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LABORATÓRIOS DE INOVAÇÃO NO SETOR PÚBLICO

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Urban Living Lab: definitions from a systematic review of literature

Abstract

With the increasing urbanization and rising climate change, the future of global sustainability will be determined by how well cities implement mitigation and adaptation measures. Within this context, Urban Living Labs (ULL) has emerged, mainly in European countries. However, to truly succeed in the ambitious tasks of tackling major urban sustainability issues, the way ULL is being addressed in developed countries and the expansion to Global South needs further research. This study aims to perform a systematic literature review about ULL to understand the central issues discussed in academic debates. Although there is no common definition from the literature review, the analysis concludes that a ULL is a type of intervention that uses Living Lab methodology, is hosted in a delimited physical space, has an emphasis on sustainable urban solutions, requires active participation from the local public authorities and has a focus on citizen's participation and validation. The conclusions also present suggestions for future research.

Keywords: Smart Cities, Urban Living Lab, Urban Planning, Sustainable Urban Development, ICT

1 - Introduction

Although cities occupy only 3 % of the Earth's surface, urban areas are home to 55 percent of the world's population, and this number is expected to continue growing to 68 percent by 2050 (UN-HABITAT, 2020). As cities grow, so does the energy consumption and the pressure on natural resources. But as Glaeser (2012), argues, urban life is better for humanity economically, socially, and most of all, in terms of environment, since a compact city has scale economies that reflect on less energy consumption and greenhouse emissions. Being centers of development, the future of global sustainability will be determined by how well cities implement mitigation and adaptation measures (DELOSRIOS-WHITE M.I. ROEBELING; VALENTE; VAITTINEN, 2020). It is also in cities where the impacts of climate change will be more severe. By recognizing this dichotomy between vulnerability and opportunity, cities worldwide are becoming protagonists in climate governance, and reports of cities aiming to reach net-zero emission gases targets by 2050 or before are increasingly heard in global climate discourse (SHARP; RAVEN, 2021).

Within this context, the so-called "smart cities" have been studied and implemented over the last decades (ZHENG et al., 2020). More broadly, smart cities' technologies have been positioned as opportunities to improve urban environments and stimulate economic development (LEVENDA, 2019). While smart cities' concept has focused initially on using "smart technologies" to address social, economic, and environmental problems more efficiently, its focus is slowly shifting towards a citizen-centric approach, also called "smart governance" (VEECKMAN; TEMMERMAN, 2021). This approach could be able to connect the traditional top-down approach with a grassroots or bottom-up approach (BACCARNE et al., 2014).

As argued by Bravo Ibarra (2020), the concept of digital cities or smart cities was widely spread across the world during the 1990s, being one of the predecessor concepts of what we know today as "Living Lab". As Living Lab (LL) is a very diverse field of knowledge due to its multiple applications, its definition lacks a common understanding in the literature (FIÚZA, 2017). Broadly, living labs can be conceptualized as a methodology for investigating and validating an

innovative solution to a complex problem (BRAVO IBARRA, 2020), whereas this innovation is co-produced and knowledge is exchanged among the participants. Even though there is a variety of concepts, two characteristics are frequently present in different living lab definitions: open innovation and the participation of the end-user or the citizen. According to Fiúza (2017), if Living Labs are an approach aiming at innovation by experimenting in real-life settings and actively involving users, Urban Living Labs (ULL) can be placed in the fertile ground of urban experimentation and active citizens involvement in the creation of innovative solutions to the main challenges faced by contemporary cities.

Based on data available from EnoLL[1] (European Network of Living Labs) and UNaLab[2], cities are adopting mechanisms for experimentation and innovation as possible sources of solutions to new and old urban problems. In this context, it is important to study ULL as one of the most promising real-world laboratories methodologies (RwLs) along with other experimental research approaches such as urban labs, change labs, urban (sustainability) transition labs, sustainable living labs, city labs, smart city initiatives, community-based initiatives, niche experiments social innovation (KLAUTZER; HONG; NARAYAN, 2020; MENNY; VOYTENKO PALGAN; MCCORMICK, 2018).

