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# A city logistics living lab: a methodological approach

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**Abstract**

The field of city logistics can be characterized by its many local demonstrations and trials, that are quite often not lasting longer than the trial period. The number of demonstrations that continued and were implemented in daily practice is limited. Freight partnerships proved to be a good first step to engage stakeholders. This contribution proposes a new way to develop a more action-driven form of these partnerships that follows from a solution approach, which has proved successful worldwide in fostering innovation deployment, but has not yet been applied explicitly in the domain of City Logistics: Living Labs. The living lab approach ensures that the stakeholders are involved much earlier in the in planning and implementation processes, and that the proposed city logistics implementation is revised and continuously improved to meet stakeholder needs and obtain maximum impact for a long time. This contribution summarizes the steps that have to be taken to set-up and work in a city logistics living lab (CLLL). A CLLL can be defined as a dynamic test environment where complex city logistics innovations can be implemented, following a cyclical approach, where several solutions can be experimented and re-adjusted or improved to fit the real-life city challenges. In the Horizon 2020 project CITYLAB, we developed practical guidelines for establishing and running a city logistics living lab based on several living lab- and field test methodologies that enables stakeholders to set-up and run a CLLL. This contribution discusses the most important CLLL phases, roles, and characteristics, as well as the tools that are available. Next, this contribution shows the first results of cities in which CLLLs are actually set up, or already running.


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## 1. Introduction

Over the last years, research in the field of urban logistics (as a generic term for all logistics activities in cities, including city logistics, urban goods movement, urban freight transport, etc.) has increased. Not only in academia as follows form the increasing number of publications in the field as well as from the topics of specific conferences, but also from (local) authorities. As a result, the number of studies and trials showing solutions for issues in and due to urban freight transport has risen. However, with this increase in demonstrations it also becomes clear that real progress in the field is limited and that many initiatives are – at best – only successful at a local level. Compare for example the book of Ogden (1992) or the PhD thesis by Van Binsbergen and Visser (2001) with current demonstrations, trials and regulations, and one can see that the progress made in these years appears to be limited. So, although the increasing interest is encouraging, one point is striking: to really make a change in current urban areas, to really make a transition in the system to a more sustainable and more efficient urban freight transport system, a new or another approach is necessary. Currently, small scale solutions are often not scaled to a larger area nor copied to other cities. Even successful trials and demonstrations are often terminated at the end and are not continued in daily city logistics operations. There has been extensive experimentation with innovations in city logistics in the past decades. Studies looking into factors of failure of initiatives are rare (see for some examples: BESTUFS (see www.bestufs.net), Visser et al. (2008), Quak et al. (2008), Van Binsbergen et al. (2014), Vaghi and Percoco (2011)). Usually failed initiatives are not evaluated as there is no money left or as people are not tended to present failing projects (a success bias). As a results, launch events of demonstrations are usually well published and announced, but quite often it is very hard to find the results of demonstrations after a while.

Causes of failure generally point towards a poor preparation of innovation deployment processes, due to limited stakeholder involvement, unclear business models or uncertainty in the environment. It is also evident that there is sometimes a mismatch between the ambitions of the public sector (exemplified by city authorities), those of the private sector (transport operators and receivers for example), and those of the researchers (both consultants as well as academia). Policy and business time cycles are often rather different with the private sector needing to concentrate on shorter term payback for project commitment and roll-out. “Bringing public and private sector decision-makers together in freight partnerships is an important step in building trust and enhancing the uptake of urban freight initiatives. Next, including researchers in these partnerships might not necessarily result in better interaction or understanding between actors, but it might help in finding common solutions or objectify effects of actions, which are required to improve the system” (Quak et al., 2015). The idea, to go to a more action driven freight partnership, where authorities, industry and research collaboratively work on the improvement of urban freight, is the main topic of this contribution: i.e. city logistics living laboratories. This contribution is based on CITYLAB’s Deliverable 3.1 ‘Practical guidelines for establishing and running a city logistics living laboratory’, see Nesterova and Quak (2015). This paper first discusses the steps from the current well-known freight partnerships to the city logistics living labs in section 2. Next, the challenges and opportunities of the living labs approach are examined and discussed in section 3. This section also presents the practical guidelines to set up and run a city logistics living lab. Section 4 comes with the first conclusions and looks forward to challenges this way of working can have.

## 2. City logistics: from freight partnerships to the City Logistics Living Labs

### *2.1. Overview of the main trends and challenges within the urban freight transport context*

The shape and characteristics of a city, its transportation and logistics industry and therefore also its urban freight logistics system are specific for each individual city. At the same time, there are also some general macro-economic trends that impact the overall development of the city logistics in Europe and can be observed in different kind of cities. European urban freight transport sector has the following general characteristics:

- Multi-stakeholder environment involving a lot of actors with conflicting interests;
- Growing negative economic, environmental, social impacts from urban freight transport;

Inefficient and unorganized last mile logistics in the majority of the cities.

Being a constantly evolving sector, the urban freight transport sector is currently influenced by two main trends which are slowly reshaping the urban freight logistics market in Europe:

- Development of the urban culture, attracting increasing amounts of young and old people to the city centers (by 2025, more than 75% of Europe's population is forecasted to live in urban areas and by 2050 the proportion is expected to increase to 84% (Verlinde, 2015);
- The growth of e-commerce and home deliveries (Verlinde, 2015) states that by 2025%, 20% of retail will happen through online channels).

