
Towards a unified definition of Urban Living Labs

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Abstract: In today's ongoing urbanisation and the climate changes there is an increasing demand on cities to be innovative and inclusive to solve these issues. As an answer to these challenges, the concept of Urban Living Labs has started to emerge. These Urban Living Labs aims to involve citizens in the process of developing the city. To date, there is a confusion concerning these Urban Living Labs are, what their objective is, their characteristics and their organisation. Hence, in this paper we build on the ongoing project UNaLab and the city representatives perspective of what an Urban Living Lab is and how it can contribute to their city's challenges, to define Urban Living Labs and its three dimensions.

Keywords: Urban Living Lab; Citizens; Nature-based solutions; UNaLab; Innovation; Stakeholders; Urban development; Characteristics, Experimentation; Sustainability

1 Introduction

The ongoing urbanisation is forcing cities all around the globe to become more smart and innovative to answer to challenges such as, e.g. pollution, waste management, citizens quality of life. Hence, cities needs to become smarter and healthier than they are today. Some of the most interesting citizen-close innovation happens in cities, in relation to for instance collaborative economy as in car-sharing and bike-sharing (Cohen et al., 2016). But opening up the innovation process requires involving different stakeholders in the innovation activities (Chesbrough, 2006) stimulating and generating exchange of knowledge between different actors (Lehmann et al., 2015). Living labs is one approach of managing open innovation processes, where different stakeholders (including citizens) are involved in co-creation, exploration, experimentation, and evaluation in open real-world settings (e.g., Bergvall-Kåreborn, Holst, and Ståhlbröst, 2009; ENoLL, 2015).

Also, living labs are based on specific methodologies and tools, and implemented through specific innovation projects and community-building activities (Schaffers & Turkama, 2012). But despite the fact that a certain body of literature attempts to clarify the concept (Almirall et al., 2012; Leminen, 2015), living lab practices are still under-researched (Schuurman, 2015). In specific, as cities today increasingly are being looked as places to drive innovation and to contribute to urban development (Evans & Karvonen, 2011).

The ideal living lab platform to integrate interests of citizens and other stakeholders with innovative experiences can be urban areas such as city centers, neighborhoods, universities and companies. Within this approach, the whole city is seen as a living lab focusing on long-term scaling of co-creating innovation; the concept that in living lab literature coined as an Urban Living Lab (ULL). The aim of an ULL is to generate and adopt sustainable innovations and solutions in the urban system in the light of the urban sustainability transition (Steen & van Bueren, 2017). However, given the early stages of the development of ULL (Bulkeley et al., 2016), to our knowledge, there is still no unified definition of what can be considered as an ULL, what is the objective of an ULL, what challenges an ULL aims to solve, what exactly can be considered as an urban context, and finally, who should be engaged in the innovation process and how. These questions show that there is a need for an explicit definition of an ULL and its objective. In a study where 90 living lab projects was investigated with the objective to identify the key characteristics of an ULL, Steen & van Bueren (2017) argue that the majority of these projects that labelled themselves as living lab are not very different from traditional system development process; and hence not including one or more key characteristics of an ULL (which are they?). However, their study is based on LL-projects in general, a more ‘top-down analysis’ (researchers have explored and investigated these LL projects) and draws the conclusion that LL can easily be translated into ULL without considering the specific characteristics the URBAN approach brings. Therefore, we argue for the need to explore the concept of ULL from a different perspective i.e., a ‘bottom-up analysis’ from city representatives’ viewpoint that enables us to better identify and understand the key components, objectives, challenges and characteristics of an ULL from both theory and practice. The way an urban living lab is defined and used is diffuse, with many different and often abstract definitions of the concept, leaving participants involved in urban living labs in the dark as to how the “living lab dimension” makes this project different from other urban innovation projects.

Research question

The purpose of this study is to explore the components of an ULL and its objectives from a city representative perspective with the aim to define the concept of an ULL, and its inherent characteristics.