Within this context, the main contribution of this article is to debate about definitions and characteristics on Urban Living Labs through a systematic literature review. This work can also be understood as an extension and updating of the effort of Chronéer, Ståhlbröst, and Habibipour (2019) and Steen and van Bueren (2017), since from the literature researched, these were the ones that most closely matches the aimed definition of ULL. However, the authors do not use a broad methodology of active search on a comprehensive basis. In this article, a comprehensive systematic literature review was adopted based on the guide of Okoli (2015). Another contribution we intend to make is a better contextualization of the Smart Cities phenomenon and to carry out a "review of the reviews," according to the procedure used by Lwoga and Sangeda (2019), discussing the concept and state of the art of Living Labs. Another contribution of this article is to present this novel concept with a broad and didactic approach so the readers can become familiar with each of the terms covered. The methodology, analysis, and results are shown in the following sections.

2 - Research Methods

[1] The European Network of Living Labs (ENoLL) is the international federation of benchmarked Living Labs in Europe and worldwide

[2] The EU-funded UNaLab project aims to develop smarter, more inclusive, more resilient and increasingly sustainable societies through innovative nature-based solutions (NBS). The UNaLab Consortium comprises 28 partners from 10 cities across Europe and beyond, including municipalities, research, business and industry. The UNaLab partner cities are committed to address climate- and water-related urban challenges with an innovative and citizen-driven approach.

According to Okoli (2015), a systematic literature review (SLR) must follow steps such as a) Identify the purpose; b) draft protocol; c) apply practical screen; d) search for literature; e) extract data; f) appraise quality and g) synthesize studies. In this section of the study, the steps used from the item "a" to "e." will be clarified. The synthesized studies and the review itself are explored in the next section.

As highlighted in the introduction, this article aims to investigate if there is an academic definition of Urban living Labs and its main characteristics and debates about it. Furthermore, it seeks to solidly contextualize the ULL inside the smart cities and living labs agenda. Finally, it will summarize the critical aspects and formulate a research agenda for academics and practitioners worldwide, but especially for those in the Global South countries inspired by developed countries to implement ULL in their cities.

The research protocol follows a similar approach to Hossain, Leminen, and Westerlund (2019), using the database of Web Of Science (Wos) and Google Scholar. First off, a search was conducted for the terms "smart cities," "living labs," and "urban living labs" on the WoS database.

ULL can be categorized as a subfield of knowledge and an emerging subject within smart cities. To start, we first search first the terms “smart cities” “living labs” and “urban living labs” on the WoS database. The results show that living labs and urban living labs correspond to only 5,9 % and 0,38%, respectively, of the 6.878 academic productions on the smart cities field. Since the existing literature on smart cities and living labs is too extensive for this specific article to define smart cities' context, this research will focus on the work of Zheng et al. (2020) that is identified as the most up-to-date literature review about the subject. Other documents were also used to complement the analysis.

As the primary database, the choice for WoS is justified because it has indexed the Technology Innovation Management Review (TIM Review), which is the leading publication of the subject of living labs (Steen and van Bueren 2017). For the contextualization of living labs, a "review of reviews" was conducted as suggested by Lwoga and Sangeda (2019 : 2) “the systematic review of reviews determines and appraises all published systematic reviews to identify their quality and summarize, compare, and contrast the strength of conclusions, thereby providing decision-makers with the best evidence”.

The second search was in WoS using the terms: ["living lab" literature review], on the topics and abstracts throughout 2017-2021. The result was 28 documents, 23 articles and 4 proceedings papers and 1 book chapter. After a practical screen, and since the focus of the Living Lab review is more about contextualization of ULL, it was selected from relevant journals 5 articles that explicitly aim a literature review as a result of the investigation, as summarized on the table below.

