URBAN LOGISTICS AS AN ON-DEMAND SERVICE

ULaaDS decision support toolbox; final

ULaaDS D6.7: ULaaDS decision support toolbox

Date: 15/02/2024

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The ULaaDS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 861833. ULaaDS is a project under the CIVITAS Initiative.

CIVITAS 2030
Sustainable and smart mobility for all

THE CIVITAS INITIATIVE IS CO-FUNDED BY THE EUROPEAN UNION

Deliverable details

Project acronym	Project title
ULaaDS	Urban Logistics as an on-Demand Service

WP	Deliverable title
6	ULaaDS D6.3: ULaaDS decision support toolbox; v1

Document history

Version	Date	Author(s)	Status*	Dissemination level**
1.0	15.02.2024	Müller, Philipp Jankowski, Sandra	Final	PU

*Status: Draft, Final, Approved, Submitted (to European Commission).

Dissemination Level: **PU: Public; **CO**: Confidential, only for members of the consortium (including the Commission Services); **EU-RES** Classified Information - restraint UE; **EU-CON**: Classified Information - confidential UE; **EU-SEC**: Classified Information - secret UE

Contractual delivery date	Actual delivery date	Deliverable type*
02/2024	02/2024	OTHER

*Deliverable type: **R**: Document, report; **DEM**: Demonstrator, pilot, prototype; **DEC**: Websites, patent fillings, videos, etc; **OTHER**; **ETHICS**: Ethics requirement; **ORDP**: Open Research Data Pilot.

Project abstract

ULaaDS sets out to offer a new approach to system innovation in urban logistics. Its vision is to develop sustainable and liveable cities through re-localisation of logistics activities and re-configuration of freight flows at different scales. Specifically, ULaaDS will use a combination of innovative technology solutions (vehicles, equipment and infrastructure), new schemes for horizontal collaboration (driven by the sharing economy) and policy measures and interventions as catalysers of a systemic change in urban and peri-urban service infrastructure. This aims to support cities in the path of integrating sustainable and cooperative logistics systems into their sustainable urban mobility plans (SUMPs). ULaaDS will deliver a novel framework to support urban logistics planning aligning industry, market and government needs, following an intensive multi-stakeholder collaboration process. This will create favourable conditions for the private sector to adopt sustainable principles for urban logistics, while enhancing cities' adaptive capacity to respond to rapidly changing needs. The project findings will be translated into open decision support tools and guidelines.

A consortium led by three municipalities (pilot cities) committed to zero emissions city logistics (Bremen, Mechelen, Groningen) has joined forces with logistics stakeholders, both established and newcomers, as well as leading academic institutions in EU to accelerate the deployment of novel, feasible, shared and ZE solutions addressing major upcoming challenges generated by the rising on-demand economy in future urban logistics. Since large-scale replication and transferability of results is one of the cornerstones of the project, ULaaDS also involves four satellite cities (Rome, Edinburgh, Alba Iulia and Bergen) which will also apply the novel toolkit created in ULaaDS, as well as the overall project methodology to co-create additional ULaaDS solutions relevant to their cities as well as outlines for potential research trials. ULaaDS is a project part of ETP ALICE Liaison program.

Keywords

Urban logistics, sustainability, data, decision support toolbox

Copyright statement

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1. Introduction

The purpose of this deliverable is to provide detailed information about the technical foundation and the final version of the decision support toolbox (short: toolbox) with implementation of data from the project.

Therefore, the deliverable is divided into three parts. First, the interrelations of other work packages (WPs) are described. As the toolbox integrates the project developments i.e. the research trials, impact assessment, qualitative output generated within the local fora etc., it strongly relies on the input generated within the project.

Next, the technical implementation is outlined. Therefore, the aim of the toolbox as well as its targeted audience is described. Second, the technical architecture and crucial components and prerequisites to fulfil are defined which are beneficial for an effective operation of the web-based toolbox. Last, the interface and design concept of the toolbox is illustrated.

The last chapter concludes this deliverable by summarizing the work done related to the ULaaDS decision support.

As this document builds on the work from D 6.3 and therefore describes the technical progress in relation to the aforementioned deliverable, various sections and their content, like the interrelations and technical implementation, have not been changed significantly. This work should be mainly regarded as a written document accompanying the actual technical implementation of the web-based toolbox.