2 Urban Living Lab

Today, cities are transforming under the influence of rapid socio-technical innovations in an open innovation context (Schaffers et al., 2011). This transformation requires opening up the innovation process and involvement of different stakeholders in innovation activities (Almirall & Wareham, 2011). The methodology Living Labs (LL) embody one approach to managing open processes, wherein different stakeholders including citizens are empowered to innovate through idea generation, co-creation, tests and evaluation in

open, multi-contextual, collaborative, and real-world settings (Bergvall-Kareborn, Holst, & Stahlbrost, 2009). Thus the concept of ‘Living Lab’ is nothing new, it was first used in the early 1990s describing a students’ experimentation with problem-solving approach by using a city neighbourhood as ‘Living Laboratory’ (Bajgier et al., 1991). Today, there is a large heterogeneity of living lab initiatives in terms of organisational set-up, encompassing a range of permanent as well as temporary projects associated with different stakeholders as institutes, technology vendors, municipalities or non-profits, innovation consultants, design or marketing companies, and industry clusters (Ballon and Schuurman, 2015).

Also today, the interest in engaging citizens and other stakeholders with innovative experiences is still asked for and highlighted in the LL research literature related to different urban settings such as city centres, neighbourhoods, universities and local business communities (Almirall et al., 2012; Schuurman, 2015). With this approach, the whole city can be seen as a Living Lab focusing on long-term scaling of co-creating innovation; in Living Lab literature this concept is coined an Urban Living Lab (ULL), in which the importance of cities and urban context as real-life setting is highlighted (Juujärvi & Pessa, 2013; Cohen et al., 2016; Steen & Van Bueren, 2017).

Other concepts related to ULL is Urban Labs describing ‘the use of public city space streets, buildings, or a designated neighbourhood as an active laboratory where companies can evaluate and pilot pre-market products and services’ (Almirall et al., 2014, p.394). Scozzi et al., (2017, p.858) state that most of the definitions describe urban labs as “the loci, in a given city, wherein a group of persons develop proposals, and possibly experiment and implement actions, to address problems and challenges associated with that city”. But, in order to develop a research agenda on how the ULL concept is being operationalised in contemporary urban governance for sustainability, Voytenko et al. (2016) conducted a literature review followed by five case studies of ULL projects. They identified following five key ULL characteristics: geographical embeddedness, experimentation and learning, participation and user involvement, leadership and ownership, and evaluation and refinement. In another study aiming to develop an operationalized definition of ULLs, Steen and van Bueren (2017) assessed 90 sustainable urban innovation projects in the city of Amsterdam. They identified characteristics of an ULL in four main dimensions i.e., aim, activities, participants, and context. Further, Franz et al. (2015) present ULLs as a tool to create a contextualized methodology within urban research with following key components: co-creation, exploration, experimentation, and evaluation, similar to the Living Lab concept.

As it can be seen, none of the above-mentioned studies have considered the view of city representative in their study nor ended up with a unified set of key components that define an ULL and its aims and objectives.

Defining Urban Living Labs

In this section, we will present the current research and approaches available in literature and we will give a definition of ULL, including ULL key components, key principles and key stakeholders.

Research regarding Living Labs shows that there is a growing trend to involve citizens (and other stakeholders) in different city development projects to make urban areas more adaptable to different citizens’ needs in order to both prevent e.g. social problems and gain advantages by being more adaptive to citizens’ needs (cf. Baccarne et

al., 2014a). Today, urban areas are seen by different stakeholders (city planners, universities, and technology companies) as natural places to develop ideas in Living Labs settings (Juujärvi & Pessa, 2013), i.e. ULL. In comparison with LL, which has a focus on facilitating interaction between end-users and private actors, ULLs are more oriented on ‘urban’ or ‘civic’ innovation (Baccarne et al., 2014b). Baccarne et al. (2014b) highlight that ULLs are often supervised by (or have a close relation with) the local government and have a strong focus on social value creation and civic engagement and on non-commercial activities (Baccarne et al., 2014a).

Though, the distinction between LL and ULL is not clear in the literature (Steen & van Bueren, 2017). Schliwa (2013) states that Sustainable Living Labs (SLL) targeting generation of knowledge within a small-scale real-life laboratory is similar to ULLs with a focus on the implementation of socio-technical innovations on a larger urban territory targeting knowledge generation as well as application. The ULL concept expands its activities on a broader urban territory, which also affects the way that key stakeholders are engaged (Schliwa, 2013) and ULL has a distinct focus on knowledge and learning as a means through which such interventions can be successfully achieved (Bulkeley et al., 2017).