To address these trends as well as the existing challenges new solutions to efficiently manage deliveries and services in urban areas as well as new knowledge and collaboration are greatly needed. Next, the trends and challenges also results in opportunities for traditional service providers or city logistics specialists, who are facing increasing competition in their traditional core business (e.g. parcel delivery and warehousing services) and are searching for smarter solutions and new markets to penetrate.

### *2.2. Traditional approaches to address urban freight challenges on the city level*

The complex environment of the urban freight transport systems with multiple stakeholders involved is one of the main characteristics of the urban freight transport. Therefore, it is difficult to speak of a one solution that fits it all. As experience shows a solution for one issue results in a problem for someone else: e.g. time windows to reduce nuisance result in higher costs for operators due to time restrictions and limited options for efficient planning (see Quak and De Koster, 2007). So, making changes in complex systems, such as the urban freight transport system, is difficult: there are many different stakeholders with different and sometimes conflicting objectives. No single stakeholder has a complete overview of the system or what the effects and rebound-effects of actions, policy measures or other interference are or will be (Quak et al, 2015).

CIVITAS WIKI (2015) identifies three different solutions to make changes to an urban freight transport system as a whole or its specific part. These directions are:

- Policy: determines the urban conditions in which urban freight transport operations can take place (time, location, etc.).
- Technical: determines on the one hand the available means (e.g. vehicles) involved in urban freight transport and on the other hand the means to plan trips and communicate (e.g. ICT).
- Logistics: determines the operational conditions for urban freight transport trips, e.g. exact location, delivery hours, delivery frequency, means used, etc.


Figure 1. The organisation of urban freight transport operations (CIVITAS WIKI, 2015)

Figure 1 illustrates that if we want to introduce changes in the urban freight transport system we have to consider all directions and not just one. This requires that for solving issues in urban freight transport cooperation between logistics (private sector), policy (public sector) and technics (again private sector) is required.

MDS (2012) provides and extensive review of most common measures and practices that are employed in order to make changes in the urban freight transport system (Table 1). Usually these measures are not performed in isolation and are used as a mix of measures. Experiences from demonstration and trial projects show that very often the measures/technologies/innovations do give a very positive result, but only within limited period of time and are not widely picked up by the big urban freight transport community improving an urban freight transport system in a long term. According to Quak et al (2015), “in order to actually make a considerable change in the urban freight transport system, it is necessary to align the stakeholders, their objectives, their abilities to act, and their perceptions on the problems that have to be tackled”. One best practice that is currently used in the cities is to setup a freight partnership (a public private partnership that deals with urban freight transport issues).

Table 1. Overview of urban freight transport measures (MDS, 2012)

| Category | Description | Measure examples |
|---|---|---|
| Regulatory | Essentially rules and prohibitions, supported by a control/enforcement system and that are designed to control private activity for the wider benefit of society | Time windows<br>Vehicle weight and size restrictions<br>Low emission zones |
| Market based | Fiscal measures such as taxes and tolls aim to “modify” the market prices of the goods whose production generates negative effects. | Congestion charging<br>Mobility credit schemes<br>Indirect subsidies |
| Land use planning | Land use planning measures taking into account the demand for urban freight transport as well as needs of freight industry | Zoning of retail & logistics activities to secure critical mass<br>New developments with off-street loading/unloading facilities<br>Safeguarding of rail-connected & water-connected sites for future use<br>Requiring large-scale distribution sites to be rail and water connected |
| Infrastructure | Measures that focus on creation/upgrade of related to the urban freight transport infrastructure | Network of on-street designated loading and unloading bays<br>Development of rail and/or waterborne connected logistics zones |
| New technologies | Application of ICT and ITS for the improvement of urban freight transport | |
| Management and other | Measures implemented directly by private actors to secure sustainable urban distribution and measures implemented both by public and private actors that did not fall into any other category | Developing Urban Logistics plans<br>Developing freight quality partnerships, involving effective consultation<br>On-line one stop shops for freight<br>Indirect subsidies to support urban consolidation centres<br>Planning permission requirements for construction consolidation centres for major construction sites<br>Developing network of e-commerce pick up points |

Local public-private partnerships (PPP) in urban freight transport do occur in the form of freight partnerships which are also called freight networks, freight charters and peer to peer exchange etc. Freight partnerships can be defined as "a long-term partnership between freight stakeholders concerned with urban freight, that on a formal or informal basis meet regularly to discuss (and sometimes find solutions to) problems and issues that occur in the urban area" (Lindholm and Browne, 2014). These differ from the traditional PPP by also involving private stakeholders for consultation and dialogue in a public decision-making (Browne et al., 2003). Freight partnerships are of a high interest when addressing urban freight transport problems because they increase a shared situational awareness of all of the participants and bring in joined knowledge production for innovation. Quak et al (2015) states they could be an attractive approach to stakeholders' involvement, since it is a way of achieving valuable results with a relatively low budget. However, freight partnerships are usually not really action driven, and as a result, these often do increase the understanding between actors and might solve some of the urgent stakeholders' discomforts, but a joint action to really improve the system on the longer term does not happen.