Authors	Title	Journal	Citations until March 21	Period of analysis	Data Source	N. Publications used
Westerlund et al. (2018)	A Topic Modelling Analysis of Living Labs Research	Technology Innovation Management Review	31	2011 -2017	TIM Review + J-Tool	86 documents
Hossain et al. (2019)	A systematic review of living lab literature	Journal of Cleaner Production	82	2006- 2018	Multiple databases (Wos, Scopus, Google Scholar)	114 documents
Dekker et al. (2020)	The Living Lab as a Methodology for Public Administration Research: a Systematic Literature Review of its Applications in the Social Sciences	International Journal of Public Administration	9	2000 - 2017	Multiple databases (Wos, Scopus)	84 documents
Greve et al. (2021)	Living Labs: From Niche to Mainstream Innovation Management	Sustainability	0	2010 - 2020	Wos	97 documents
(Bravo Ibarra 2020)	Revisión sistemática del concepto de laboratorios vivos	Dimensión Empresarial	0	2007- 2019	Multiple databases (Proquest, Scopus)	74 documents

Table 1 - Selected papers of Living Labs Literature Review.

The third search for literature was in WoS using the terms: "urban living lab" on the topics and abstracts throughout 2017-2021. The return was 26 documents, 19 articles and five proceedings papers, and two book chapters. After a practical screen, only one document was dropped, as it was a proceeding paper with few insights. Since the focus of this article is the Systematic Literature Review (SLR) of ULL and agreeing with the considerations of Hossain et al. (2019 : 978), it was also added Google Scholar, since "However, although these databases (Wos and Scopus) are considered to be the most comprehensive databases for academic articles, we are aware that some highly cited studies may not be included in them, so we used Google Scholar to identify such articles". In the end, the database of ULL consists of 33 documents, as described in the table below.

Sources of Documents				
Articles (25)	Proceeding papers (5)	Books chapters (3)		
Main Publications				
Sustainability (3)		TIM Review (2)		
Solar Energy (2)		Urban Planning (2)		
Year				
2017 (4)	2018 (7)	2019 (5)	2020 (13)	2021 (4)
Cases studies by countries				
Netherlands (7)	Sweden (6)	Germany (4)	Australia (3)	
UK (2)	Belgium (2)	USA (2)	Finland (2)	
Norway (1)	Portugal (1)	Egypt (1)	South Korea (1)	
Document focus				
Specific (20)	General (2)	Both (11)		

Table 2 – Resumed information of ULL database.

Some details of the data collected can be helpful to understand how the academic debate around ULL is unfolding over the last years[3]. First, it is essential to highlight that most of the documents are published in journals, many of them with high H-Index (>10), indicating the quality of the works. Four journals, as indicated in the table above, concentrate almost 40% of the articles. It is also clear that ULL is an emerging research topic since the preponderance of documents was published over the last two years.

As part of the practical screening and the search for the literature as suggested by Okoli (2015), all documents were sorted into three categories about the in-depth discussion about the definition of ULL. If the research was a case study, it would be tagged as specific. Most of the documents (20) were identified as specific. Only two articles were more comprehensive research and had no specific case studies. In another 11 documents, besides having specific investigation locations, there were contributions to a broader debate about the conceptualization and reflections about ULL.

Finally, it becomes evident how the phenomenon of ULL is distant from a Global South perspective. Most of the documents describe and/or analyze interventions in developed countries, especially in Europe, like The Netherlands, Sweden, and Germany.

The methodology described above can be reproduced so other researchers can independently get on the same results. In the next section, the main findings are synthesized and analyzed for this SLR's purpose.

3 - Analysis and Results

Smart Cities (SC) and Living Labs (LL)

To investigate deeper the concept of ULL it is necessary to understand the context of the current debate on the Smart Cities (SC) and Living Labs topics. There is still no consensus among the practitioners and academic researchers within Smart City's thematic field (ZHENG et al., 2020). This concept has been used in a diverse way and different circumstances, producing several conceptual variants arising from the replacement of the term "intelligent" by other alternative adjectives (NAM; PARDO, 2011).