Looking at the definition of ULL, Steen and van Bueren (2017) state that researchers often adopt existing definitions related to the concept of ‘Living Lab’, such as the one used by the European Network of Living Labs (ENoLL, 2016): “Living Labs are defined as user-centered, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings” (Steen & Van Bueren, 2017, p.22), see Table 1 for some examples of the ULL definitions. But Steen and van Bueren (2017) highlight that the term “Urban Living Lab” often refers to a variety of local experimental projects of a participatory nature, but often used interchangeably with the terms: “testing ground”, “hatchery”, “incubator”, “making space”, “testbed”, “hub”, “city laboratory”, “urban lab”, or “field lab”.

Table 1 ULL definitions.

<i>References</i>	<i>ULL definitions</i>
JPI (2013) Urban Europe, p.29) in e.g. Friedlich et al., 2013); Lund and Juujärvi (2015); Bulkeley et al. (2016)	It is a forum for innovation , applied to the development of new products, systems, services, and processes, employing working methods to integrate people into the entire development process as users and co-creators, to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts.
Juujärvi and Pessa (2013)	An urban Living Lab can be seen as a special type of regional innovation network that puts emphasis on residents and their communities as users (i.e., ordinary people who want to solve their real-life problems).
Westerlund and Leminen’s (2011)	A “virtual reality or a physical region” in which different stakeholders form public-private-people partnerships acting in a real-life contexts .

Nevens et al. (2013, p.115)	An Urban Transition Lab as the locus within a city where (global) persistent problems are translated to the specific characteristics of the city and where multiple transitions interact across domains, shift scales of operation and impact multiple domains simultaneously (e.g. energy, mobility, built environment, food, ecosystems). It is a hybrid, flexible and transdisciplinary platform that provides space and time for learning, reflection and development of alternative solutions that are not self-evident in a regime context.
Juujärvi & Pessa (2013, p.22)	A physical region in which different stakeholders form public-private-people partnerships of public agencies, firms, universities, and users collaborate to create, prototype, validate, and test new technologies, services, products, and systems in real-life contexts.
(GUST, 2015).	ULL can be seen as part of a phenomenon by which forms of innovation and experimentation are being marshalled as a means through which to govern particular (urban) conditions.
Nesti (2017)	ULLs represent a good example of methodology based on co-production and aimed at coping with policy challenges occurring at the local level.

Source: Own.

ULL literature shows that there is a variation and fuzziness in the ULL definition and no uniform definition (Voytenko et al., 2016). Steen and van Bueren's literature review (2017) also shows that ULLs have been explained to encompass a methodology, an environment, a system, and a governance approach. One reason for the fuzziness is that it is an emerging concept referring to a Living Lab in an urban environment (e.g. neighbourhood (Juujärvi & Lund, 2016)). Also, urban areas are often of different character, and characterized by complex problems, such as social and economic deprivation, segregation, or bureaucratic administration (Juujärvi & Lund, 2016). Also the way an urban living lab is defined and used is diffuse, with many different and often abstract definitions of the concept, leaving participants involved in urban living labs in the dark as to how the "living lab dimension" makes this project different from other urban innovation projects.

To give some clarity to the ULL definitions with some examples in Table 1, Lund and Juujärvi (2015) distinguish at least three types of Urban Living Labs: 1) they represent an ecosystem or networks involving multiple stakeholders that are motivated by different objectives but would benefit from collaboration. 2) ULLs provide tools for enhancing and implementing public and user involvement. 3) ULLs can be seen as an innovation management tool for building networks and user involvement in urban development.

Related to the ecosystem concept, Baccarne et al. (2014a) focus on Urban Living Lab as a collaborative ecosystem allowing for the co-creation of sustainable, future proof innovations that improve life in the city and boost the economy, thereby contributing to

Smart City targets. Such Urban Living Labs should act as ‘reuse enablers’ through central governance of ‘fertilizing’ resources. What is clear across the multiple definitions is that ULLs are bringing existing constellations of urban actors together in new ways to create more collaborative and experimental ways of ‘doing’ urban development (Voytenko et al., 2016). Urban Living Lab can also be a vehicle to foster communication in public space (Gaiddon et al., 2013). Urban Living Labs could work as an intermediary bringing self-organizing groups and city developers together to co-create urban space. Thus this potential can be lost if urban Living Labs are poorly managed (Juujärvi & Lund, 2016).