*2.3. From freight partnerships to Living Laboratories*

Where the freight partnerships bring together the various stakeholders, collaborative and joined innovative actions and ambitions are often not the direct result of these partnerships (Quak et al, 2015). Creation of the Living Laboratories (Living Labs) provides a new way to develop an action driven form of freight partnerships, fostering innovation deployment and improving communication and cooperation between different stakeholders of the urban freight transport system. This way to develop a more action-driven form of freight partnerships follows from a solution approach, which has proved successful worldwide in fostering innovation deployment, but has not yet been applied explicitly in the domain of City Logistics. The concept of Living Labs is credited to William J Mitchell of MIT in early 2003. Mainly owing to insights into the potentials of information technology, he proposed to move R&D to in vivo settings—in other words, to 'wired' living settings such as in a building or part of a city—thereby enabling to monitor and respond to users' responses and interactions, with the ultimate aim to speed up development and deployment of innovations. In Europe, the concept of living labs was already recognized by the European Commission in 2006 as a key tool for open innovation. Since then, living labs have spread over Europe in various waves, first focusing on new ICT tools but later extending to other fields, such as sustainable energy, health care, and safety. The achievements of the living lab movement went beyond fostering the development of demos, pilots, experiments and test beds: it changed the emphasis from the solution as an isolated object to the process of integration with its environment. It allowed the creation of experimentation environments that were sufficiently connected with real world stakeholders and their business models, to allow near-simultaneous development and deployment (Quak et al., 2015).

In this deliverable, the Living Laboratory is defined as a "test environment for cyclical development and evaluation of complex, innovative concepts and technology, as part of a real-world, operational system, in which multiple stakeholders with different background and interests work together towards a common goal, as part of medium to long-term study" (Lucassen et al, 2014). The Living Lab approach distinguishes form the freight partnerships as the Living Labs are more action driven, and focus on the entire experimental arena. Next, the Living Lab approach is also different from the traditional field tests and demonstrations that are often undertaken in the urban logistics field. Table 2 summarizes the distinction between these traditional field test, demonstrations and Living Labs.

*2.4. Living laboratories for the city logistics*

In this paper, we explore some main characteristics that Living Labs should have within cities. For city logistics, we argue that the set-up of a Living Lab has to fulfil three important conditions:

- Inclusiveness: connection of all relevant stakeholders and business models within a city, with a joint recognition of a problem and solution spaces.
- Anticipatory capability: means to (collectively) make predictions of the effects, based on simulations, gaming or more simplified means of analysis.

- Responsiveness: measuring of impacts and agreements to respond to this with the aim to ultimately deploy a solution.

Table 2. Distinction between field tests, demonstrations and Living Labs (Quak et al., 2015)

| Field tests and demonstrations | Living Labs |
|---|---|
| Characteristics | |
| Simple | Complex |
| Linear development | Iterative, cyclical development |
| Predetermined | Learning effects and improvements during activities |
| Isolated environment | System in system, real-life environment |
| Individual values | Shared values |
| Mainly operational goals | Grand challenges |
| Single actor as driver and owner | Multi-stakeholder and collaborative governance (incl. public-private partnerships) |
| Little uncertainty | Deep uncertainty |
| Short to medium term orientation | Medium to long term orientation |
| Re-active planning and steering | Adaptive and pro-active planning and steering |
| Purpose | |
| Closed research & development | Open innovation and live analytics |
| Expert design | Co-creation of multi-stakeholders |
| Closed system evaluation | System in system evaluation |
| Analysis for single department / actor | Analysis for multi-department / multiple actors |

The Living Lab approach ensures that all main stakeholder groups, and, especially users, are regularly involved throughout all the phases of the trial process (planning, implementation, evaluation, feedback) and that the proposed measure or technological solution is revised and continuously improved to meet stakeholder needs and obtain maximum impact during the project. The Living Lab approach needs to have a common vision and start from a shared ambition bringing all kind of stakeholders around one table. There is no need to have a clear roadmap of ready to implement solution from the beginning. One of the main strengths of the Living Lab is that solutions are born in a close dialogue between key stakeholders and users and are continuously adjusted to the user needs and requirements. The activities undertaken in a Living Lab contribute to achieving the ambition, but, in time, new, adjusted or other activities might become necessary. This implies that there is no full planning of all activities in a Living Lab in advance, and maybe not even full budget. But the stakeholders commit to finding activities and funding in this process so that the objectives are met in the end.

The Living Lab approach is a suitable methodology for testing new solutions in the urban freight transport sector. First, solutions in urban freight transport often ask for a multi-stakeholder approach, bringing together the Living Lab participants, stakeholders, users and customers within one Living Lab environment (see the example in the Figure 2). The goals and barriers faced by the different users are often not aligned to each other. The Living Lab methodology focuses heavily on stakeholder involvement and on communication between different types of stakeholders. Furthermore, the short cycle approach in a controlled environment makes it easier for stakeholders to try new ideas for which they do not immediately see advantages.

Second, due to the organisational, operational and regulatory complexity of the sector, it is unsure in advance what type of solution will best fit with problems faced. However, many solutions for the city logistics have high investment costs. The Living Lab methodology allows for a quick testing of multiple types of solutions within a limited, controlled scope. This can help to identify the best practice cases for further implementation.

