ULaaDS decision support toolbox; v1

ULaaDS D6.3: ULaaDS decision support toolbox; v1

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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, concept, first version

Copyright statement

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1. Introduction

The purpose of this deliverable is to provide detailed information about the technical foundation and the first version of the decision support toolbox (short: toolbox) with implementation of data from the project. This version represents the starting point of an iterative improvement process based on partner feedback.

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 toolbox to this point and provides an outlook about the process to continuously improve the toolbox during the remaining project period.

2. Interrelationships of WPs

This deliverable incorporates (provisional) 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 and is essential. Discussions were and are focussed on data formatting and address 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 is crucial for evaluating the trials, especially for maintaining baseline data and data gathered post-trial implementation, such as for Deliverable 5.4, which focuses on "Economic Impacts, User Experience Acceptance, and Awareness." This approach ensures comprehensive and meaningful analysis of the trials' outcomes which then must be 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.
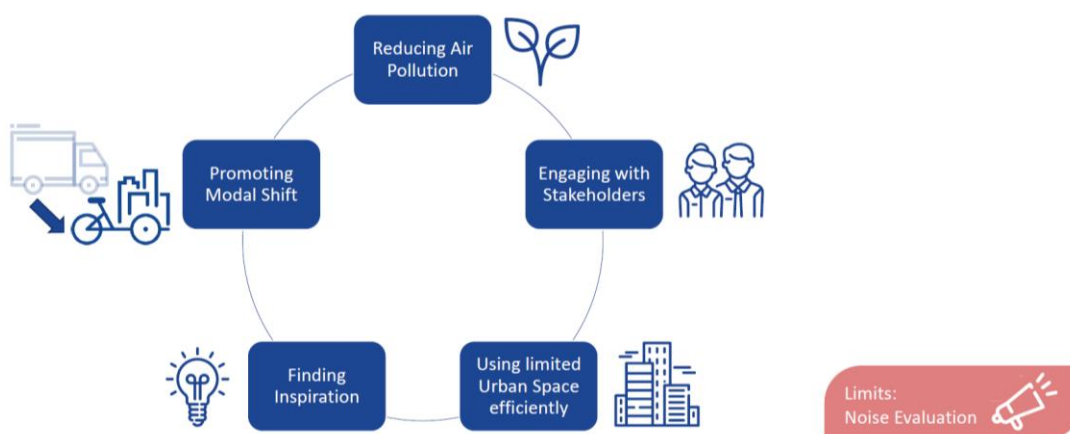

Figure 1: Main user intentions for using a "decision support toolbox"

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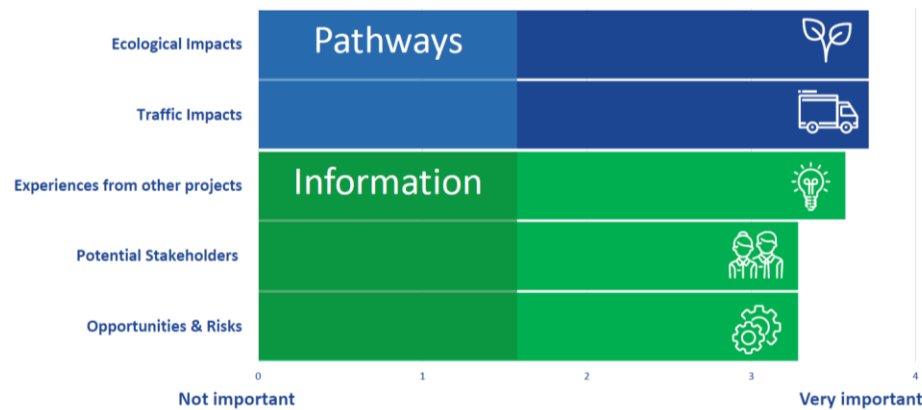
Figure 2: Usage purposes of a "decision support toolbox"

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.
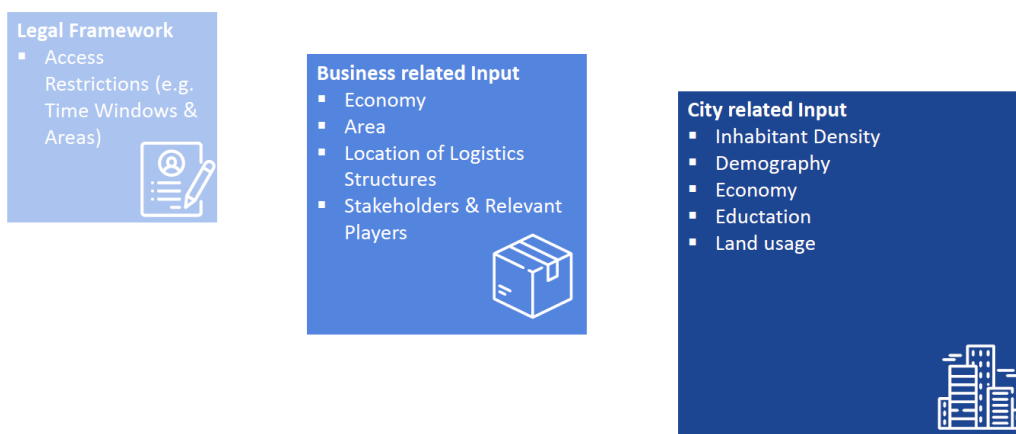

Figure 3: User input of a "decision support toolbox"

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.