2. Interrelationships of WPs

This deliverable incorporates content from various WPs. Moreover, this deliverable is interconnected with other WPs because of its own content. Content from other WPs for this deliverable includes inter alia:

- **WP 1:** D 1.3 (“Data Management Plan” (DMP)) is pivotal as it serves as the primary guideline for adhering to the General Data Protection Regulation (GDPR) and respecting the data sovereignty of each project member who contributes data. It lays the foundation for data handling and ensures compliance with legal and ethical standards.
- **WP 2:** The data emerging from the local urban fora are predominantly qualitative in nature. This characteristic should be a central consideration in the development of the project's toolbox to ensure that these qualitative insights are effectively captured and utilized.
- **WP 4:** D 4.1 (“Pre-trial set-up”) was instrumental in guiding the implementation of the research trials. Due to its significant data-related implications, ongoing and clear communication among partners was essential. Discussions were focussed on data formatting and addressed any concerns or possibilities raised by data originators regarding the provision of specific data sets for a toolbox that will be publicly reachable.
- **WP 5:** D 5.1 (“Framework, methodology and KPI identification”) outlines the framework for assessing the impact of the ULaaDS trials. It involves mirroring the trials against defined areas of impact, objectives and indicators. An effective data architecture and collection was crucial for evaluating the trials, especially for maintaining baseline data and data gathered post-trial implementation, such as for D 5.4, which focuses on “Economic Impacts, User Experience Acceptance, and Awareness” and D 5.5 “Impacts on logistics and traffic efficiency, land use and the environment”. This approach ensured comprehensive and meaningful analysis of the trials’ outcomes which then were fed into the toolbox.

3. Technical Implementation

In this section, the technical implementation of the ULaaDS decision support toolbox is described. First, the aim of the toolbox and the targeted user group is presented. Second, the technical archicterure as well as prerquisites that were defined are outlined. Last, the interface and design concept of the prototype is illustrated.

3.1 Aim and Audience

The toolbox aims to address public authorities and interested companies help them fulfilling their sustainability goals related to urban logistics. Therefore, its aim is to identify and provide information of suitable measures for urban logistics solutions. The interested stakeholders can inform themselves about the different research trials by using the toolbox which aims to provide meaningful derivations and results from the individual key performance indicators (KPIs) defined during the project period.

To gather information about the user preferences and requirements for using a toolbox, a survey was conducted (Q2/2021). Furthermore, the goal of the survey was to raise awareness of technical constraints to avoid a mismatch between input (data) and possible output (toolbox). Therefore, the structure of the survey covered the following aspects:

- **Information:** The project consortium (covering different stakeholder groups) was asked which qualitative information they would like to obtain from the toolbox.
- **Impact:** Additionally, they were asked about what kind of fields of impact they would like to obtain quantitative insights of the different trials of ULaaDS.
- **Own Data and Toolbox Structure:** Survey participants were asked what data they could feed into a toolbox which could lead to more detailed insights based on local circumstances.
- **Other Remarks:** “Other remarks” cover miscellaneous aspects like other examples of (logistics) tools/websites from which the development process of the ULaaDS toolbox can benefit, whether English as language is sufficient to get information about the ULaaDS solutions and an open comment section for further remarks.

At first, users were asked about their main intentions for using a toolbox (see Figure 1). The answers focussed especially on the sustainability, efficiency and knowledge related to the different urban logistics solutions but also limits related to the project’s scope:

- **Sustainability:** Overall, the main intention for using a toolbox is to find measures that help promoting a modal shift from fossil-fuelled vehicles to (local) zero-emission vehicles to reduce the air pollution in the urban environment.

- **Efficiency:** As urban space is scarce, innovative urban logistics should not just be ecologically sustainable but also use the limited space efficiently. This aspect goes hand in hand with promoting a modal shift as the purpose is to reduce the number of vehicles occupying the urban road network but also other areas dedicated to pedestrian like sidewalks.
- **Knowledge:** Finding inspiration for new innovative urban logistics solutions that potentially can be applied in other cities is important for local authorities. Furthermore, the knowledge about which stakeholders should be engaged to efficiently tackle the challenges of implementing new urban logistics measures, is crucial for a successful roll-out.
- **Limits:** As noise also represents an impactful emission caused by vehicles used for logistical purposes, some survey participants also mentioned this aspect. As the scope of the project is not focused on the simulation of urban logistics processes and the reproduction of sound propagation is a complex topic, it was communicated within the consortium that this aspect is technically not realisable in ULaaDS.

