimalistic clock set on 3 hrs
Size on screen	1/40 screen height
Pixel ratio	1:1 (5x5 px)
Relative position on screen	bottom line field, aligned left
Link to multi-channel information (e.g. associated text or auditory signs)	/
Movement or Animation triggers (e.g. rollover)	/
Responsive behaviour (resizing, colour)	/
Linked interaction	On the first screen no action is triggered through the icon, it is only associated with expected time of delivery.  In the second screen, during order confirmation process, by clicking on the clock the time of delivery can be personalised.
Users' comments	In transport apps it may represent schedules or calendars, maybe also availability of service/opening hours, expected time of arrival of the ride-sharing vehicle. In delivery apps it could be waiting time before preparation, time of delivery or opening hours of the restaurant/food provider. It's not clear if the clock is associated with the departure or arrival time. The fact that it is used in multiple ways in the same app creates confusion. Unfortunately there is no text label in most screens where it is used. It would be clearer with hour numbers. <ul style="list-style-type: none"> <li>- 56% - set alarms</li> <li>- 20% to see current timing of smt</li> <li>- 10% to know the expected time of arrival/delivery of smt</li> </ul>



## ICON #1 ANALYSIS Evaluation

	Older people	Caregivers	Low digital skills	PMH Visually impaired	Foreign people	Lower educated people	Non connected people	BIPOC minorities	Lower income people	Socially isolated people	COVID-19 isolated people	People living in peri-urban or rural areas	Women
68%		56%				53%	58%	72%	57%				77%
4		5				5	5	5	5				5
1		2				2	2	3	3				3
0		0				0	0	0	1				1
0		0				0	0	0	0				0
1		2				2	2	3	2				3
3		3				3	3	4	3				4
5		5				5	5	5	5				5

### Practical examples | Pros and Cons



Home screen

- PROS**
- monochromatism
  - wireframe style
  - high contrast
  - position of the icon



#1 Icon screen

- CONS**
- too small
  - low consistency (used for more than a single action/interaction)
  - no label or textual explanation

### Evaluation summary

[Short Evaluation + Proposed solutions, mitigations]

The clock icon in the first screen can be rendered bigger and provided with a label  
The clock icon in the second screen can be substituted by a bigger hourglass and a label

### Icon evaluation

Results from the evaluation of icon accessibility from target users (1:5)\*

Comprehensibility Test-users who recognized the icon's intended meaning [%]	63%
Colour and contrast (visibility level for the related user group)	5
Size and position on screen (appropriateness level for the related user group)	2
Label and textual description (meaningfulness level for the related user group)	0
Associated multi-channel cues (meaningfulness level for the related user group)	0
Consistency of use in the app	2
Consistency of use in other apps	3
Multi-Cultural mindfulness	5
Usability testing**	/
<b>SCORE</b>	<b>17/35</b>

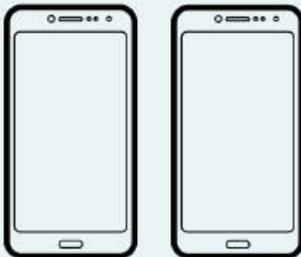
\* Due to shortage of time and available respondents, the evaluation from target test-users is only simulated, therefore data are hypotheses based on the few opinions collected during UIL exercises and from UIL survey  
\*\* Icons' usability tests can be run on whole sets of icons of a prototype or existing app. Adapted heuristics are included in D2.3 - Annex 4



## ICON NAME: CLOCK Analysis

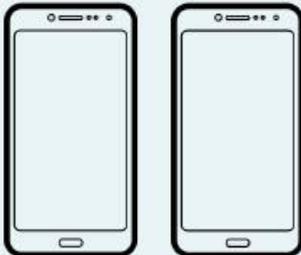


### Application screens

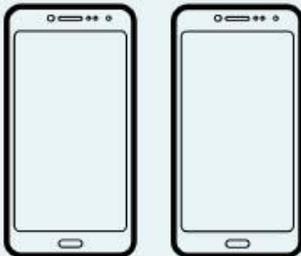


Welcome screen

Home screen



#1 icon screen



### Intrinsic characteristics of icon

Colour	[main colour code - RGB web, up to 3 colours]
Contrast	[contrast ratio from contrast checker]
Style	(e.g. Wireframe/Abstract/Realistic, Flat design 2D, Skeuomorphic design - 3D)
Animation	[describe or leave empty if absent...]
File format	[raster, vector]
Type	[Object, Pointer, Control, Tool, Action]

### Characteristics of icon dependent on their use in the UI

Name	
Label	
Textual description	[describe or leave empty if absent...]
Size on screen	
Pixel ratio	
Relative position on screen	
Link to multi-channel information (e.g. associated text or auditory signs)	[describe or leave empty if absent...]
Movement or Animation triggers (e.g. rollover)	[describe or leave empty if absent...]
Responsive behaviour (resizing, colour)	[describe or leave empty if absent...]
Linked interaction	[what happens when the user interacts with this icon]
Users' comments	