In sum, urban living labs engage urban stakeholders and residents in innovation, and offer stakeholders opportunities to develop their city in a real-life context in a way that responds to the needs of the users (Mulder, 2012). Some stakeholders in a city are public organizations facing different demands and different goals may that pose different challenges on communication, collaboration, and coordination between the stakeholders and departments. Also, the cross-national comparison revealed different traditions with regards to ideas about the extent to which residents should be involved in decision making (Buhr et al., 2016). In addition, it is unclear what the objective of an ULL is, what challenges an ULL aims to solve, what exactly can be considered an urban context, and finally, who should be engaged in the innovation process and how. These questions show that there is a need for an ULL framework that clarifies its objective and work process.

3 Research design

Given the lack of previous research in this area, a qualitative exploratory research approach was chosen for this study. As recommended by social scientists, within a qualitative approach, in order to promote stronger interaction between research and practice, different perspectives should be included in the study (Kaplan & Maxwell, 2005). This approach is in line with Van de Ven’s (2007) recommendation to conduct social research which is labelled as “engaged scholarship”. Engaged scholarship is defined as:

“A participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems. By involving others and leveraging their different kinds of knowledge, engaged scholarship can produce knowledge that is more penetrating and insightful than when scholars or practitioners work on the problem alone” (p. 9).

This study was performed as part of UNaLab project (730052-2); a project which funded by the European Union under the Horizon 2020 research and innovation program. The UNaLab project aims to develop smarter, more inclusive, more resilient and increasingly sustainable societies through innovative nature-based solutions (NBS). The UNaLab partners (including 10 municipalities, research, business and industry) commit to address the challenges that cities around the world are facing today, by focusing on climate and water related issues, within an innovative and citizen-driven paradigm.

The UNaLab project will fulfil the present need to develop a framework that can support the development of ULL from a different perspective, and to identify and understand the key components, objectives, challenges and characteristics of an ULL based on both theory and practice. Also there are related concepts as ‘urban planning living laboratory’ comprises of four parallel processes sustained by the city: visioning,

strategizing, performing and assessing (Hirvonen-Kantola et al., 2015). In the UNaLab project, existing knowledge on ULLs forms the basis for the ongoing work. We will continue developing the framework based on experiences from the training sessions and the workshops with UNaLab cities.

The five key ULL characteristics: geographical embeddedness, experimentation and learning, participation and user involvement, leadership and ownership, and evaluation and refinement (Voytenko et al., 2016) form the starting point for the development of the ULL framework in the UNaLab project.

In order to explore different perspectives of urban living labs, a workshop was convened in Genova, Italy, with seven UNaLab project partners to deepen the participant's knowledge on the topic of ULL; while at the same time gathering information on the topic and capture their perspective as the city representative in UNaLab project. The workshop participants were asked to respond questions such as: what are the key components of an ULL; what the ULL should achieve at the end; what is the problem or challenge they aim to solve; what is an urban context to experiment in; who should be engaged in the innovation process and how; and finally, how the management structure for the governance of an ULL looks like.

In order to promote stronger and more reliable results, the collected data was analyzed by three researchers and Microsoft Excel 2016 was used as a spreadsheet tool for coding and combining the collected information.

4 Result and Analysis

As seen in the literature, there is a growing trend to involve citizens in different city development projects to make urban areas more adaptable and valuable to different citizen groups. Though, the distinction between LL and ULL is not clear in the literature (Steen & van Bueren, 2017; Voytenko et al., 2016). Therefore, our result explores the components of an ULL and its objectives from a city representative perspective with the aim to define the concept of an ULL, and its inherent characteristics. This clarification is needed to facilitate future design and organization of ULL. Further, the result presented here and can be viewed as a starting point towards a unified definition of Urban Living Labs, i.e. the development of a ULL framework.