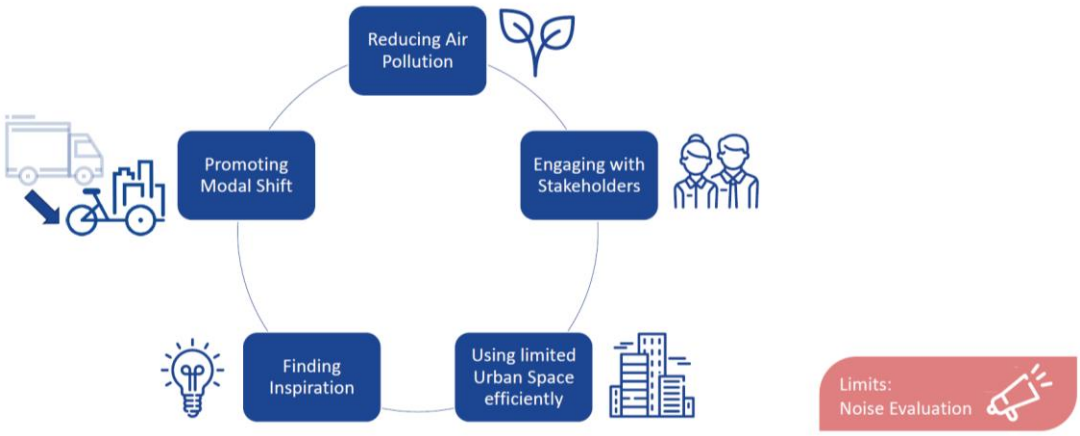

Figure 1: Main user intentions for using a "decision support toolbox"

It became clear that two content pillars are important for the potential users: Pathways and information (see Figure 2). The so-called "pathways" cover quantifiable ecological and traffic impacts a certain trial has on its urban environment. These were marked as the most important aspects. "Information" on the other side cover qualitative knowledge about the trials. The survey participants underlined the importance to learn from the experiences made in other projects/research trials to derive own procedures for taking up the promoted solutions, stakeholders that should potentially be included during the conception, implementation and operation period as well as opportunities and risks that are related to the different trials.

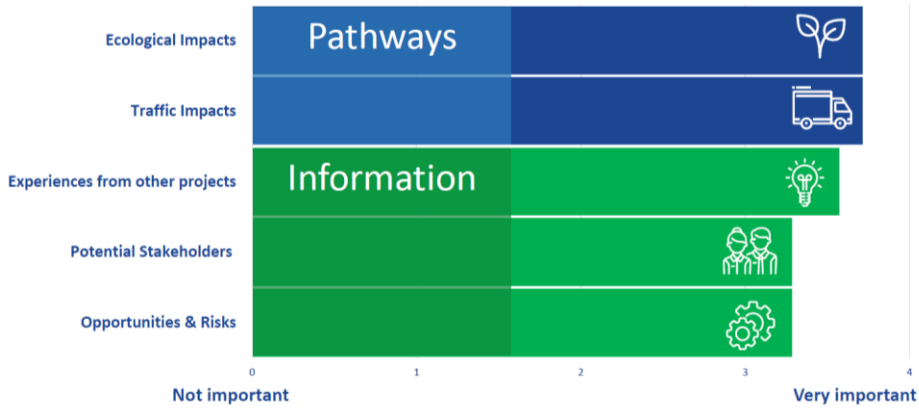

Figure 2: Usage purposes of a "decision support toolbox"

The potential users of the web application have indicated that they could input a diverse array of data (see Figure 3). This includes data pertaining to the legal framework, such as access restrictions, time windows, and designated areas that might impact urban logistics operations. From a business perspective, inputs could cover economic metrics, geographical coverage, the locations of logistics structures, and details about stakeholders and relevant players within the logistics ecosystem. Additionally, city-related data points are also considered vital inputs; these encompass inhabitant density, demographic profiles, economic indicators, education levels, and land usage patterns. Collectively, these data types would enable the toolbox to provide a comprehensive analysis of urban logistics challenges and opportunities, tailored to specific local contexts. Nevertheless, it must be noted that the feedback related to the possible input data varies greatly among the survey participants.