SC's contemporary origins are related to the "smart growth" movement of the late 1990s towards "sustainable urbanization." Most of the initial definitions of smart city had a strong appeal in the diffusion of ICTs (Information and Communication Technology) and tended to disregard the importance of other crucial factors outside the scope of the technology. More recent approaches include the needs of people and communities, as well as their quality of life, as in the case of the

[3] Although not essential to understand the aims of this paper, all the detailed information, including the classification and aspects addressed of the database documents can be requested by email.

concept of SC4D (Smart City for Development) derived from ICT4D (Information and Communication Technology for Development) (Lwoga and Sangeda 2019). The idea of implementing smart city solutions can positively impact the growth of developing regions, observing necessary adaptations to the different realities and challenges found in these regions (JOIA; KUHL, 2019).

Within the complexity of the definition of SC, current studies point to the main categories that involve the trend of the debate. Zheng et al. (2020) show, through a scientometric review of research on SC from 1990 to 2019, three major relevant points: (1) ICTs and the field of planning or urban studies are the two fundamental axes in structuring the development of SC. However, it raises concerns about data security and privacy, especially regarding emerging approaches to public safety and privacy and waste management; (2) In sustainable smart cities, people must come first. Specifically, it requires "smart people " who will use the advances of ICT's as a means to promote and guarantee sustainable urban development for citizens, and not technology as an end itself; (3) Governance for smart cities, where the scope of SC should be extended from the local to the national scale. The presence of smart urban collaboration with multilevel stakeholders characterizes the recent developments in SC governance.

Although Willian Mitchell of MIT was the first to inaugurate the Living Lab terminology in 2003, when he set up the Place Lab, the methodology of investigation and validation of solutions to complex problems in the context of real-life environment spread throughout the world, especially for Europe (WESTERLUND; LEMINEN; RAJAHONKA, 2018). The ENoLL (European Network of Living Labs) has more than 150 active living labs worldwide and has recognized more than 440 since 2006 when the network was founded.

The literature on the subject is relatively recent (WESTERLUND; LEMINEN; RAJAHONKA, 2018), and the phenomenon is usually addressed by researchers from different areas, such as architecture, urban planning, public policies, innovation, information technology, among others, with very different themes: agriculture, education, environmental pollution, public transport, pharmaceutical industry, among others. Furthermore, the living lab environment includes cities, urban and rural areas, households, institutions such as museums, mobile laboratories, among others (LEMINEN, 2015). As a result, there is no unique definition in the literature and different authors present similar concepts but without any unanimity.

It is also important to present a different view on what living labs are between North American and European literature (HOSSAIN; LEMINEN; WESTERLUND, 2019). According to Leminen (2015:19), while Americans understand LL as home laboratories and homes of the future, European authors understand as platforms for studying the real-life context of users.

Despite the differences, in practice, the two approaches are used interchangeably by the literature, using different definitions for living labs.

Bravo Ibarra (2020), when conducting a literature review between 2007 and 2019 on living labs, presents as a result 16 different conceptual definitions on the theme. In the definitions found by the author, it was observed that most converge on two common living lab characteristics: innovation and the participation of the user. The participation of public authorities, although considered important by the literature (FRANZ; TAUSZ; THIEL, 2015) is not present in most definitions. On the other hand, the idea of innovative processes or solutions with user participation is almost unanimous.

Thereby, following Hossain et al.(2019) and Greve et al. (2021), this article considers LL as environments that provide shared resources and bring together multiple stakeholders using multi-methods of real-life experimentation to create, communicate and provide new knowledge, validate existing products, services and processes. The objective is to support innovative solutions in a co-creation process with the participation of public and private people, partnering and aiming for a common goal, usually creating social benefits. This study considers that this definition covers the different approaches and themes highlighted in the reviews selected in Table 2.

The understanding of LL concept passes through understanding common characteristics, methodologies, and types (BRAVO IBARRA, 2020). Therefore, as well as analyzing the challenges these platforms face to be implemented, it contributes to leverage LL as useful instruments to build sustainable solutions in the long term.

