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DELIVERABLE

D1.6 – 2nd version of GREEN-LOG requirements specification

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Executive Summary

This report describes the work done in Task 1.2: Requirements and living labs formulation approach of the GREEN-LOG project, which has as its main objectives to engage all the stakeholders of the pilot sites to set up local Urban Living Labs (LL) based on quadruple helix co-creative knowledge building models. Through this LL formulation process, LL stakeholders have been invited to work together to identify local LL requirements, barriers and opportunities for setting up successful LL for implementation of innovative Last Mile Delivery (LMD). These scoping activities aimed at creating common understandings and synthesize different goals, interests, and agendas of the enrolled actors into a common vision about the delivery solution that each LL wants to develop and deploy through GREEN-LOG. Part of task 1.2 was also to facilitate sharing findings and ideas across LLs through joint activities.

Deliverable 1.1 documented the initial setup activities completed during Months 1-6 of the project. These activities included engaging key stakeholders from the pilot sites, defining an initial version of local requirements (identifying barriers and opportunities), and integrating the diverse goals, interests, and agendas of involved actors into a unified vision for the pilot demonstrations.

In the subsequent period of Months 7-12, Task 1.2 played a pivotal role in advancing the Living Labs (LLs) by developing strategies for engaging with local stakeholders, including users. This phase focused on the creation of user stories and scenarios that were instrumental in the development of use cases and solution blueprints, in collaboration with Task 1.3. The outcomes of these initiatives are detailed in Deliverable 1.2, Section 3 ('Co-creation Workshops and Use Cases').

From Months 13-18, the project moved into a second iteration of the initial LL formulation. During this phase, Task 1.2 organized and led tailored workshops aimed at refining the LL goals and key success factors. This refinement process was informed by insights gained from an extensive range of co-creation workshops and user engagements, as well as comprehensive desktop research on user perspectives regarding Localized Micro-delivery (LMD). This iterative approach ensured the LLs were continually adapted and improved to meet the evolving needs and insights of local stakeholders and end-users.

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1.0	01-07-2024	INTRA	Final QA'ed version

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Acronyms	
GA	Grant Agreement
KPI	Key Performance Indicator
LL	Living Labs
LMD	Last Mile Delivery
LSO	Local Shop Owner
LSP	Logistics Service Provider
MCC	Micro Consolidation Centre
MDH	Mobile Delivery Hub
Definitions	
LL	GREEN-LOG co-creative quadruple helix Urban Living Lab.
LL set up	Establishing an LL community of multiple stakeholders, identifying their roles in the LL, and involving them in the co-creative process of setting up these solutions in their cities.
LL GREEN-LOG delivery solutions	Delivery solutions (cargo bikes, MCC, automated delivery services etc.) to be demonstrated in GREEN-LOG.
LL demonstration sites	The cities that establish LLs provide the GREEN-LOG projects with sites for trials of the GREEN-LOG delivery solutions (and how they can be powered through the GREEN-LOG platform functionalities).
LL requirements	Specify the requirements for setting up a successful Urban Living Lab, defined here as joint understandings of goals, local barriers and opportunities for the solutions to be realized.
LL users	Users of the delivery solutions (citizens, drivers, operational managers, local shop owners etc.).

1 Introduction

1.1 Document scope

This report outlines the comprehensive work undertaken in Task 1.2 during M7-M18 of the project, specifically focusing on collaboratively setting goals, and identifying barriers and opportunities for the successful establishment of LLs (LL requirements) through the GREEN-LOG LL formulation approach. The central objective of this task is to engage stakeholders at the GREEN-LOG pilot sites to establish local Urban Living Labs (LL), utilising a quadruple helix co-creation model to facilitate collaboration between private and public actors (including knowledge institutions and last-mile delivery users) (see Figure 1).

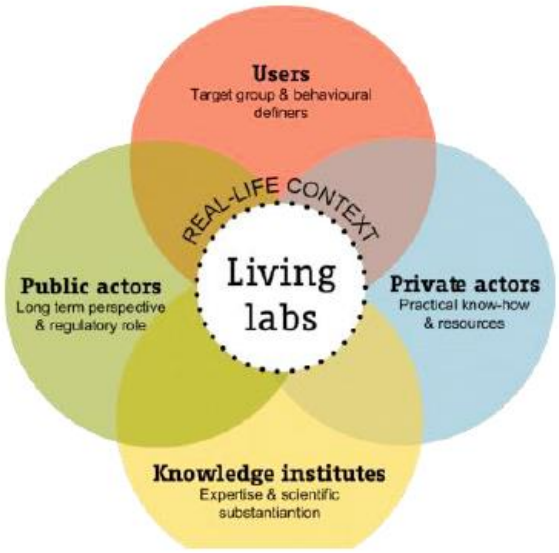

Figure 1: The GREEN-LOG LL quadruple helix co-creation model

During the initial phase of the GREEN-LOG project (months 1-6), Task 1.2 facilitated a series of workshops involving core stakeholders in the LLs. These workshops aimed to perform an initial iteration on setting and aligning stakeholders with primary goals for each LLs delivery solutions, identifying potential barriers and opportunities, recognising key stakeholders for engagement, and pinpointing specific locations for trial implementations. The findings were documented in D1.1 (submitted in M6).

In the subsequent phase (M7-M12), Task 1.2 continued to support the LLs by refining and tailoring their stakeholder engagement activities in alignment with the GREEN-LOG LL formulation approach. This phase involved providing inputs and developing strategies for engaging local stakeholders, including potential users, within each LL context. Additionally, the task facilitated the LL teams to create credible user stories and user journeys to underpin the development of blueprints and use cases for GREEN-LOG technologies, in collaboration with Task 1.3. This work is documented in D1.2 (submitted in M18).

