Establishing Living Labs for City Logistics: Scoping and Initial Outcomes

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Abstract. Living Labs (LLs) are collaborative spaces where stakeholders are offered the opportunity to address relevant challenges. In the context of city logistics, LLs promote knowledge exchange, innovation, and learning among stakeholders, while also focusing on understanding how different UFT solutions are perceived by stakeholders, and how these perceptions influence solution adoption. In this direction, the aim of this study is twofold; first to provide a framework for establishing city logistics LLs, and second, to validate this framework via showcasing the challenges and barriers of LLs of different size, purpose and scope, to elicit requirements and foster the actual implementation of the envisaged solutions and their scale up. The research contributes to the advancement of sustainable urban logistics practices to enhance the efficiency, sustainability, and resilience of Urban Freight Transport (UFT) systems.

Keywords: Urban Freight Transport · Co-creation · Stakeholder Engagement · Knowledge Exchange

1 Introduction

Living Labs (LLs) are collaborative environments where various groups of stakeholders come together to co-create and co-design solutions addressing complex urban challenges [1]. In the context of city logistics, establishing LLs provides a platform for stakeholders to collaborate and test innovative solutions that improve the efficiency, sustainability, and resilience of Urban Freight Transport (UFT) systems. They facilitate the exchange of knowledge, ideas, and resources, enabling stakeholders to learn from each other successfully without being hampered by conflicting interests and agendas [2].

Recent literature on Living Labs (LLs) for last-mile delivery innovations indicates that LLs are a pluralistic approach centered around bringing together diverse sets of stakeholders in new formations to co-create products and services in complex settings [1]. While most LLs focus on fostering interactions between end-users and private actors for technology development through a triple helix perspective, the emerging concept of urban LLs specifically emphasizes urban and civic innovation through quadruple helix co-creation. This approach facilitates spatially embodied collaboration between private entities and civil society [2, 3]. As a result, urban LLs have become a means to approach

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smart mobility or smart city futures, where multiple actors need to align to solve complex challenges [3].

The innovation of the current framework discussed in this article lies in recognizing that, while urban LLs provide a promising arena for co-creation, there is room for expanding the methodology further. Key areas for improvement include how to engage and align stakeholders throughout the innovation process [4], how to create environments where stakeholders can co-create and learn from each other successfully without conflicting interests and agendas, and how to leverage outcomes from Living Labs on a larger scale [2, 5]. Additionally, there is a need for further research on methods for citizen engagement in urban LLs to better understand how these labs could and should interact with citizens [6, 7].

In this direction, the aim of this study is twofold; first to provide an innovative framework for establishing city logistics LLs, and second, to validate this framework via showcasing the challenges and barriers of LLs of different size, purpose and scope, to elicit requirements to foster the actual implementation of the envisaged solutions and their scale up. To achieve the first objective, key stakeholders involved in the city logistics sector were identified, along with their respective roles. Then a conceptual framework for the establishment of LLs is developed. The envisaged framework outlines a process for developing a shared vision and establishing governance and management structures to promote stakeholder engagement and effective collaboration. The framework is applied to five case studies –Athens/Greece, Barcelona/Spain, Flanders/Belgium, Ispra/Italy, Oxfordshire/UK– currently deployed in the frame of the European Horizon project GREEN-LOG [8]. As per the second objective, through iterative engagement with stakeholders in the period January-June 2023, challenges and barriers for all five LL were identified.

2 Developing a Co-creative Living Lab Framework - Charting the Scoping Phase

LL co-creation has to be tailored to the local social and cultural context and organised through inclusive and iterative processes that involve engaging diverse stakeholders, fostering open dialogue, facilitating knowledge exchange, and providing opportunities for collaborative decision-making and experimentation. While many LLs primarily emphasize on enhancing interaction between end-users and private entities to drive technology development within a triple helix framework, the GREEN-LOG LL model distinguishes itself by placing a particular emphasis on urban and civic innovation. This is achieved through a quadruple helix co-creation approach that encourages collaborative efforts within physical spaces between private entities and civil society [3].

The adopted framework approach of this study is inspired by the methodology of Smith & Iversen [9]. It begins with Scoping activities, serving as a preliminary Phase Zero phase in participatory design projects; it is then followed by subsequent phases involving Developing and Scaling dimensions. Focusing on the Scoping dimension, it involves predefined stakeholders in co-design activities and timelines to initiate the development of protagonist communities within the LL. A protagonist community refers to a group of individuals or stakeholders who actively take a leading role in initiating and driving

positive change within their community. Moreover, user definition and participation configuration are also integral parts of the phase.