Greve et al. (2021) list numerous benefits of living labs for different actors - policymakers, business, users, and society as a whole. For instance, LL helps conduct experiments that aim to solve complex problems by promoting a real co-creation environment. In addition, living labs are able to bring on the surface not-so-obvious issues, which in an environment that promotes co-creation end up manifesting themselves more clearly. This can be explained by the central role the users play in the innovation and problem-solving stages (HOSSAIN; LEMINEN; WESTERLUND, 2019).

As a result, Hossain et al. (2019) argue that the key element for Living Labs are users. The end-user's participation is what differentiates LL from other innovation methodologies because it allows those who use or will use a given technology to contribute with their opinion during the development process. As quoted by Dekker, Franco Contreras, and Meijer (2020), the most common methodological approach applied in a living lab is to monitor a product or a service usage in real-life conditions. This allows one to evaluate the performance of a technology and also the behavior and/or behavioral changes of users on a regular basis. Even though user participation in the innovation process is a common feature in LL, the literature points to four living labs types

according to each actor manages the activities: utiliser-driven, enabler-driven, provider-driven, or user-driven (in the latter case can be community-driven) (GREVE et al., 2021; HOSSAIN; LEMINEN; WESTERLUND, 2019). Living Labs also differ from each other in terms of structure, activity, organization and coordination (GREVE et al., 2021).

Therefore, the literature has described LL based on their diverse institutional designs, suggesting that there is no specific approach. Regarding the coordination approach for living labs, it can be both: top-down or bottom-up (FRANZ; TAUSZ; THIEL, 2015). This flexibility highlights the importance of the user and its active involvement in the process of co-creating innovative solutions. The monitoring of the end-user, the real-life setting, and the collaborative process are at the core of a LL. However, the main challenge to implement a successful LL is to design a governance model that makes it possible to implement innovative solutions beyond prototypes.

Urban Living Labs (ULL)

From 33 documents analyzed, the majority consists of specific cases (20). Thirteen have a broader debate about conceptualization and analysis on the ULL subject, and they were the ones to be zooming in to extract detailed information.

The works from Chronéer et al. (2019) and Steen and van Bueren (2017) were the researches from the literature reviewed that most closely achieve the objective of delivering a definition of a ULL and its goals. However, these authors do not use an active research methodology on a systematic basis, using a citation index such as WoS or Google Scholar.

Theoretical and real-world definitions of a ULL, adherence to the Quadruple Helix model, and governance frameworks are at the core of the current debate in the literature. At first, the lack of academic consensus on the ULL definition, as a common understanding of its meaning is missing, both in real life as well as in the literature (OLDENHOF et al., 2020; STEEN; VAN BUEREN, 2017), and it is underexposed in current academic literature (BACCARNE et al., 2016). Another aspect of the literature is the observation that it is hard, but necessary, to differentiate ULL from a "standard" Living Lab (CHRONÉER; STÅHLBRÖST; HABIBIPOUR, 2019). Table 4 aims to present some cases placed in Europe, where most ULL is located; summarize the main findings of three cases profusely mentioned in the reviewed literature, and ease the understanding of the main characteristics of ULLs.