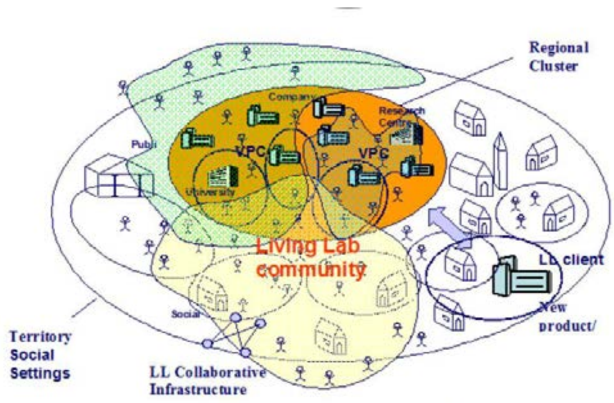


Figure 2. A graphical example of a Living Lab in a city (i.e. living lab as functional region, Innovation Alcotra, 2011)

## 3. Living Lab approach: challenges and opportunities

Living Labs are not a new phenomenon and there are already several examples of setting up a Living Lab in the urban context. Currently European Network of Living Labs (ENoLL) is a structure that brings together a variety of existing Living Labs worldwide. Today it counts over 170 active Living Lab members. The majority of Living Labs are focusing on the technology/digital society aspects and health, but there is also a growing number of Living Labs that are looking into such issues as smart city, green city, mobile city in general and on transport and logistics topics in particularly. At the same time, research recently performed by Nesti (2015) concludes that from 354 Living Labs registered in the ENoLL database only 47 are currently still in operation. The author explains this phenomenon with several factors:

- After the initial popularity of the Living Labs and the diffusion of successful stories, interest to the concept has declined and people have realised that they do not need Living Labs.
- Living Labs have high organisation costs due to staffing, selection of users, selection of real settings, etc. and public funding is essential for their operation;
- Living Labs do not produce ‘disruptive innovation’, they do not produce outputs that alter significantly the market, so enterprises do not perceive Living Labs as a real tool to improve their products.

There are also some specific risks that need to be taken into consideration during the Living Lab process in urban logistics. They are related to the characteristics and challenges of the urban freight transport system which are described in the previous paragraph. These risks are: stakeholder complexity, legal complexity, heavy financial load for private operators, limited visibility of positive impacts, restricted data availability, available technology. These considerations need to be addressed carefully within each particular Living Lab and integrated in the risks mitigation plans where necessary.

### *3.1. Living Lab architecture for city logistics*

As defined before, a Living Lab is a dynamic test environment where complex innovations can be tested and improved in real-life. The city or city centre can typically be such a living lab environment where several implementations performed by different stakeholders run in parallel. On the conceptual level, a City Logistics Living Lab environment consists of three levels as illustrated in Figure 3.

First is a strategic level, where different Living Lab participants (city authorities, industry, research organisations, etc.) are interacting with each other providing actual governance of the Living Lab. The ambition, the concrete goals and the objectives for the City Logistics Living Lab are defined at this level and are usually framed within dedicated policy documents: e.g. urban freight plan, logistics plan, local transport strategy, etc. On this level local city authorities play a leading role, defining urban freight transport development priorities together with other involved parties and providing and maintaining efficient cooperation mechanisms, bringing together a variety of stakeholders and users concerned with urban freight transport problems in the city. Usually the local authorities have the role of Living Lab owner and provide the basic infrastructure for a management of the Living Lab process (Figure 3).

The next layer consists of the practical and tactical implementation of the solutions or, so-called “implementation cases” or “measures” aiming at resolving or addressing concrete goals and objectives which are established on the strategic level. These implementation cases are carried out by city, industry partners or research partners, or combinations of these actors. The implementation cases might share common stakeholders, users, infrastructure and benefit from the information received from evaluation of each other. In any case, they need to address the main ambition of the Living Lab environment established in city (i.e. the Living Lab activities in Figure 3).

The third layer deals with the results of the implementation cases: the final customers of the Living Lab are benefitting from the results. Based on the feedback loop’ they decide on the new cycles for the implementation cases and possibly for the new directions for the Living Lab. All implementation cases are benefiting from cross-evaluation. The Living Lab environment also assures that transferability of solutions is taken into consideration.

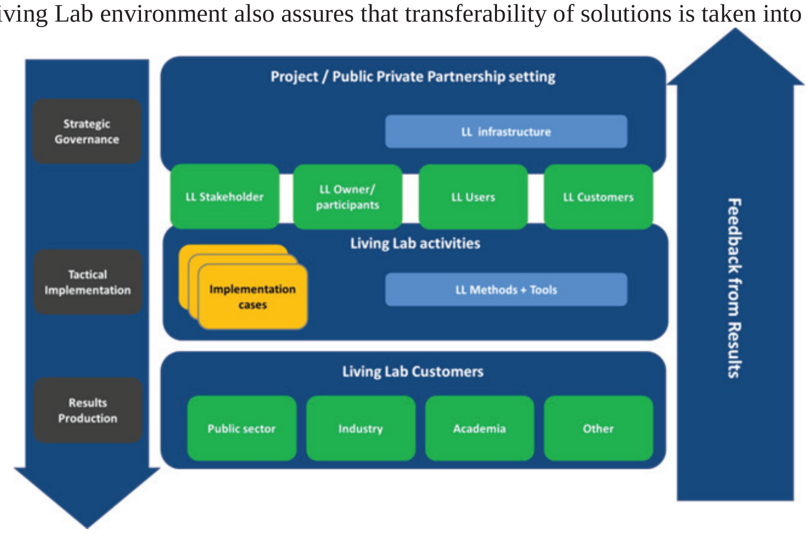


Figure 3. A Living Lab conceptual architecture (Innovation Alcotra, 2011)