The Scoping phase is characterized by two distinct subphases; the introduction of the LLs, and the alignment of goals and visions. As per the former, LLs are often requested to provide two key contacts (in the frame of city logistics, these could be a city representative and a logistics service provider) to conduct initial interviews. These interviews aim to map existing activities, experiences from previous projects, expectations, collaboration visions and future activities.

3 Results of Scoping Phase

The first step of Scoping phase in the GREEN-LOG project required the identification and clustering of stakeholders whose perspectives are crucial for developing effective policies/solutions. Based on an extended literature review [10], four main clusters main clusters emerged. The corresponding stakeholder categories to these clusters can be seen in Table 1.

Table 1. GREEN-LOG stakeholder clustering.

Cluster	Stakeholder Category
Cluster A	Local government agencies, Environmental groups, Community groups/Citizens, Emergency responders
Cluster B	Researchers and academics, Financial institutions, Insurance companies
Cluster C	Businesses/Shippers, Logistics companies, Technology companies, EV manufacturers and charging infrastructure providers
Cluster D	End users/Customers

Moreover, customized "Meet-Ups" were arranged for all five LLs. These involved, inter alia, determining potential local stakeholders; developing goals' and barriers' alignment; planning potential user journeys and more.

3.1 Determining Local Stakeholders and Organizational Structure

The various LLs underwent a facilitated process to create an organizational structure that defines the roles of local stakeholders within the project. This structure delineates core team members (fully dedicated to the project), involved team members (regular contributors), and informed team members (stay updated and provide input as needed) (Fig. 1).

3.2 Goals and Barriers

The LLs within the GREEN-LOG project engaged in collaborative discussions to articulate their respective goals/visions and barriers. The discussions took place on a

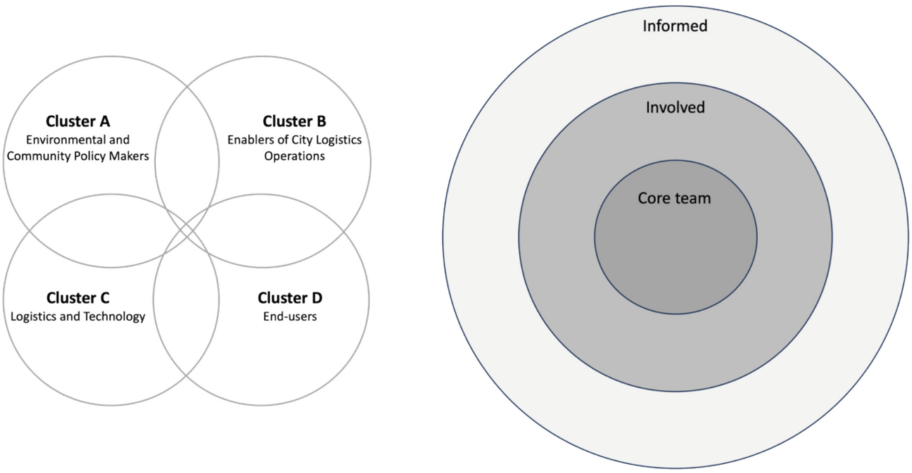

Fig. 1. LL structure to organise local stakeholders by clusters and levels of engagement.

Table 2. LL goals identified by core teams in GREEN-LOG's Living Labs.

LL	What does it want to achieve?
ATH	1. Improve citizens quality of life 2. Raise awareness on green innovative solutions 3. Promote Athens as a green tech implementation hub 4. Digitize last mile solutions
BAR	1. Public Transport participation in last mile delivery solutions 2. Greener and more efficient last mile logistics 3. More sustainable city logistics (less driven kilometres and vehicle movements, visible changes in the city)
FLA	1. Connecting supply and demand for both sender and receiver, with a technological solution that is data driven 2. Sender's and receiver's role being effectively included in the last-mile logistics Awareness of societal costs of last/first mile deliveries
ISP	1. Sustainable delivery process 2. Mixing different vehicle technologies to exploit their unique comparative advantages 3. Prototype this service and transfer it to a city-like case 4. Facilitate the promotion of innovation 5. Enable growth and economy at JRC site
OXF	1. Real world demonstration and data collection of the possibilities and benefits of using micro consolidation including simulation of CAVs 2. Understand the feasibility, potential, and societal response to micro consolidation 3. Long-term space to continue collaborative innovation and testing green logistics solutions among a wider group of stakeholders

shared digital platform using MIRO software, and the outcomes are summarized below (Table 2).

LLs identified also key barriers that challenge the realization of their objectives. These barriers span a range of logistical, regulatory, and operational challenges as follows (Table 3).