	CIRCULAR BUIKSLOTERHAM	FLOODCITISENSE	NEXTHAMBURG
sustainability aim	To transform Buiksloterham, a neighborhood in the north of Amsterdam, into a living testbed and catalyst for Amsterdam's broader transition to becoming a circular, smart, and biobased city.	To develop urban pluvial flood early warning service and reduce the vulnerability of urban areas and citizens to pluvial floods, which occur when heavy rainfall exceeds the capacity of the urban drainage system.	To give citizens the possibility to contribute to current discussions about urban development in Hamburg with their own ideas.
starting year	2015	2017	2009
location	Amsterdam, The Netherlands	Brussels, Belgium Rotterdam, The Netherlands Birmingham, UK	Hamburg, Germany
geographical embeddedness	Physical interventions in the Buiksloterham neighborhood	Specific locations within the Cities	City-wide online and offline collection of ideas from the citizens
stakeholders	**Public** ● Housing corporation; ● local water utility; ● Municipality of Amsterdam development agency; **Private** ● DELVA Landscape Architects; ● Studioninedots architecture studio; ● New Energy Docks **Research centers** ● TU Delft ● Inholland University of Applied Sciences **Civil Society** ● Amsterdam Smart City ● 22 signatories of the Circular Buiksloterham Manifesto; ● Citizens.	**Public** ● City of Amsterdam; ● Birmingham Council; ● City of Brussels ● Severn Trent Water **Private** ● Ecosystems Services and Management Program; ● RainPlusPlus Ltd; ● RPS Environmental Management Ltd; ● Disdrometrics **Research centers** ● Vrije Universiteit Brussel; ● Delft University of Technology; ● Imperial College London; ● International Institute for Applied Systems Analysis; ● National Taipei University of Technology; ● HYDR (Department of hydrology and hydraulic engineering) **Civil Society** ● Local Government Information Unit; ● Citizens. ● Etats Généraux de l'Eau à Bruxelles	**Public** ● Federal Ministry of Transport, Building and Urban Development of Germany; ● City of Hamburg **Private** ● Urbanista / NEXTHAMBURG team **Research centers** ● HafenCity University Hamburg **Civil Society** ● Hamburg inhabitants.
role played by the public sector	**Enabler and provider** to flexible local regulations, fostering urban innovation in the territory	**Enabler and provider** Funding by EU and coordinated by city governments	**Provider** to fund the NEXTHAMBURG as a pilot project of the national urban development policy from 2009 to 2012
official website	https://buiksloterham.nl/	http://www.floodcitisense.eu/	https://nexthamburg.de/
cited in SLR database	(Ersoy and Van Bueren 2020) and (Kronsell and Mukhtar-Landgren 2018)	(Veeckman and Temmerman 2021) and (Verbeiren et al. 2019)	(Menny et al. 2018) and (Kronsell and Mukhtar-Landgren 2018)

Table 4 - Overview of three analyzed Urban Living Labs most cited on the SLR results.

As pointed out by Steen and van Bueren (2017), even the notion of the ULL has not been clearly defined, being treated as a methodology, an environment, a system, or a governance approach. For Massari (2019), ULL aims to offer an open and collaborative environment that considers the inhabitants as agents in urban transformation processes and enables the exchange and co-creation of shared value in the city. ULL's are perceived as a means to jointly tackle social issues (well-being, health, debt, work) and material challenges in urban development (energy sustainability, redevelopment projects) (OLDENHOF et al., 2020). Terms such as co-creation, co-production, participation, involvement, empowerment, quadruple-helix model, and multi-stakeholder or public-private-people partnership are used to describe the collaborative nature of ULLs (MENNY; VOYTENKO PALGAN; MCCORMICK, 2018).

Although the distinction between the terms Living Lab and Urban Living Lab is not well covered by the literature, there are some major insights delimiting each of these two definitions. The core difference lies in the ULL need for a physical location and a focus on sustainability, especially the "urban" dimension of sustainability challenges (MENNY; VOYTENKO PALGAN; MCCORMICK, 2018; STEEN; VAN BUEREN, 2017).

Chronéer et al. (2019:58) offers a formal definition and identifies seven key components of an Urban Living Lab: "these components are derived from the literature and modified according to the perspective of the city representative in the study. The following components are highlighted: 1. Governance models including management structure, politics, and policies 2. Financing and business models 3. A physical representation that takes place in a real-life setting in the city context 4. An innovation to experiment with. 5. Partners and end-users, including citizens, public and private actors, and academic institutions (i.e., a quadruple helix) 6. Approaches for engaging different stakeholders and collecting data 7. ICT and infrastructure such as IoT devices, sensors, and tools".