The final phase (M13-M18) involved summarising the results of these stakeholder engagement activities through a series of tailored workshops. These workshops were designed to help LLs iterate and refine their previously established LL requirements through the lens of user perspectives they had identified through user and local stakeholder engaging activities in the previous phase. The workshops also aimed to identify any unknowns about local users of the delivery solutions, which will be further investigated in upcoming activities.

These workshops assisted the LLs in defining GREEN-LOG user journeys and use cases (D1.2), by clarifying the social and societal contexts for implementing the various delivery solutions. Additionally, they set the direction for future user and stakeholder engagement activities in the forthcoming demonstrations of the delivery solutions.

Overall, this report presents the outcomes of the second iteration of GREEN-LOG LL requirements (M7-M18), showcasing the iterative process of refining and enhancing urban delivery solutions through stakeholder engagement and collaborative innovation.

1.2 Document structure

The document is divided into four sections:

Section 1 “Introduction” is the introductory section of this deliverable.

Section 2 “GREEN-LOG LL formulation approach” presents the way the LLs are designed to be set up and continuously developed through the GREEN-LOG approach and workload organisation. It also presents how this formulation has been enabled through a variety of workshops and LL interactions by task 1.2 and task 1.3 through the first 18 months of the project. Finally, it describes how this second version of GREEN-LOG LL requirements specification builds upon the initial LL requirements established during the original set-up incorporating insights from stakeholder and users within and across the LLs.

Section 3 “LL requirements specification” reports the second iteration of LL requirements from user perspectives. It includes findings from a research overview on user perspectives, factors, and aspects of LMD that has fed into this iteration. Additionally, it encompasses results from workshops conducted with the LLs to identify known and unknown aspects about users at this stage. These insights were crucial for refining the LL requirements and pointing out directions for future stakeholder and user engagements.

Section 4 “Conclusions: Frictions and Future engagements” presents an analysis of the developed LL requirements in terms of similarities and differences across the LLs. It is summarises these findings through four points of contradictions that causes friction in the implementation of the LMD. The section reflects on why and where collaboration and communication become important in the continuation of the implementations. This means both in terms of collaboration between delivery companies and other logistics players at the demonstration sites, as well as collaboration and cooperation among stakeholders within the LLs. This section also concludes themes for future user and stakeholder engagements based on what the LLs have identified as unknowns requiring further investigation.

2 GREEN-LOG LL formulation approach

The GREEN-LOG LL formulation approach unites city stakeholders in a LL setting to jointly identify goals, barriers, and opportunities (LL requirements), and establish LMD that addresses these shared objectives. GREEN-LOG LLs focus on urban and civic innovation through a quadruple helix of co-creation, fostering collaboration between private bodies and civil society to develop sustainable LMD (Figure 1). GREEN-LOG applies this methodology to last-mile ecosystems, engaging stakeholders in collaborative trading zones free from conflicting interests. Special emphasis is placed on citizen/user engagement in developing LMD. Thus, establishing local LLs tailored to each site's uniqueness, each lab engages with local actors to foster valuable collaborations and influence. Therefore, co-creation activities vary between LLs to ensure appropriate participation methods, enabling citizens/users to shape the project's direction and empowering citizen groups to influence and increase impact.

During M1-M18 (what in the project is called phase 1) the GREEN-LOG LLs have been formulating themselves accordingly through different activities as part of the workload under one of six axes called 'Living Labs and Social Innovation' (A1) (Figure 2).