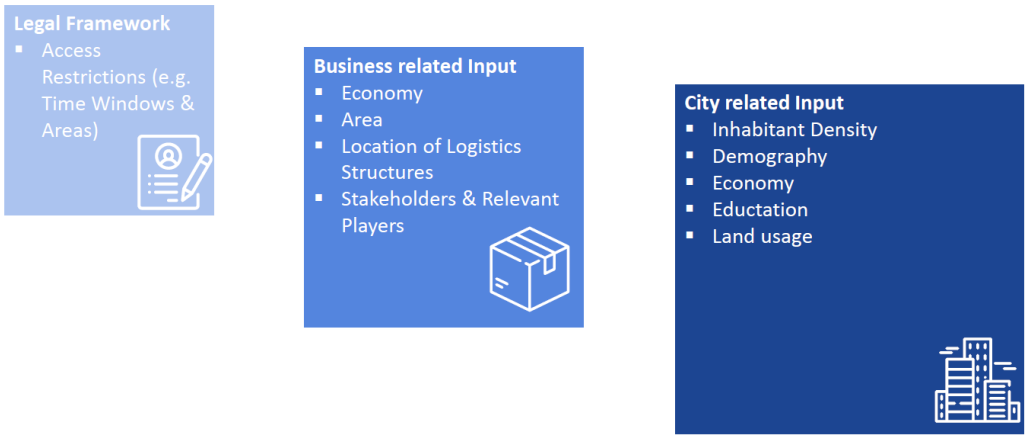

Figure 3: User input of a "decision support toolbox"

3.2 Architecture and Functionality

This chapter outlines the technical realization of the toolbox. Therefore, technical prerequisites are described which are beneficial for an effective operation of the web-based toolbox. Furthermore, the comprehensive framework for building a resilient and user-centric web application is described. Importantly, the toolbox can be deployed in two distinct configurations: as a standalone web application or as a plugin for WordPress. Each deployment option has its general requirements as well as specific considerations to ensure optimal performance and integration.

General Requirements for Both Configurations:

Angular 14 Framework:

- The first version of the toolbox is developed by using Angular 14. By this, it can take advantage of the latest features and improvements of the framework.

Responsive Design:

- The toolbox should be responsive and compatible with various devices, including desktops, tablets, and smartphones.

Hosting and Infrastructure:

- A reliable and scalable cloud hosting service capable of handling the traffic of 500 clicks per day.
- Server resources should be capable of handling concurrent usage by 50 personas (users) at a time.

Caching Mechanism:

- Implement a caching mechanism (e.g., Redis) to reduce server load and improve response times for frequently accessed data.

Security Measures:

- Implement proper security measures to protect against common web application vulnerabilities, such as e. g. Structured Query Language (SQL) injection, Cross-Site-Scripting (XSS), Cross-Site-Request-Forgery (CSRF).
- Ensure secure communication using Hypertext Transfer Protocol Secure (HTTPS) for data transmission.
- Implement user authentication and authorization mechanisms to control access to sensitive data and features for test phase and upload functions.

Performance Optimization:

- Optimize code to ensure fast loading times and smooth user experience.

Scalability and Redundancy:

- Design the toolbox with scalability in mind to handle potential traffic growth in the future.
- Implement redundancy and failover mechanisms to ensure high availability and minimize downtime.

Testing and Quality Assurance:

- Conduct thorough testing, including unit testing, integration testing, and end-to-end testing, to ensure the toolbox functions are as expected and free from critical bugs.

Accessibility:

- Ensure the toolbox is accessible to users with disabilities, adhering to accessibility guidelines (e.g., Web Content Accessibility Guidelines (WCAG)).

Version Control:

- Use version control systems like Git to manage and track changes to the codebase.

Documentation:

- Maintain comprehensive documentation that covers installation, setup, and development guidelines for the toolbox.

Legal Compliance:

- Ensure compliance with relevant data protection and privacy regulations (e.g., GDPR) if applicable to the toolbox's users.

Specific Requirements for Standalone Docker Container:

Docker:

- A recent version of Docker must be installed, allowing the toolbox to be containerized, ensuring consistency across different environments and simplifying deployment and scalability.