Starting with the city stakeholders, the city representatives in the workshop highlighted the importance of identifying and engaging multiple citizen groups ranging from elderly to children, and incorporating different groups as business owners, public servants, researchers, visitors of the 'space' and disables.

Looking at the cities' urban challenges, i.e. what the cities want to accomplish, they all highlight environmental issues; on a global level as well as on a more common and local level. On a global level climate change and developing an ecosystem were highlighted, on a more common city level the focus was on bringing the nature back into the city and on a more specific local level the focus was on decreasing local climate problems as e.g. flooding, see Table 2 for further examples. This is in accordance to what is stated in previous research is that ULLs are more oriented on 'urban' or 'civic' innovation (Baccarne et al., 2014b) and in the case of ULLs, the arena is more focused on the implementation of socio-technical innovations, a focus on knowledge and learning, in a larger urban territory targeting, which also affects the way that key stakeholders are engaged (Schliwa, 2013).

Table 2 Examples of urban challenges highlighted in the UNaLab workshop.

<i>Global</i>	<i>Common</i>	<i>Local</i>
- Improve quality of life equitable	- Increase urban green spaces	- Make the city and the citizens more resilient against fast flooding
- Brings nature back into peoples' life	- Public space is not a transit space anymore	- Salty layer bottom lake decrease oxygen
- Nordic conditions in challenging climate	- Focus on small spaces in relation to green & blue infrastructure network	- Flood risk and water quality risk
- Urban resilience to climate change	- Merge city and nature	- Local problems about flood and climate change
- Developing more circular systems	- Communicate experimental nature of projects (risk management)	- Water inflow surrounding lake
- Badly functioning ecosystems	- Sustainable and resilient cities for everyone	- Rainwater management
		- Adaptation of buildings
		- Flooding
		- Water inflow surrounding lake

Source: UNaLab workshop.

The potential ULL objectives discussed by the city representatives were in several cases similar to the LL concept as providing a framework for research work, a platform for innovating, experimenting, knowledge transfer, and co-creation. However, some more urban-related aspects highlighted in the definitions were:

- Environment when **citizens** participate in designing solutions.
- The way to **co-construct** the city with citizens and local authorities.
- A **place** where to involve citizens to experiment ideas.
- A shared long-term program of activities.
- Get people involved in **creating their future**.
- A **real life** innovation and experience.
- A focus on **long-term scaling** of the innovation.

Specific urban related aspects in the cities' ULL objectives were to:

- cover 360° of **challenges of the city**
- solve the **urban problems** in an effective and sustainable way adopting a user centered design
- add visibility to NBS

- improve the **liveability, sustainability, social-hydrological** resilience of the urban area
- include the public in decision making regarding issues related to their living environment
- raise awareness of the citizens
- have a good **ecosystem** and joint value system model
- create **urban development**

The most difficult component to discuss in the workshop was the potential management structure for governance of the ULL. (Almost) all groups identified this as the most difficult to answer. One reason for this can be the multi-citizen view, wanting to engage different types of citizen groups in the ULL setting. But engaging different citizen groups may require different type of governance and management.

There were also other aspects that were mentioned by the workshop participants when they were asked to explain and elaborate on the key defining components of an ULL. These aspects include but are not limited to, testing new solutions, the way to co-construct the city with citizens and local authorities, an innovative governance experience in a real urban context, and a place for implementing new networks.

5 Defining Urban Living Labs

By analysing the literature and our data we have identified six main components that constitute the ground for an ULL. These components are 1) an innovation to experiment with, 2) citizens to engage, 3) a mix of methods for engagement of different stakeholders and data collection, 4) management structure for governance of the ULL, 5) infrastructure to support real-life experimentation (e.g. Sensor networks, distributed tools), and finally, 6) a mixture of partners with stable and dynamic relationships, see figure 1.