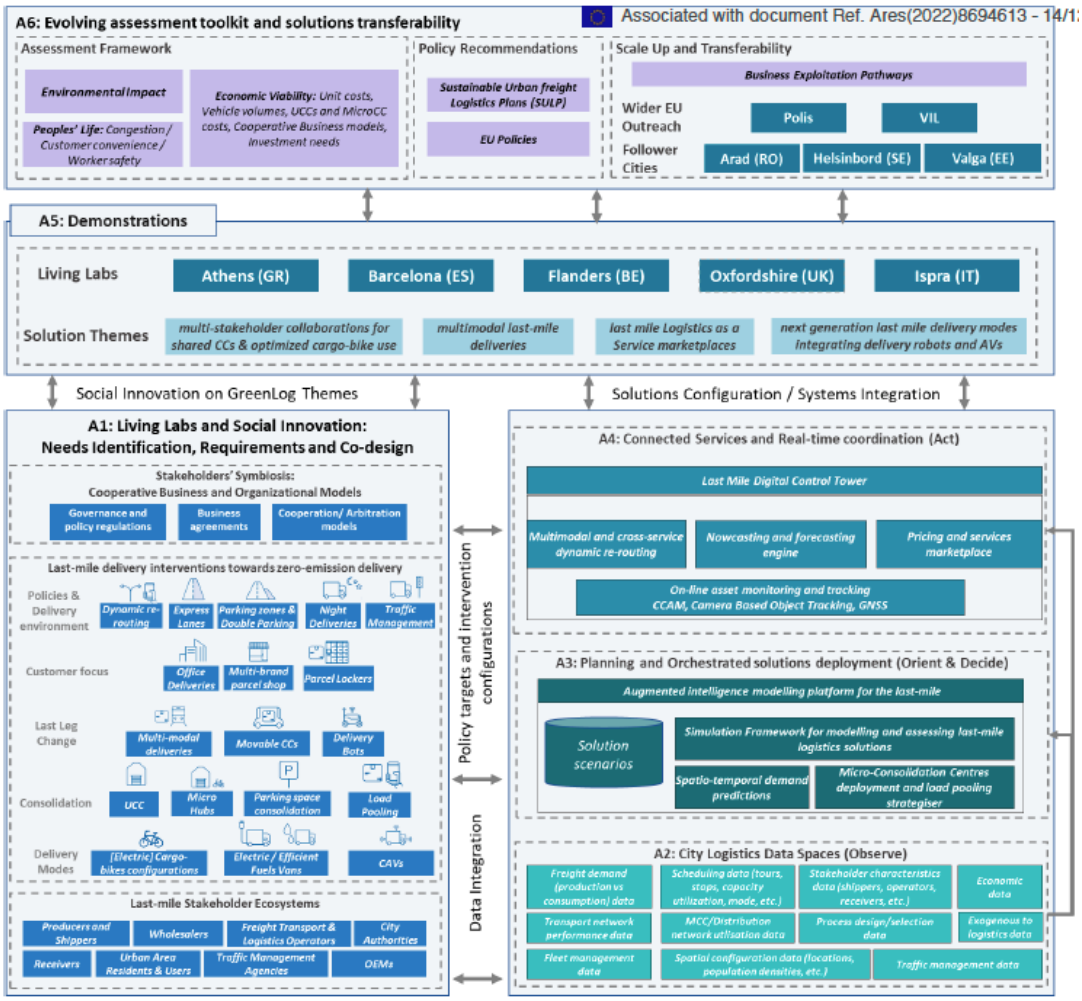

Figure 2: The GREEN-LOG workload organisation

A1 activities in GREEN-LOG align with what Smith & Iversen [REF-01] define as *Scoping* in the first stage of establishing co-creative LLs. In this phase, user definitions and participation configurations are integral parts of the project and the urban community itself, rather than

being determined solely by researchers. In the next section, the methodology for formulating GREEN-LOG Living Labs (LLs) will be presented.

2.1 Mapping LL requirements through user perspectives

The GREEN-LOG LL formulation is informed by principles of human-centred design. Through iterative development, the delivery solutions are continuously refined based on user feedback, ensuring that they meet the users' evolving needs effectively. Collaboration is crucial throughout the process, involving the stakeholders from private and public actors with Local Shop Owners (LSO), local Logistics Service Providers (LSP) and people living and working in the pilot sites, in the LL activities to bring diverse perspectives and insights. This approach also implies a holistic perspective that considers the broader context in which the design will be used (social, cultural, economic, and environmental factors) to create comprehensive and inclusive solutions. In an iterative loop, these principles can be described as a process of understanding, defining, designing and evaluation.

While the first establishment of the LLs produced initial understandings and definitions of LL requirements based on the core teams of stakeholders from LSP, public authorities, HEIs and local stakeholders (presented in D1.1 and also mentioned in D1.2), the second iteration of the scoping was done based on the LL teams' continuous engagements in the local context and the needs and values of the different users of the delivery solutions. In establishing the GREEN-LOG LLs, users have been approached by the LL teams in the following ways:

- **Workshops & focus groups**: Collaborative sessions involving stakeholders and users to discuss and define requirements collectively. This method has been deployed in GREEN-LOG co-design workshops that is presented in delivery report 1.2
- **Interviews with local stakeholders and users on the demonstration sites**: The different LL core teams have according done continuous observations and non-structured interviews with people in their demonstration sites in tandem with the set-up of the Living Labs and have also brought in knowledge gained from earlier similar implementations. The results from these interviews and observations were gathered and organised through the task 1.2 workshops (see below).
- **Prototyping**: Simulating or building early versions of product/system to gather feedback from users. For example, in Ispra's LL, early versions of a delivery service have been tried out with small groups of users, followed up by simulations of robot deliveries.

To analyse learnings from these engagements within and across LLs in GREEN-LOG, task 1.2 organised the following activities to enable a refinement and development of the LL requirements set up during M1-M6 from user perspectives:

- M8-M12: Follow up on LL co-creation workshops and stakeholder and user engagement activities, and tailor possible user engagement techniques and methods.
- M13: Bilateral meetings across work packages, as well as a design sprint over three days (22-24 Jan) to develop a 'LL requirement canvas' in MIRO (Figure 3 and Figure 4).
- M13-M16: Desk-top research on user perspectives on LMD as an input to workshops and for reflecting in the analysis of GREEN-LOG LL requirements.
- M14: A kick-off with the LL core teams was organised to present and demonstrate the 'LL requirement canvas' for the LL teams.
- M14: Interviews with LL core leaders to prepare for the canvas workshop.

- M14-M15: Meetups with the LL core teams for collaboratively analyse local LL requirements through the canvas.
- M16-M17: Follow-up questions and interviews to gather input.
- M18: Analysis of second iteration of LL requirements.

2.1.1 LL requirement canvas

The first exercise on the "LL requirement canvas" was to identify the users of their delivery solutions and discuss how they had engaged with them this far into the project. During the workshop the LL teams discussed what they had learned through these engagements in terms needs and barriers from both a user and a contextual perspective as well as what conclusions could be drawn out in terms of success factors for their use cases (Figure 3).

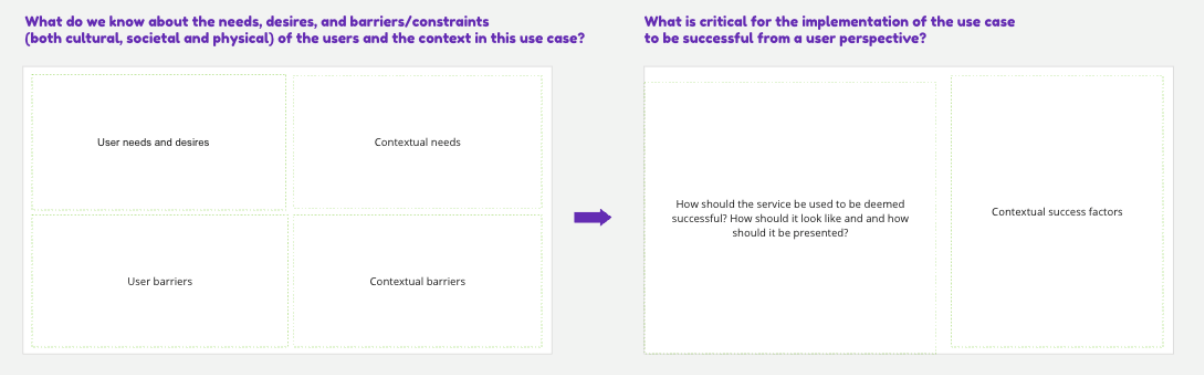

Figure 3 GREEN-LOG LL requirement canvas – mapping the known needs, barriers and success factors

In the second exercise on the LL requirement canvas, the LL teams continued to discuss what was still unknown about the LMD users – and how these unknowns could be found out in coming user engagement activities (Figure 4).