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.

Docker:

- The first version of the toolbox uses a Docker image for deployment.

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 frontend and backend code to ensure fast loading times and smooth user experience.
- Minimize HTTP requests and reduce payload size by compressing assets (e.g., JavaScript, CSS).

- Use lazy loading techniques for components and modules to improve initial page load times.

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.

Monitoring and Analytics:

- Integrate monitoring tools to track server performance, identify bottlenecks, and proactively address issues.
- Implement analytics to gather insights into user behaviour and toolbox usage.

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.

Data Backup and Recovery:

- Regularly backup the toolbox's data and ensure the ability to recover the system in case of data loss or failures.

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.

3.3 Interface and Design Concept

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 3.1). 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 will also enable the integration of other possible add-ons at a later point as well as redesign individual (sub-)modules and related content.

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.
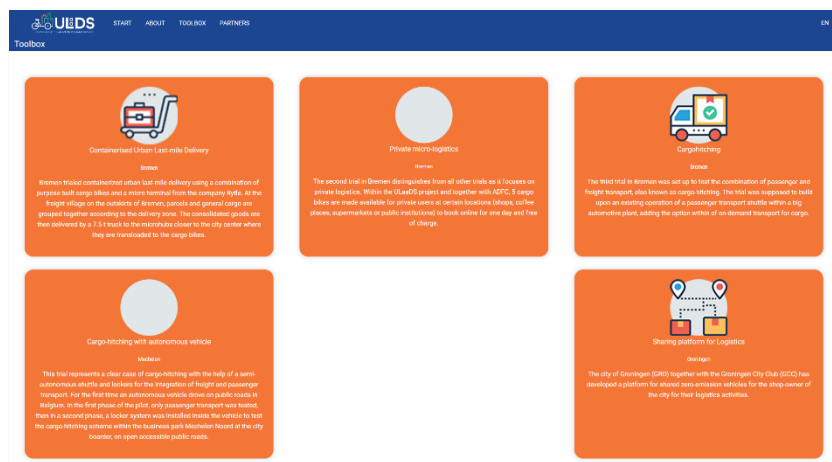

Figure 4: Main page of the "decision support toolbox"

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.

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 initials communicated objectives (see Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**). 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 for a 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 for example a three-point scale with icons) for the impact of the measures chosen and will attach explanations for the given results. 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).
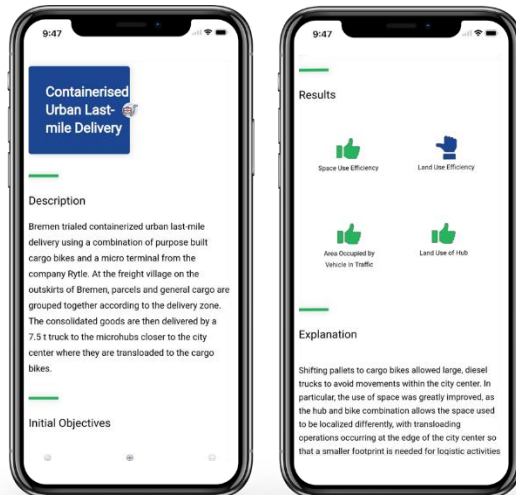

Figure 8: Responsive and compatible design using an example page on a smartphone screen

4. Conclusion and Outlook

To this point, the initial prototype of the ULaaDS decision support toolbox with a functional menu and a brief description of every trail, is developed. The development of the toolbox is proceeding in a methodical manner: initially, it will be hosted on a server using a Docker image for temporary and secure access, limited exclusively to project partners.

The subsequent phase involves incorporating further information generated by the other WPs Partners will then provide feedback, refining the toolbox's user experience. Moving forward, iterative releases of the toolbox with new content regarding the projects results will be introduced, each informed by partner feedback. This iterative process will continue until the project's conclusion.

In essence, the evolution of the toolbox is characterized by an organized approach that includes the improvement of the prototype, secure hosting, continuous integration of content, regular feedback from partners and systematic updates. This approach ensures that the toolbox remains in step with both the project's evolving needs and user preferences, culminating in a tool that is both flexible and user centric.

In subtask 6.4.2, the toolbox rollout has already commenced with an initial testing phase by the ULaaDS partners. This phase is crucial for identifying and rectifying errors, thereby progressively enhancing the user experience. During this phase, partners have the possibility to test the toolbox. Through various feedback loops, the aim is to fine-tune the toolbox's functionality and performance. After these comprehensive testing phases, the toolbox will be launched online for use by external users in February.

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