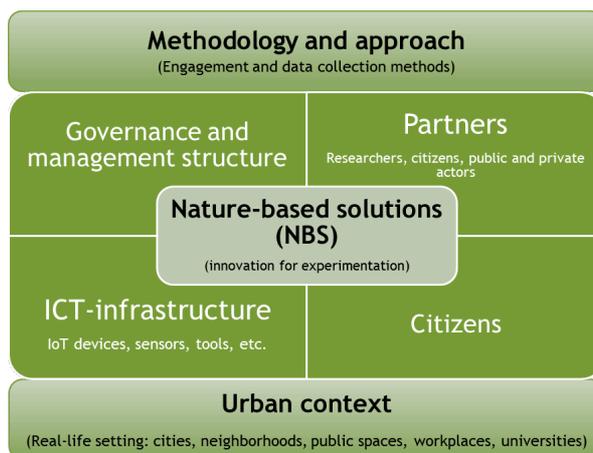


Figure 1 The components of the ULL

These components will provide the basis for an ULL when setting it up and managing it. But merely having the components in place, will not guarantee a viable and sustainable ULL, it is also important to define its objective and design its inherent characteristics to increase its likelihood of success.

Based on the results from our study, the objective of an ULL is to contribute to sustainable development of the cities on a long-term basis with the aim to create value for its stakeholders. The ULL should contribute to challenges on three different levels; global challenges such as urban resilience to climate change, common challenges such as merging the city and green places and local challenges such as flooding in the city. This means that the ULL should be aware of these different levels and define how their local actions will contribute to the challenges on an overarching level. This perspective is somewhat different from ordinary LL operations where often the innovation and its value is considered in a narrower perspective aiming at individuals. In an ULL the value is for the city as a whole and the sustainability on a global scale. Hence, the challenges an ULL aims to solve is strongly related to sustainability on a local level (e.g. flooding) but it should contribute to higher level challenges, such as climate changes.

Another characteristic of ULL is its place. This means that in contrast to ordinary LL that are mobile and dynamic, the ULLs in our study was bounded to a place in which the experimentations and co-constructions will take place. These places also need to alter their character to create an experience of nature and enhanced feeling that increases citizen's awareness of nature and sustainability.

Also the characteristics of the citizens and their role is somewhat different in ULL. This means that in ULL the citizens are involved as citizens not as users, as in traditional LL, since there might not be a solution to "use" but only to experience or being affected by once the solution is in place. For instance, a nature-based solution that prevents a city from flooding has no obvious users, but it has affectees that no longer have a flooded city and thus their experience is affected positively. By being engaged in the co-construction of these nature based solutions in urban areas, citizens also get the opportunity to become actively engaged, more responsible and also being empowered to take action against situations that might have an impact on them. Hence, the component citizens includes the inherent characteristic of participation and inclusion which can lead to empowered, enlightened and active citizens that collaboratively wants to contribute to the sustainability of the city. Involving citizens in ULL also means that the focus might shift from co-creation to co-constructing. This means that in the cities we have studied, the focus is on constructing a nature based solutions in a specific place and thus creating an attractive space where citizens can enjoy the place. Hence, the co-construction of the place precedes the co-creation of the space.

Combining these aspects with the six key identified components enables us to provide a unified definition for an ULL from the city representative view. Thus, an initial definition of an ULL based on our study is:

“ULL is a local place for innovative nature-based solutions that aims to solve urban challenges and contribute to long-term sustainability by actively and openly co-constructing solutions with citizens and other stakeholders.”

Hence, an ULL has three dimensions, first it is a long-term organisation that support the process of enhancing sustainability in an urban area by having all the suggested components organised in a viable manner. It is not an innovation project carried out in a city context with citizens. Second, it is an approach in which citizens and other stakeholders should be engaged by using different methods with the objective to create value and long-term sustainability of the solution, and third, it is locally bounded to a place where local issues in the urban area can be experimented with while contributing to global challenges.

Contribution:

This study contributes to the existing living lab literature by providing a definition for an ULL from a city representatives' perspective by adding the contextual dimensions to the concept. Identifying the key components of an ULL, understanding the main objectives of an ULL, the problems or challenges that can be solved by an ULL and the way that citizens should be engaged in the ULL projects are other factors that enable us to provide an empirically derived definition for the ULLs.

Practical implications:

The results of this study will help cities to setup, govern, and manage their ULLs by gaining better understanding on factors influencing the innovation and development process of NBSs in an ULL. They will get support answering questions such as who should be engaged and how, what methods should be applied to engage citizens, who starts the process, who is responsible to run the experimentation process, and how the governance model of an ULL should be structured.

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