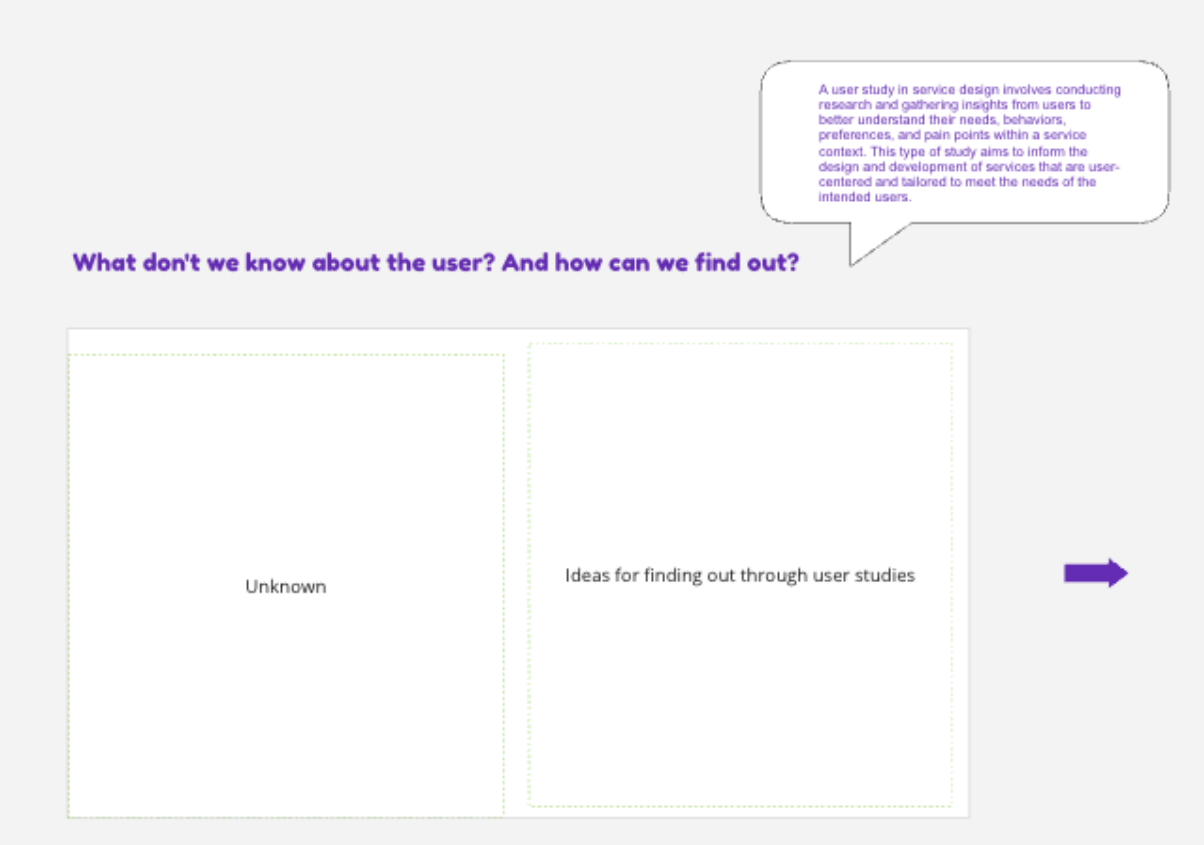

Figure 4 GREEN-LOG LL requirement canvas – mapping the unknowns and potential ways to find out

In the last exercise on the LL requirement canvas, different ideas for user engagements were discussed from a list of possible methods to use. One tailored method of co-creative filmmaking was presented to the LLs (this is described in more detail in D1.2 in "Continuous Stakeholder engagement" section).

The canvas was also prepared with tailored 'evocations' based on the unknowns the LLs previously had mapped out to trigger a discussion on how to approach users with the questions the LLs had identified earlier under "unknowns." These evocations were small texts that presented an unknown and ideas for how these unknowns could be explored. Below we present how the canvas looked like for this exercise, with evocations and example answers

from the workshops with LL Oxfordshire, LL Flanders, LL Ispra and (the discussions in LL Athens and LL Barcelona were not documented through post-its (Figure 5).