As seen from Figure 3, several implementation cases can run in parallel and focus on different or closely related subjects, all, nevertheless, falling into the scope and ambition of the same Living Lab. Therefore, they might have in common different actors participating in it, share some parts of the infrastructure, benefit from common analysis and, most important, from the cross-evaluation in the Living Lab environment. It is also important to remember that the decision taken on one implementation case will impact the development of the solutions / measures from other implementation cases.

### *3.2. Living Lab roles*

A clear understanding and acceptance of different roles, especially within a setting of the city logistics sector which is characterized by its stakeholder complexity, is crucial for the Living Lab success. There are at least four main roles that need to be managed within the Living Lab framework (Figure 4).

The Living Lab owner is a real or virtual organisation appointed to lead the whole Living Lab process and to act on behalf of the Living Lab. It is suggested to have one or two people appointed to this role. The Living Lab owner will take the lead in setting up, organising, conducting and monitoring the process of the Living Lab. Within a CLLL ideally this role should be undertaken by city authorities.

The Living Lab stakeholders contain a group of organisations that need to be involved in the organisation and implementation of the Living Lab. Stakeholders are usually involved in the strategic and practical governance and the actual implementation of the Living Lab. For example, in the case of the urban consolidation centre (UCC) implementation, the following organisations will fall into the category of the stakeholders: architecture / construction company that help with the preparation of the building, the organisation managing the UCC. The Living Lab stakeholders are – although it is easy to confuse – not the stakeholders in the urban logistics context, but the actors that are actually (physically) developing something for the living lab implementation. For example, in the case of the floating depot (a CITYLAB implementation in Amsterdam), the constructor of the depot can be considered to have the role of the ‘Living Lab stakeholder’.

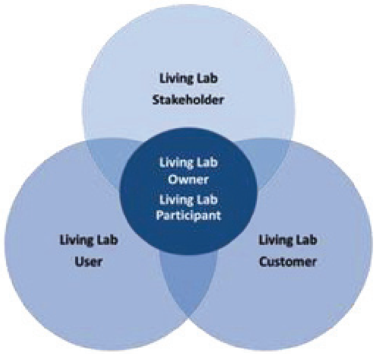


Figure 4. Overview of the Living Lab roles

Users are the organisations that are involved in testing the proposed innovation or solution in real life. Depending on the solution, users can be organisations as a whole, or a specific group within organisations. In the case of the consolidation center, transport operators and logistics providers will be the users. The Living Lab users are also stakeholders, but their role is slightly different from what was defined as ‘Living Lab stakeholders’, as these actors are actually using the developed solution. In some cases the ‘Living Lab stakeholders’ and the ‘Living Lab users’ are the same. For example, in the case of the floating depot (a CITYLAB implementation in Amsterdam), the logistics service provider using the depot can be considered to have to role of “Living Lab user” as well.

Customers are actors that benefit from the results of the Living Lab, whether this is a generation of results from trials or implementation of concrete technology or solution. For example in the case of the floating depot (a CITYLAB implementation in Amsterdam), the local authorities can be considered as the ‘Living Lab customer’ as these have the benefits of the reduction in emissions and vehicle movements.

Very often, Living Labs are set up by a group of motivated people united together to reach the outset goal. This project team often includes representatives of the Living Labs stakeholders, users and customers. At the same time it does not provide a full necessary coverage of all inputs/competences. Therefore, if the Living Lab is set up within a framework of the project (like in the case of the CITYLAB), another group needs to be distinguished: Living Lab participants.

Living Lab participants might play several different roles during the process of the Living Lab. That is why all project partner roles and responsibilities are to be clearly defined the earliest possible in the project, both from the point of view of the Living Lab process and from the point of view of the project in order to have a clear understanding who when and in which role need to provide an input into the Living Lab process. At the project level also attention need to be paid to include all relevant and important stakeholders, users and customers even though they are not part of the project team.

### *3.3. Twofold application of the Living Lab methodology*

A cyclical approach is in the foundation of the Living Lab methodology. Following this approach, several solutions can be tested and readjusted / improved to fit the needs of the real-life environment. One cycle within a Living Lab usually consists of the following phases: planning, implementation, evaluation and acting phases (Figure 5). The cycle can be continued into a new loop with the improvement of existing solution, can be finalised with rolling out of the solution or interrupted because the solution is considered as not interesting. During a cycle also a new idea for the Living Lab can be born and be than developed within another implementation case.