Table 3. LL barriers identified by core teams in GREEN-LOG's Living Labs.

LL	Main Barriers
ATH	1. Lack of infrastructure and regulation on micro mobility 2. In order to expand and replicate the solution, concern should be given to the implementation process of the micro consolidation centres
BAR	1. Lack of economic viability 2. Lack of alignment between stakeholders both internally and externally 3. Slow and difficult decision-making processes for public entities 4. Operators loosing clients/money during trial-phase 5. Lack of understanding of the LL trial-error approach 6. Conflicts of interests related to multiple stakeholders
FLA	1. Finding common ground for all 3 cities: overcome the differences in cities 2. Resistance to the involvement of end-receivers/shop-owners/traditional LSPs/political representatives 3. Time to bring in all stakeholders in all cities
OXF	1. Procurement issues and processes: delays, and value for money 2. Problems finding suitable site with good cycle access 3. Too slow development of technology 4. Difficulties in buy-in couriers and national parcel carriers outside of consortium 5. Social, legal and political barriers 6. Problems with involving the right partners
ISP	1. System continuity 2. Paths identification physical barriers (sidewalks, steps) 3. Final users' involvement 4. Delivery robot traveling without interfering with other road users 5. Administrative coordination between stakeholders 6. Technical integration of the solution 7. How to offer a continuative service and manage corner cases (guarantee the delivery if technical faults arise, location of logistics hubs, etc.)

3.3 Tentative User Journeys

Each of the LLs was also guided through the Scoping phase to cultivate a user-centric approach to developing delivery solutions. This involved identifying potential users and mapping their interactions with the solution through a process known as "User Journeys." A User Journey serves as a design tool that illustrates the complete sequence of interactions and experiences a user undergoes when engaging with a product or

service, starting from their initial awareness and engagement, and concluding with the desired outcome or conversion. User Journeys are invaluable for gaining insight into user perspectives, pinpointing pain points and opportunities, and guiding the design and optimization of products or services [11].

In the GREEN-LOG project, this particular activity was primarily centered around 'proto personas.' Proto personas are preliminary and generalized representations of potential users, often based on assumptions or limited research. They serve as a foundation for guiding early-stage design decisions. As a result of this activity, tentative User Journeys were created. These User Journeys played a crucial role in planning upcoming user-involved co-creation activities and defining user requirements. Moreover, these provisional User Journeys also served as effective communication tools during co-creation activities. They helped solidify the local delivery solutions, paving the way for future engagements with LL stakeholders. Figure 2 shows the tentative User Journeys of Ispra LL which is focused on the development of a delivery platform that integrates a booking system with delivery robots.

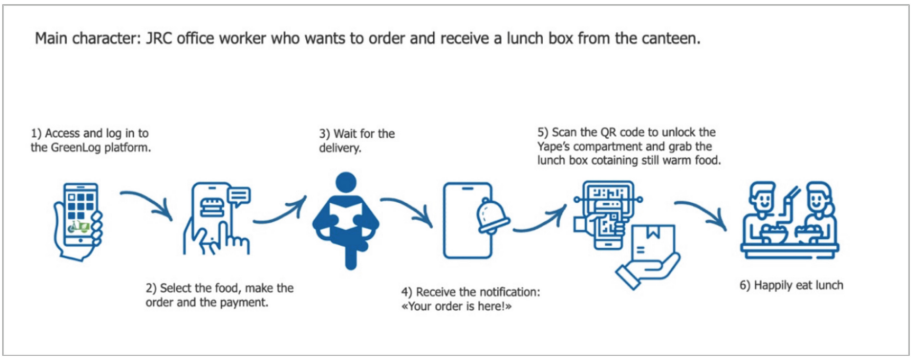

Fig. 2. LL Ispra's tentative User Journey presents how an office worker orders a lunch box from the canteen delivered by a delivery robot service.

4 Concluding Discussion

During the Scoping phase presented in this study, co-exploration was facilitated, relevant participants were identified and dialogues leading to common understandings among stakeholders and researchers were encouraged. Other key conclusions was the strong consensus on the importance of sustainable logistics solutions among stakeholders and the revealed varying perspectives and priorities of different stakeholders.

Moving forward, the next critical step is to transition the LLs into the Developing phase. In this phase, collaborative work will be undertaken with stakeholders to engage iteratively with the technological solutions, addressing various levels of abstraction. To initiate this phase, the creation of both generic and context-specific activities and frameworks, aligned with the active involvement of citizens and local stakeholders, will

be pursued. Through these measures, the aim is to encourage experimentation and co-development of their own implementation practices, fostering innovation and sustainable solutions within the GREEN-LOG project.

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