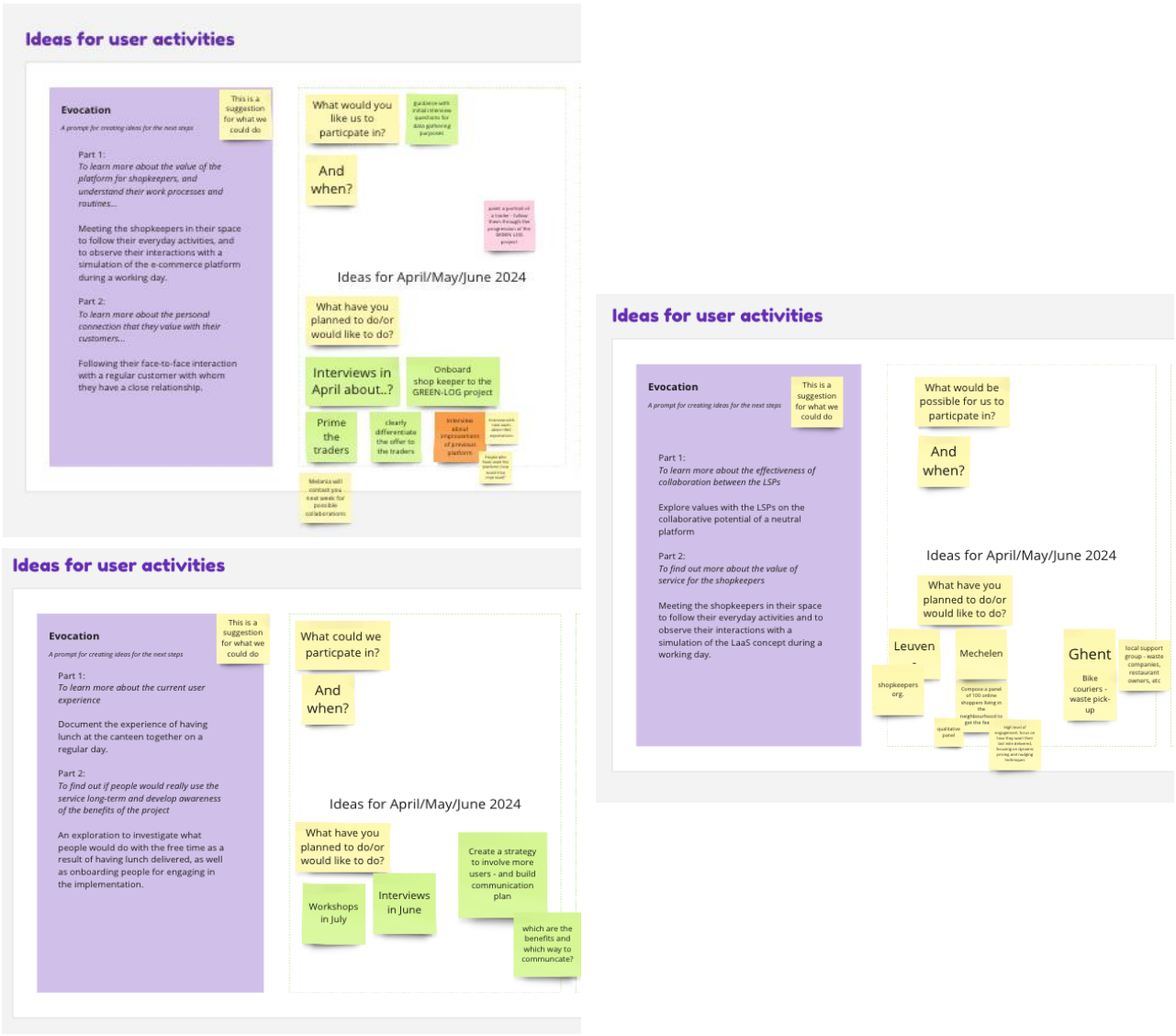

Figure 5 GREEN-LOG LL requirement canvas – evoking ideas for user activities

3 LL requirements specification from user perspectives

This section presents how the LL requirements were developed by bringing in user perspectives on LMD, both through desktop research and the outcomes from the workshops on the LL requirement canvas presented in Section 2.1.1. More specifically, Section 3.1 draws from previous literature and contextualises, expands, and affirms the LL requirements that have been identified in each GREEN-LOG LL. This overview has also been instrumental in facilitating the LL requirement workshops, as well as when suggesting further user studies in the LLs.

The following section 3.2 outlines the significant outcomes derived from the workshops. It details the refined, second version of requirements that iteratively built upon the initial prerequisites for establishing a successful Living Lab. These prerequisites include a mutual understanding of goals, and the identification of local barriers and opportunities, all enhanced by incorporating user perspectives.

3.1 User perspectives on Last-Mile Delivery – an overview

This overview of user perspectives on LMD solutions has been conducted through a review of previous research relevant to GREEN-LOG LLs. A handful of factors appear irrespective of the type of LMD innovation being tested, and these mainly relate to what users prioritise. *Zhu et al* [REF-02] observed "price, time, reliability, trust, and risk" being relevant to their decision-making. The connection between a user's trust in the courier service and the ease of delivery has been emphasised by *Vrhovac et al* [REF-03], who further point to the possibility of it being bidirectional in nature, meaning that a positive experience of product collection process would increase trust, while increased trust would mean a higher likelihood of a positive experience. Meanwhile, *Karli and Tanyaş* [REF-04] also found that consumers preferred lower delivery price, faster delivery times, and delivery points that are closest to them.

The following subsections present in short relevant research on user perspectives on LMD solutions that are implemented through GREEN-LOG that have been used as input in discussions in LL requirement workshops. Subsequently, the overview focus on user experiences of cargo bikes, e-commerce services, automated robot deliveries and pick-up points and delivery lockers.

3.1.1 User perspectives on cargo bikes

Cargo bikes are being implemented in LLs in Oxfordshire, Barcelona, Ispra and Flanders. When it comes to the route choice preferences of cargo bike users, *Liu et al* [REF-05] identified safety as the most important aspect influencing their choice considering factors such as traffic speed, number of heavy vehicles, street lighting, cycling lanes being separated from car traffic and slope. Comfort in cycling experience is another aspect, partially related to safety, that plays a role in the user's route choice, considering factors such as road condition, narrowness of spaces, intersections, cobblestone roads, and number of turns, all of which can influence the comfort level of a cargo bike route for the rider. An older study focused on employees of courier and express logistics companies supports rider comfort being of high importance when considering the usage of e-cargo bikes. They reported little-to-no concerns about theft protection and vehicle safety in terms of choosing whether to use e-cargo bikes, meaning that it was considered a relatively safe delivery method, regardless of route choice [REF-06].