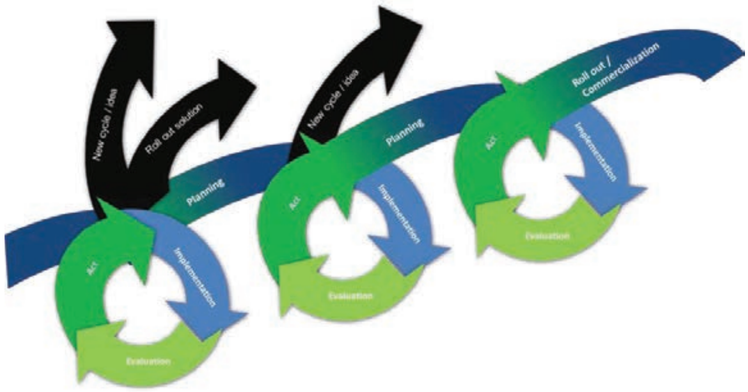


Figure 5. Living Lab cycle

Following this cyclical approach, the Living Lab methodology focusses on how to plan, implement, evaluate and act in the context of the Living Lab environment. At the same time, cities do find themselves in different stages of the Living Lab process: some cities have already established cooperation structures similar to the Living Labs environment, have clear goals and priorities for the urban freight transport development and sometimes have even data collection in place to monitor progress of the goals. Within other cities the authorities are only in the process of development of urban freight plans. There are also cases where the freight plan is not yet on the local agenda. Therefore, to actually setup or run a City Logistics Living Lab, like it is performed within the CITYLAB project, one needs to apply the Living Lab methodology at least for two levels: to set up the Living Lab environment in a city and to perform specific implementation cases and measures.

Figure 6 illustrates how the same methodology is applied for these two different levels: the phases described in the guidelines, i.e. plan, implement, evaluate and act / decide, are applied to:

- the Living Lab environment, where the local authorities are usually the Living Lab owner (in CITYLAB, for example, supported by the local research partner); and
- the implementation case(s), where other stakeholders can be the owner. For implementations industry partners could be owner and for policy measures governance agencies could be owners.

The steps and phases that were described in the guidelines are for the majority similar, but the level on which they are applied differs. The strategic level (larger circle on Figure 6) addresses the steps necessary to establish the City Logistics Living Lab in the city. This is a macro-level, which defines ambition, scope, partners and cooperation structures necessary to be involved in the Living Lab environment on the city level. It also provides a clear vision of what the Living Lab environment is about and tries to achieve. The evaluation of the Living Lab environment will focus more on the Living Lab process and on the combined effects of implementations and measurements. The cross-evaluation between the cases should be assured and the process on how case can learn from another in the real-time setting. It also looks on the transferability of cases to other stakeholders. The second level (inner circle on Figure 6) focusses on the implementation cases running within Living Lab environment. Similar steps as describes in the Living Lab guidelines are applied to these cases, but focusing on the concrete implementation of solution, measure or technology.

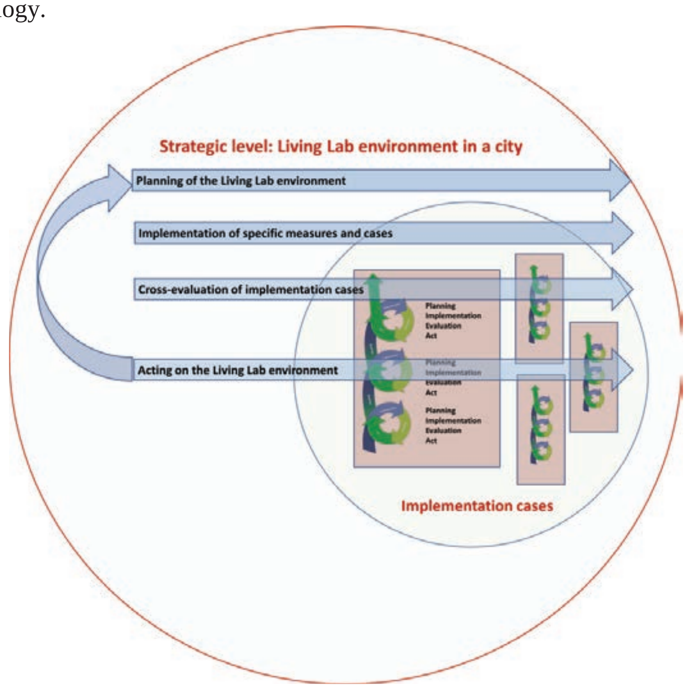


Figure 6. Setting up a Living Lab environment and specific cases / measures

### *3.4. Living Lab methodology for city logistics*

Figure 7 illustrates different Living Lab phases, that can apply to both the Living Lab environments as the Living lab implementation case (LLic).

The goals of the Planning phase (Figure 7) are to agree on the Living Lab or Living Lab implementation approach and the way of working, to build knowledge and define the exact goals and requirements for the later phases (i.e. Implementation and Evaluation). In order to achieve these goals the following activities are suggested

- Set-up: the overall goal and ambition for the Living Lab or for the Living lab implementation case (LLic) are defined; the crucial partners are identified, consulted and get involved. The scope of the Living Lab system (or of the LLic) , as sub-system of the real-world logistics environment is determined.
- System analysis: depending on the Living Lab ambition and scope a set of analyses is performed in order to get a clear overview of the outside elements that may influence the success of the Living Lab.
- Design: in the design block implementation cases (technological solutions or soft measures) to be tested are designed and described. The evaluation and monitoring system for the current cycle is developed.
- Implementation plan: the outcome of the planning phase is an implementation plan where all previous steps are summarised and timing, resources, milestones and other necessary information for the Living Lab cycle are defined.