Container Management:

- Knowledge of container orchestration tools (e.g., Docker Compose, Kubernetes) is beneficial for managing the application, especially in production environments.

Environment Variables:

- Utilizing environment variables to configure the Docker container, making it easy to adjust settings such as database connections and external API keys without code changes.

Persistent Storage:

- Configuring persistent storage solutions for Docker to ensure data (e.g., user data, application settings) is preserved across container restarts and updates.

Specific Requirements for WordPress Plugin:

WordPress Version:

- The toolbox plugin requires WordPress 5.5 or higher to ensure compatibility with WordPress core updates and features.

WordPress Theme Compatibility:

- The plugin should be tested with various WordPress themes to ensure that it integrates seamlessly without affecting the website's appearance and functionality.

WordPress Security Standards:

- Adherence to WordPress coding standards and security practices is crucial to protect user data and prevent vulnerabilities.

3.3 Interface and Design

This section provides an overview of the design and operational aspects of the web application. Within this design framework, the section explores strategic methodologies that have been carefully crafted to ensure a browsing experience that seamlessly aligns with user needs, placing them at the centre of the digital interaction.

A special focus is placed on a user-friendly interface which meets the aims of the targeted interest groups (see Chapter). The target groups were informed about the roll-out of the the first version of the toolbox on several occasions via email or in person (e.g. again at the final event in Barcelona (November 2023)) and were also invited to share feedback to gradually improve the user experience. By including this feedback, the final version has some (minor) changes compared to the first version. The objective is to provide a clearly structured layout. For this reason, the toolbox is built in a modular way to be able to serve different focal points of the conducted survey. This also enabled the integration of other possible add-ons at a later point as well as redesign individual (sub-)modules and related content. This was the case for some research trials as they shifted their focus and their final results could therefore not be included in the first version.

The main page of the toolbox has a tile pattern (see Figure 4). The tiles represent the different research trials of ULaaDS. Besides small icons that match the design of the existing ULaaDS website, a short text provides a small introduction of the specific research trial scope as well as the city in which the trial was rolled out.

Figure 4: Main page of the "decision support toolbox"

When users click on a tile, a dropdown menu expands to reveal detailed information of a specific research trial, providing easy access to relevant content without cluttering the main page (see Figure 6). The drop-down navigation menu provides a short description which is in line with the introduction text on the main page as well as a gallery of images so that the user can get a better impression.