When considering the perspective of local shop owners, some studies focused on the preferences of local business participants when deciding whether to use e-cargo bikes for the delivery of goods. *Malik et al* [REF-07] found that they prefer e-cargo bikes for deliveries in

warm and dry weather and are more inclined to opt for them for short distances. However, as the trip length increases, the probability of choosing the e-cargo bike delivery mode drops significantly. Cold and wet weather conditions were also factors identified as a significantly less attractive option. *Mangano et al* [REF-08] also considered the perspective of retailers, whose results showed that they are likely to accept higher costs in exchange for more reliable deliveries and stock reduction, wherein punctuality and flexibility are valued since they allow for better inventory management, higher control, and improved customer service.

3.1.2 User perspectives on E-commerce services

LLs in Oxfordshire and Flanders are setting up e-commerce services in relation to their LMD. Focusing on the experience of online shopping for customers of an e-commerce platform, *Vrhovac et al* [REF-03] identified six factors that could significantly affect their experience of last-mile delivery: delivery efficiency, parcel tracking, smooth delivery, visual appeal, joyful anticipation, and convenience. When it comes to determining which factors encourage customers to buy online, *El Moussaoui et al* [REF-09] listed: temporal and spatial flexibility, competitive prices, and quality of the website. In other words, online shopping options were preferred in order to save time by avoiding physical trips and parking, to save money, and up-to-date information on the e-commerce website. However, inaccurate product specifications, unreliable delivery times, and privacy & security concerns were found to be deterrents. This echoes the idea that building a user's trust in the reliability of a courier service is key to its success. Out of the factors that encourage online shopping for customers, *Kiba-Janiak & Cheba* [REF-10] found price to be the most important one.

Specifically investigating green delivery methods in e-commerce, *Kader et al* [REF-11] find that utilitarian motivations were the strongest predictor of a customer's intention to choose a green delivery option. In other words, this study also shows convenience and delivery efficiency to be of high importance to e-commerce platform users. Additionally, it also reveals that consumers with adventurous attitudes are more likely to engage with new shopping methods and make green-delivery purchases.

3.1.3 User perspectives on automated robot deliveries

In Ispra and Barcelona LLs, the LMD includes automated robot deliveries. Automated delivery robots have been found to be a more efficient and sustainable option especially in areas with restricted traffic zones and many one-way streets [REF-12]. In connection to the implementation of Yape droids in Ispra and a potential automated delivery option via railway transport in Barcelona, here are a series of studies focused on the end-user perspective on the introduction of such delivery methods. *Karli and Tanyaş* [REF-04] briefly noted that consumers preferred delivery methods without human interaction. However, *Edrisi & Ganjipour* [REF-13] identified a lack of human interaction in autonomous robot deliveries as having a negative effect on a customer's attitude towards them, along with other factors such as performance risk and delivery risk (i.e. potential for goods to be damaged or untimely arrival). On the other hand, the optimism of online shoppers and their environmental concerns were noted to have positive effects on their attitude, which in turn influenced the likelihood of intending to interact with the robots.

Saravanos et al [REF-14] also investigated end-user acceptance of autonomous vehicles in last-mile deliveries, and the identified determinants were as follows (starting from most significant): performance expectancy (i.e. perceived usefulness of the technology), social influence (other people's opinions), hedonic motivation (enjoyment derived from interactions with it), and perceived risk.

Another aspect of implementing autonomous delivery robots to consider would be their interaction with pedestrians and others who are not an end-user or part of the delivery scenario. *Weinberg et al* [REF-15] conducted an ethnographic study of the public's interactions with sidewalk delivery robots over the course of a pilot. They found that interactions were initiated by both robot and pedestrians including children and pets. Many interactions were observed to be the result of curiosity, approaching the robot with the intention to learn more, and engaging with peers to theorize about its purpose. Helpful behaviour towards immobilized robots in need of human assistance was observed. However, there were documented incidents of people kicking the robot, flipping it or throwing it into a dumpster, and instances of vandalism on the robot. This highlights the types of dangers that such a robot would encounter in public areas, and the higher the risk, the higher the likelihood of end-users refusing to choose this option, seeing that perceived risk has been noted to be a factor considered by consumers [REF-15]. Still, this awareness also presents a valuable opportunity to enhance safety measures and improve user trust, potentially leading to greater acceptance and success of robotic technologies in public spaces.

3.1.4 User perspectives on pick-up points and delivery lockers

Barcelona, Oxfordshire, Athens and Flanders LLs are establishing pick-up points and/or delivery lockers in their LMD. Pick-up points have been one of the most popular sustainable last-mile delivery solutions [REF-16]. However, home delivery still seems to be the most preferred method of delivery from the customer perspective and the only service that *Patowary et al* [REF-17] found they were willing to pay more for, even though pick-up points and delivery lockers were next in the ranking. In this context, convenient hours of delivery and cost of delivery were observed as the customers' main concerns. *Karli and Tanyaş* [REF-04] also noticed an overall preference for home delivery, followed by smart delivery lockers over service points, due to accessibility in terms of hours available for pickup being a key factor determining consumer preference. This order of preference is important to keep in mind when considering how to ensure that the potential for using more sustainable options becomes maximised.

That said, from the customer's perspective, insufficiently dense parcel locker networks have been observed to be a feature that deters customers from choosing this option compared to home delivery, since the cost of time and energy to travel to it shifts from the delivery company to the customers. Therefore, delivery lockers that are easily accessible in terms of proximity are important from the user perspective. [REF-18] In an older study, details of customer expectations regarding locker location were found to be, in order from most important: closeness to home, presence on the way to work, parking spaces nearby, safety, closeness to shopping centre, and closeness to public transport stops. When it came to reasons for using the lockers, they were, in order: price, localisation, 24h availability, time, and parcel tracking. [REF-19] Similarly, *Lai et al* [REF-20] found five determinants of customer satisfaction with parcel locker services, starting from the strongest predictor: timeliness, reliability, security, responsiveness, and tangibility. The same overall factors apply to pick-up points, according to the findings of *El Moussaoui et al* [REF-09], where location, density, security, and opening hours were identified as affecting consumer preference for this delivery option.