Note that in the case the methodology is applied to the specific implementation case the same steps are followed up, but in relation to the specific implementation case (e.g. set-up, system analysis, design and implementation plan of the implementation case).

The goal of the Implementation phase (Figure 7) is to deploy solutions in the real life environment and gather the actual results. In this phase all arrangements are to be made in order to start and perform field experimentations. This phase is composed from two activities:

- Preparation: the Living Lab system and concrete implementation case(s) are prepared for actual execution. For example the functionalities needs to be developed, staff needs to be trained and fall back procedures and escalation protocols need to be put in place. Also a baseline measurement needs to be performed.
- Execution: execution refers to real-life implementations of the specific LLic (new technology or concept) in the Living Lab. The input for the evaluation is gathered.

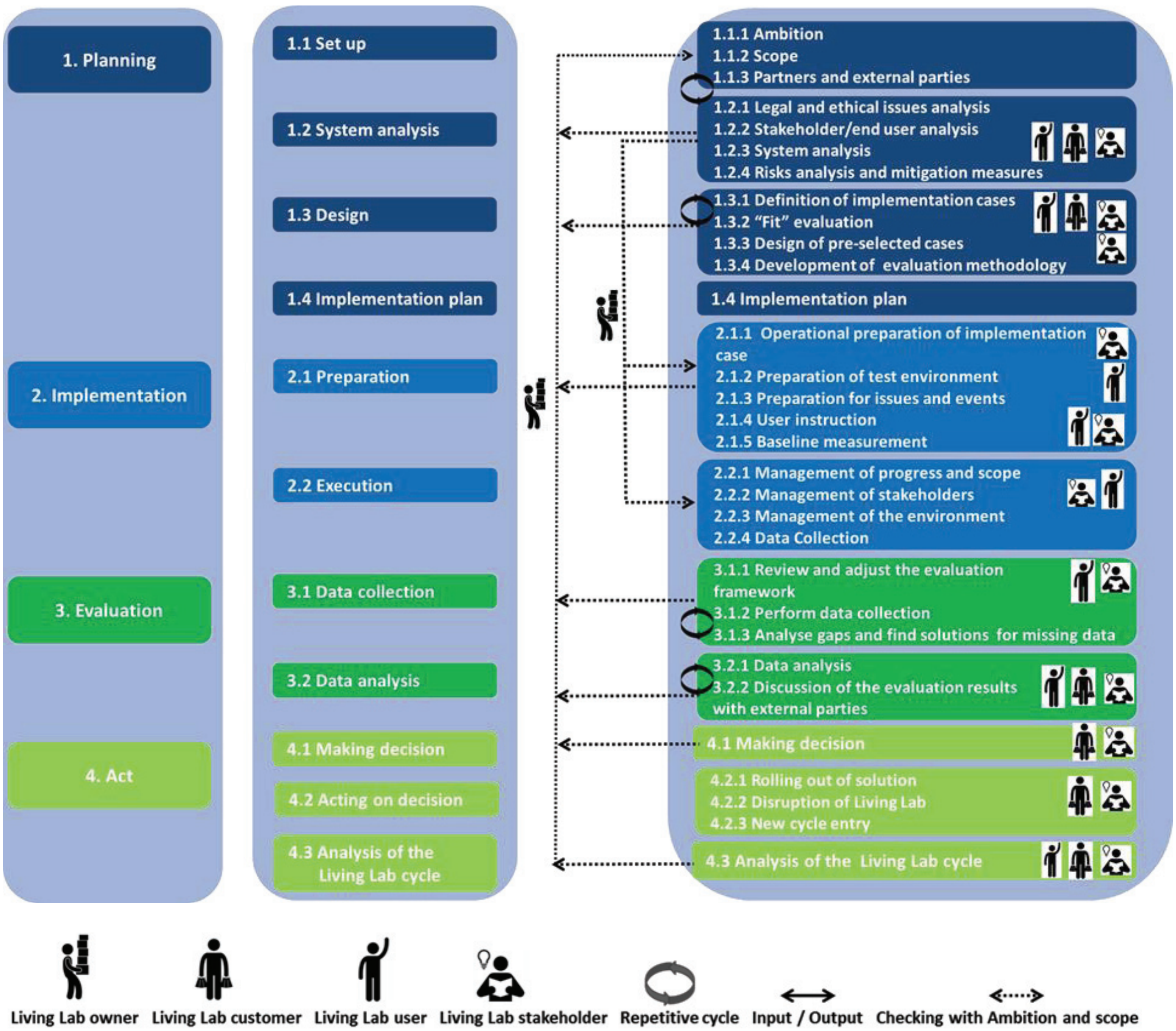


Figure 7. Living Lab methodology steps and main characteristics

The goal of the Evaluation phase (Figure 7 ) is to evaluate the results and to compare them to original ambitions and targets as well as to the 'business as usual' situation. Depending on the tested concept or technology, a number of key performance indicators (KPIs) is evaluated as well as feedback from external parties is collected. The phase consists of:

- Data collection: data collected during the previous phases is to be evaluated and checked for gaps. Where missing data are identified, solutions are to be found to fill in missing data.
- Data analysis: data analysis is to be performed and conclusions need to be drawn about KPIs, process and stakeholder evaluation, technological maturity of the solution/technology as well as business case feasibility.