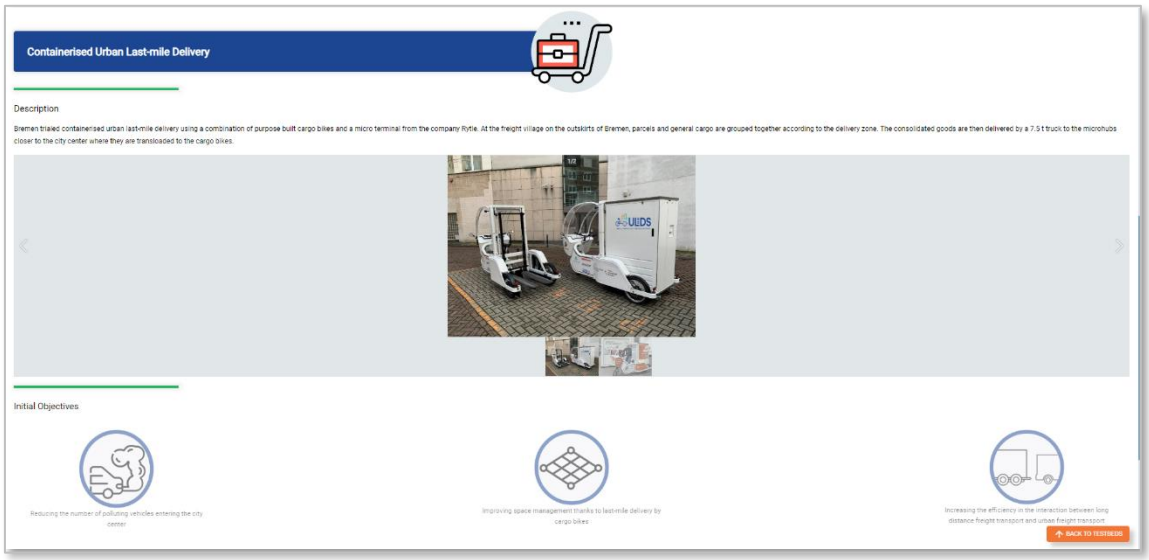

Figure 5: Exemplary subpage of an ULaaDS research trial

Subsequently, objectives of the trial can be unfolded by clicking on the icons (see Figure 5 and Figure 6). These objectives are taken from the work conducted by TOI and Miebach which have measured the impacts of each trial against the initial communicated objectives. By doing this, it is possible to evaluate different KPIs related to the objectives. In some cases, this is possible by using quantitative data like the land or space use efficiency of different urban logistics solutions. In other cases, this is

done in a qualitative way by explaining the potentials and hurdles of these solutions as well as their conception, implementation and operation. Therefore, also input from the local fora is included.

A restriction in the model lies within the concreteness of the evaluation given. Often, it is not possible to give detailed recommendations on e.g. concrete CO_2 savings in a certain environment as the data base provided by the research trial leaders was already aggregated to a certain degree. In these cases, the toolbox will provide tendencies (using a three-point scale with icons) for the impact of the measures chosen and will attach explanations for the given results. At the end of each trial the related deliverables and partners are presented. Therefore, this also restricts the input of data by external users even though it was a desired option (see Chapter 3.1).