When it comes to location convenience, pick-up point accessibility can be increased to encourage customers to choose this option by meeting this requirement. *Schwerdfeger & Boysen* [REF-21] suggest that mobile parcel lockers are a development that can significantly shorten travel distances for customers. In light of the Mobile Delivery Hub (MDH) to be implemented in the Oxfordshire, implementing this solution can be seen as a way of meeting this user requirement, considering the specificities of its Living Lab context.

3.2 GREEN-LOG LL requirements – second version

The previous section summarise research on user perspectives, aspects and factors that is relevant for the GREEN-LOG LMDs. These insights have been an important resource in organising, designing, and facilitating the LL requirement workshops, as well as for conducting further user studies in the LLs. This section summarises the insights derived from the LL requirement workshops, that specify the initial goals, opportunities, and barriers from user perspectives to create successful LLs and LMD. The results from this second iteration of the LL requirements are followed up in D1.2 in terms of more explicit user journeys and use cases, as well as service blueprints for the connection to the GREEN-LOG platform and cooperative business models for each LL LMD.

3.2.1 LL #1 Athens refined LL requirements

A Micro Consolidation Centre (MCC) is to be developed in the historic city centre of Athens as part of Athens LL. This MCC will be supervised by operators to distribute deliveries either by drivers in e-vans or through a locker system for on-site pick-up by recipients. This MCC will be shared between FedEx and ACS SMSA deliveries through existing services, and it will be in a old municipal parking facility. The LL users are identified to be the LSPs (primarily the *drivers* of the e-vans, and the *operators* of the MCC), and the *customers* (recipients of the parcels).

The LL requirement workshops resulted in identifying that the following qualities of the LMD was important for LL Athens from a user perspective. The LMD has to:

1. Be safe for drivers and safe shared handlings of shipments.
2. Enable collaboration between LSPs through a shared system that is compatible with approaches in both LSPs.
3. Include an operational-friendly MCC for drivers with traffic information and routing through a relevant hardware option.
4. Include user-friendly MCC lockers for recipients with on time notifications that informs about the shipment delivery.
5. Include an operational-friendly system for both LSPs with possibilities for parcel reallocation from the LSPs that covers operational needs.

The aim of further activities involving user perspectives through follow-ups in Task 1.3 and qualitative impact assessments in Task 4.7 (the lather starting in M19) would be to get a better understanding of how LSPs collaboration can be made as effective as possible, and to find out more about drivers' needs when using the MCC space, along with checking for any potential obstacles within their user journey. Thus, important unknowns about the drivers that needs to be further investigated through coming user engagements are:

- The drivers' current difficulties and constraints, i.e., how do they want to receive information about deliveries?
- What are the pain points in a driver's user journey with the system?
- What are the key factors for successful deliveries from the driver's perspective?

3.2.2 LL #2 Barcelona refined LL requirements

In the city of Barcelona, multiple options for multimodal sustainable last-mile delivery methods are being explored and developed through the LL collaborations, ranging from e-cargo bikes to the use of robots on rail transport services to reach further distances, using GREEN-LOG technologies to help pick the optimal delivery modes for each route, and track delivery times and parcels as they make their way from the hub to the customer. The LL key users in this

case are the *cargo bike riders* and the *operations managers* as they navigate these multimodal delivery options.

The LL requirement workshops resulted in identifying that the following qualities of the LMD was important for LL Barcelona from a user perspective. The LMD has to:

1. Be efficient and cost-effective parcel delivery routes.
2. Ensure a smooth delivery process for delivery riders using national rail services, including the potential integration of transfers to robots, which is currently under consideration
3. Be safe and functional vehicles (e-cargo bikes, scooters, vans) that are appropriate for the chosen routes.
4. Be user-friendly interface for both riders and Operational managers.

Further activities involving key LL user perspectives would aim to further understand, the potential for effective collaboration of LSPs through using rail-based transport, find out more about the rider's experience of the multimodal delivery journey, and investigate human-robot interactions. Thus, the unknowns about the users that needs to be further investigated through coming user engagements are:

- What are the pain points in the rider's user journey with the system?
- What are the key factors for successful deliveries from the rider's perspective?
- In-depth understandings of riders' unforeseen difficulties and constraints when doing deliveries in testing situations.

3.2.3 LL #3 Flanders refined LL requirements

The partners in LL Flanders are developing Last-Mile Logistics as a Service platform across the cities of Mechelen, Leuven and Gent. This platform can offer shopkeepers and consumers various delivery options, such as combined food delivery and waste collection, based on factors such as dynamic pricing and delivery time, in a way that encourages sustainable choices. The collaboration between *LSPs* play a crucial role in the development of a neutral platform, while the choices and preferences of *shopkeepers* and *customers* play an essential role in its success, which is why they have been identified as the three key LL users. By compiling knowledge from each of their perspectives through the LL requirement workshops the following qualities of the LMD was identified as important for LL Flanders from a user perspective.

The LMD has to:

1. Provide free choice of cost for LSPs.
2. Provide a neutral platform to allow collaboration between LSPs.
3. Provide user-friendly interface for shopkeepers.
4. Enable a maintained contact between customers and shopkeepers.
5. Increase efficiency for deliveries.

The aim of upcoming activities involving user perspectives would be to further investigate in what ways the LSPs would like to collaborate and share information and how a neutral software can facilitate this. Furthermore, investigations in how actually the LSP do their pricing today could give clues to how a dynamic prizing module could work in this context. It would also aim to find out more about the level of service that shopkeepers would like to give to the end customer (along with the customer's own preferences) and how these preferences can be combined with collaboration with transport companies.