Ideally, data collection takes place in a LL on the city level and can be used to evaluate several LLic. In practice some specific data collection activities have to be undertaken in both the LLic as the Living Lab itself. The LLic's data can feed to the data collection in the Living Lab. Based on the data collection, evaluation is performed on the level of the Living Lab environment. For the Living Lab environment a focus on a higher level is made on cross-evaluation between the LLic(s) and extra effort is put in the transferability of tested solutions.

The Act/decision phase (Figure 7) takes the results of the evaluation phase and use these to decide on the continuation or not of the implementation case (LLic) as well as the Living Lab itself.

- Making decision: this activity focuses on taking decisions on the future development of the implementation case and consequently on the future of the Living Lab as a whole.
- Acting on decision: the decision taken falls into one of the following categories which than represents the second activity block in this phase:
    - New cycle entry: a new cycle can start with introducing adjustments to an existing implementation case, or with a completely new idea that came out from one of the previous phases. In case the Living Lab implementation results need to be readjusted, some activities in the Planning and Implementation phases will need to be reviewed or rebuild by going into the new Living Lab cycle. This phase is crucial as it provides a cyclical turn of the Living Lab.
    - Roll out of solution: the technology or solution is ready for rolling out. Further rolling out or commercialisation can be done outside of the Living Lab.
    - Disruption of Living Lab: the decision is made to stop the Living Lab or a LLic. All the arrangements necessary to finalise the implementation case or / and to stop the Living Lab environment and report on its outcomes are to be performed.
- Analysis of the Living Lab cycle: at the end of each cycle it is important to evaluate whether the Living Lab environment (still) corresponds to ambitions, goals and means and is the best environment to achieve project results and to decide what kind of improvements can be introduced into the process of the next Living Lab cycle.

Continuous monitoring of the environment, and, more precisely of the Living Lab ambition, the scope, the key factors from the external environment as well as the potential risks is necessary in order to keep the Living Lab up to date with important developments in the environment and increase the final adoption rate of the tested solutions by the users. For example changes in legislation could impact the chances of success for the Living Lab or make the implementations easier or more difficult. These changes need to be incorporated in the other Living Lab activities at any time if they influence the Living Lab results, which might request for reviewing of some previously done work. Figure 5 highlights that monitoring of the environment should be in the responsibility of the Living Lab owner, who, in case of really big changes, communicates it straightforward to all the Living Lab participants. In some cases changes in the environment / ambition / scope might bring to reconsideration of the whole Living Lab cycle.

Secondly, a distinctive feature of the Living Lab methodology is a necessity to ensure continuous stakeholder / user / customer commitment. Ideally, results from all of the steps need to be checked and / or validated with external partners. Figure 7 identifies the steps where involvement of the external parties is of the most importance. Note that this paper is based on CITYLAB's deliverable 3.1 “Practical guidelines for establishing and running a city logistics living laboratory” and that all steps discussed from figure 7 as well as section 3's contents is discussed in more detail in Nesterova and Quak (2015).

## 4. Conclusion

The mentioned general Living Lab risks as well as the risks specific to the urban context need to be carefully addressed in order to make a successful experience from the Living Lab process in city logistics. The proposed Living Lab methodology addresses these risks and provide preconditions necessary for the successful implementation of the City Logistics Living Labs.

Nesti (2015) states, that even if the number of Living Labs is declining, most of them are still publicly funded. The author explains that "these are often set up by public administrations or research institutions because of the experimental nature of their activities. Particularly in the European Union, where innovation is often costly and risky, the enterprises – in particular small and medium – are encouraged to participate in the innovation process transferring the costs for R&D to public institutions and allowing them to test product or services before they have been launched in the market. This is precisely what happens in the case of urban Living Labs where municipalities become testing environment for enterprises in exchange for future investments in the smart city project". In this framework, the best combination of core participants for the city logistics Living Labs is a combination of three main actors: local authorities, research partners and industry stakeholders. This combination of different participants will give a good start for a Living Labs. Further in the Living Lab process this initial group of participants should be further extended by the involvement of external users in different steps of the Living Lab process.

Second, the Living Lab guidelines, described in this paper specifically highlight the necessity of continuous monitoring of legal issues as well as importance of ensuring continuous user/customer/stakeholder commitment. Following the repetitive cycles suggested in the methodology will allow tackling of any emerging issues at an early stage and act accordingly, therefore addressing the issues of legal and stakeholder complexity. The presented methods show that this is the case for the Living Lab environment as well as for the Living Lab implementation cases.

Third, available technology can be dealt with in a city logistics living lab by making sure the right partners with knowledge on available technology are involved, as well as by creating an environment where stakeholders can discuss their experiences with new technology.

Finally, an extensive evaluation process included in the methodology should facilitate the identification of impacts from concrete measures implemented within the Living Labs and will make it public through the dissemination channels foreseen.

Setting-up and running a city logistics living lab might be challenging, but the results could counterbalance the efforts. In the EC Horizon 2020 project CITYLAB we are experimenting with these guidelines, and see how cities can function as a city logistics living lab. The final results will be reported at the end of the project, but intermediate results and insights are available from the CITYLAB website (www.citylab-project.eu)

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