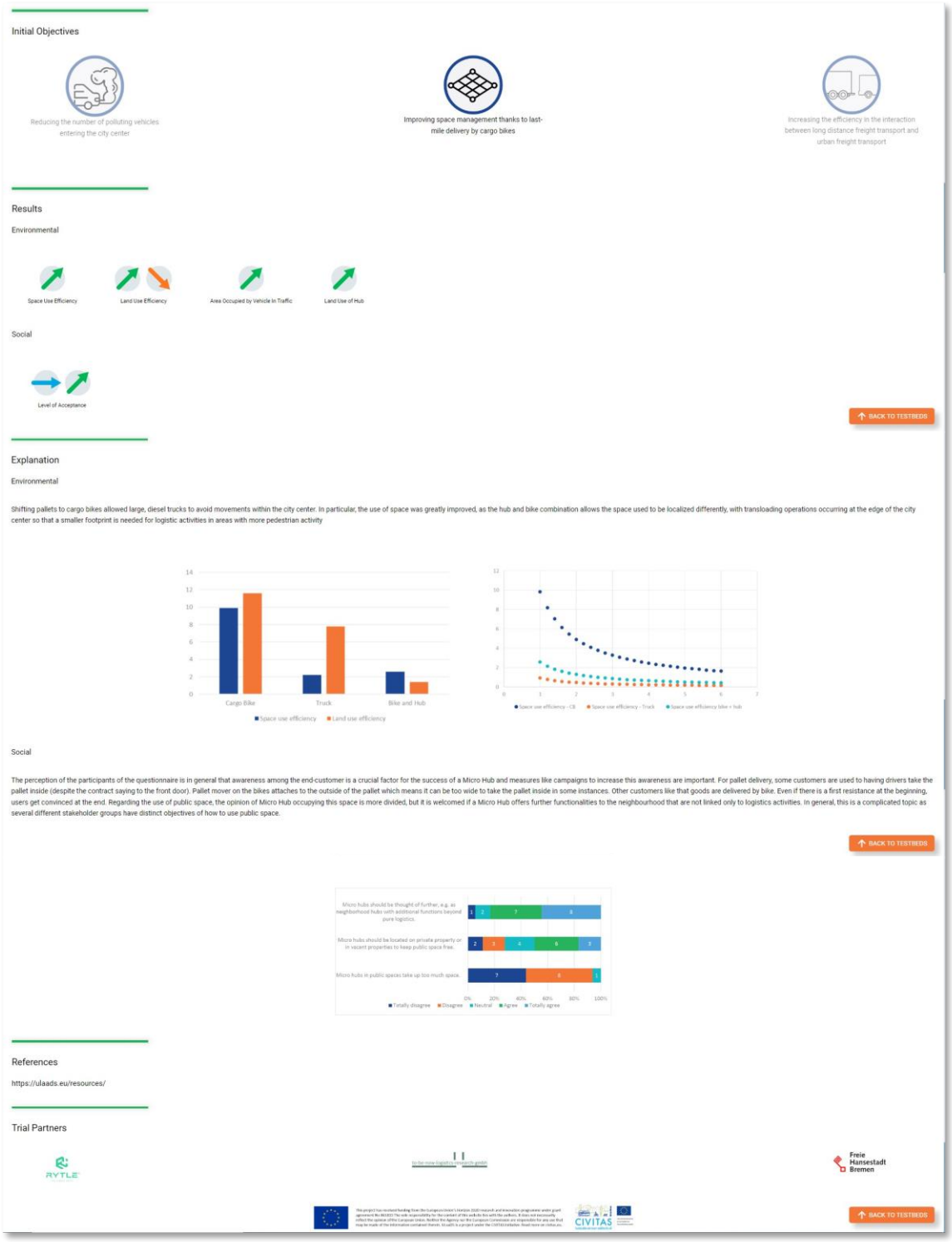

Figure 6: Content modules: Initial objectives, results, explanations and trial partners

Clickpath, also known as breadcrumb navigation, is a visual representation of the user's path within a website. It displays the sequence of pages or steps the user has followed to reach their current location and provides users with a clear understanding of their location within the website's structure. This way it is reducing disorientation and improving navigation efficiency. Users can easily

backtrack to previous pages or levels in the website's hierarchy, as well as grasp the relationship between different pages, which is helping them comprehend the context of the current content. The toolbox also offers the possibility to jump straight back to the different research trials by clicking on a button on the bottom of the website (see Figure 7).

Figure 7: Return button on the bottom of the website

The use of the Angular framework offers the possibility of a responsive design (see Chapter 3.2). By doing so, it is possible for the toolbox to be responsive and compatible with various devices, including desktops, tablets, and smartphones (see Figure 8).

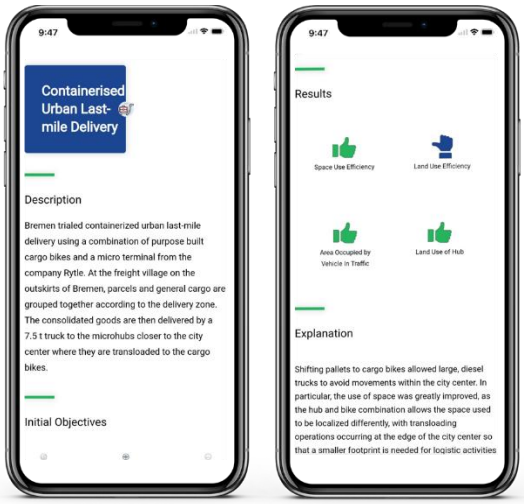

Figure 8: Responsive and compatible design using an example page on a smartphone screen

4. Conclusion

The completion of the "ULaaDS Decision Support Toolbox" signifies a crucial point in the ULaaDS project. The toolbox's technical implementation was characterized by a structured development process, incorporating state-of-the-art technologies and data analytics frameworks. A modular system architecture was adopted, facilitating adaptability and scalability to accommodate varying urban logistics research trials. The design and development phases emphasized creating a tool that is not only technically robust but also user-centric, ensuring ease of use for a broad spectrum of stakeholders.

The deployment phase of the toolbox involved a strategic roll-out to target users in ULaaDS. This phase included comprehensive stakeholder engagement, aimed at validating the toolbox's applicability. Initiatives, such as interactive workshops/presentations during partner meeting, were integral to this phase, designed to enhance user familiarity with the toolbox's features and functionalities. This approach also facilitated the collection of user feedback, which was instrumental in refining the toolbox's design and functionality.

In conclusion, the "Final Version of the ULaaDS Decision Support Toolbox" represents a concerted effort to provide a scientific and practical resource for urban logistics decision-making. The technical implementation and roll-out process underscore the project's commitment to delivering a decision support tool that is both methodologically sound and pragmatically valuable covering the input collected from the project, the partners and the work carried out during the project period.

Acronyms

Acronym	Meaning
CSRF	Cross-Site-Request-Forgery
DMP	Data Management Plan
GDPR	General Data Protection Regulation
HTTPS	Hypertext Transfer Protocol Secure
KPI	Key Performance Indicator
SQL	Structured Query Language
WCAG	Web Content Accessibility Guidelines
WP	Work Package
XSS	Cross-Site-Scripting