3.2.4 LL #4 Oxfordshire refined LL requirements

The introduction of MDH as a form of e-cargo bike, with the potential to double as a delivery locker, a MCC, as well as an e-commerce platform connecting customers to local retailers in Oxford are the logistics innovations within this Living Lab. These innovations enable customers to order from multiple retailers and receive their orders within a single deliver. In Oxfordshire LL, the users have been identified as the *Covered Market shopkeepers,* and *customers,* where the tight relationship between the two is valued in the local community. By compiling knowledge from each of their perspectives through the LL requirement workshops the following qualities of the LMD was identified as important for LL Oxfordshire from a user perspective. The LMD has to enable:

1. Consolidation of deliveries from multiple shops to reduce delivery costs and increase convenience for customers.
2. Efficient and on-time delivery.
3. Maintenance of personal contact between shopkeepers and customers.
4. Safe operation of MDH.
5. User-friendly interface for e-commerce platform for both shopkeepers and customers.

Upcoming activities would continue to integrate user perspectives within the iterative process of implementation, with the aim of obtaining further clarity on the motivations for choosing this e-commerce platform with e-cargo bike delivery methods guided by the following questions:

- Clarity on user desires - what would motivate them to use an ecommerce platform with e-cargo bike delivery?
- How to target the most effective common customer base for shops with diverse offerings?
- What products would be appropriate for sale on an ecommerce platform and consolidated delivery?

3.2.5 LL #5 Ispra refined LL requirements

In the environment of the JRC-Ispra campus, the Living Lab will develop a multimodal last-mile delivery service with Yape droids and cargo bike riders to ensure an efficient, low-contact, and high-quality delivery of lunch food for its customers. The LL users for this case have been identified as the *lunch customers, cargo bike drivers, canteen workers, and Yape operators,* who all play an essential part in ensuring a successful delivery, yet they all have different experiences of this service from their respective points of view. For instance, a lunch customer would prioritise saving time by using this service, while a canteen worker would value the seamless integration of this new delivery service into their plan. By compiling knowledge from each of their perspectives through the LL requirement workshops the following qualities of the LMD was identified as important for LL Ispra from a user perspective. The LMD has to enable:

1. Easy and smooth package tracking.
2. Accurate up-to-date information about number of orders and their status.
3. Smooth integration of new service into canteen routine.
4. Effective communication between customers and the canteen.
5. Accessible digital interface.
6. Efficient and on-time deliveries.
7. A wide range of hot and cold food options.

Further activities involving user perspectives could aim to uncover and maximise the probability of long-term engagement with the service, find out more about the current lunch experience of a canteen-goer to understand how to best integrate the service into pre-existing

routines, and to develop a general awareness of its benefits (for example how it can be communicated as a service that actually provides the customer with more free time during lunch break).

4 Conclusions: Frictions and unknowns

This section concludes the insights about LL users' perspectives on the LMD under development in the GREEN-LOG LLs. It presents an analysis of the developed LL requirements in terms of similarities and differences across the LLs, as well as points out directions for further inquiry through user engagements.

4.1 Frictions and contradictions

An analysis across the different refined LL requirements through user perspectives shows the importance of cooperation, both in terms of collaboration between delivery companies and other logistics players in the demonstration sites, as well as collaboration among stakeholders within the LLs. The need for LL cooperation became evident in how the different LLs experienced points of contradictions that caused friction between user perspectives and aims with implementing LMDs:

- While the services are developed to unburdening shopkeeper's working situation with bringing in other delivery solutions than personal contacts, their businesses still rely on maintained customer contacts.
- While the services are developed to increase efficiency, fill rate, and drop density of deliveries and optimize routings and prize, the local service providers and shop keepers still wants to have flexibility to choose costs and routings themselves as part of their business models.
- While the services are developed to save time and money for customers through online platforms, there is still a need for direct interactions with customers to increase awareness, induce demand and communicate benefits.
- While innovative automated delivery services engage users through its newness, however, to stay interesting for long-term use it also needs to support old routines, habits, and social life.

These kinds of frictions demand engagements in local values to be able to tailor solutions to the demonstrations sites to avoid problems with solutions that contradict how LL users want to deal with their last mile deliveries without giving viable options.

4.2 Unknowns and possible future user studies

Through the work with the LL user requirement canvas, key unknowns to move forward with the development of the LL delivery solutions were identified. Among others, the following themes stood out as interesting avenues for coming engagements with the users:

1. Delivery service drivers and shopkeeper experiences:

What are the drivers' current difficulties and constraints? How do drivers and shopkeepers prefer to receive information about deliveries? What are the pain points in the drivers' user journey with the system? What are the key factors for successful deliveries from the drivers' perspective?

2. Logistical Collaboration:

How will the neutral software delivered through GREEN-LOG facilitate collaboration and what kind of values for the shopkeepers/local delivery providers will become evident through the testing? How will the GREEN-LOG software enable LSPs collaborations around exploiting the potential of the delivery solutions?

3. User Preferences and Engagement:

What would motivate users to use an ecommerce platform with e-cargo bike delivery? What technique will be the most efficient and sustainable, financial or non-financial nudging? How to target the most effective common customer base for shops with diverse offerings? What products would be appropriate for sale on an ecommerce platform and for consolidated delivery? How can the service support new types of social interactions/activities? How can this service become part of already existing routines? Are the use case scenarios acceptable to the recipients? What specific service level do the shopkeepers want to give to the end customer to retain them?

These themes and questions could be developed into interesting topics for cross-country LL trading zones. By employing a diverse range of user research methods, the LL core teams can gain comprehensive insights into the various aspects of user experience, preferences, and behaviour related to the delivery service. This approach can inform the development of user-centred solutions and optimize the delivery service to better meet the needs and expectations of all stakeholders.

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