Indeed, the physical setting paradigm is one of the most cited characteristics of ULL in the literature, especially to differentiate it from LL. A specific area such as a neighborhood or a city emphasizes the need or desire of involved stakeholders to capture the real-life context in all its complexity (STEEN; VAN BUEREN, 2017). The mandatory physical representation contrasts with the traditional living lab settings, which tend to be more mobile and dynamic (CHRONÉER; STÅHLBRÖST; HABIBIPOUR, 2019). According to Massari (2019) ULL is both a methodology and a place, where different energies of the territory meet, consolidated skills aggregate, and local knowledge is combined, with the aim to deliver innovative and transformative improvements across the urban environment.

ULL often follows the quadruple helix model approach, bringing together stakeholders from academia, the business community, the public sector, and civil society (partly mediated

through media and cultural institutions) (DELOSRIOS-WHITE M.I. ROEBELING; VALENTE; VAITTINEN, 2020). This is closely aligned with the Citizen-Public-Private partnership (C3P) or Public-Private-People Partnerships (PPPP or 4Ps). These partnerships can yield potential advantages, such as greater public involvement, transdisciplinary research, creativity, and knowledge exchange, and influence public affairs and policy innovation (KLAUTZER; HONG; NARAYAN, 2020; VEECKMAN; TEMMERMAN, 2021)**.**

Including the private sector in the partnership can foster urban improvement because financing social infrastructure is one of the biggest challenges to promote a more sustainable urbanization. Over the last decade, 80–85% of all infrastructure investments in developing countries have been funded by the public sector (XIONG et al., 2020). The scarcity of public funds combined with the inefficiency in public service provision has sparked initiatives to encourage private parties to invest their resources in urban infrastructures (KOPPENJAN; ENSERINK, 2009) . The ULLs subject is in line with New Public Management pursuing new forms of local partnership and system innovation (OLDENHOF et al., 2020).

The uniqueness of each location where a ULL is settled highlights the important role played by the local administration in the conception and implementation phases (BACCARNE et al., 2016). Due to their experimental essence, ULLs are temporarily exempted from standard rules and regulations, which arguably enables them to experiment with new methods, models, and concepts. However, Oldenhof et al.(2020) alert to two aspects: the adoption of the local government 'system' logic can hinder the freedom to experiment; and the risk of the lab being “swallow up” by the local government or being used 'instrumentally' to implement public policies, due to the proximity between the lab and the local government. Kronsell and Mukhtar-Landgren (2018) warns that municipalities can inhibit an innovative active process as a result of local political priorities or, in an indirect sense, with institutional obstacles that make processes more difficult and thus create barriers to management innovations.

Another aspect presented by the literature refers to the characteristic of ULL to understand the whole city as a living laboratory where citizens and other stakeholders are actively involved in the processes of designing, developing, implementing, testing, and evaluating a sustainable urban innovation. The inhabitants are involved as citizens, and not necessarily as users, given that there might not be a solution to "use" but only to experience or to be affected by once the policy change is in place (CHRONÉER; STÅHLBRÖST; HABIBIPOUR, 2019).

The governance arrangement to manage these kinds of partnerships is also highlighted in the literature. The need for leadership, ownership and management stresses the delicate balance between steering and controlling versus the lab's need for flexibility and effectiveness (CHRONÉER; STÅHLBRÖST; HABIBIPOUR, 2019). Management factors (legitimacy,

responsiveness, stable funding, leadership) and contextual factors (path dependency, political environment, demographics, good governance) also are crucial to determining how effective the contributions from the partners are (OLDENHOF et al., 2020). Stakeholder engagement is usually a complicated and messy process, tainted with conflict, disagreement, and diverging points of view (DELOSRIOS-WHITE M.I. ROEBELING; VALENTE; VAITTINEN, 2020). According to Klautzer et al. (2020), involving citizens and the other stakeholders in the decision-making processes about the purpose, the design, and the construction materials and techniques will foster knowledge sharing.

Although most of the SLR academic papers highlight the expected positive outcomes of experimentation and innovation, few studies express some critiques about the ULL implementation. Levenda (2019) brings us, through a Foucauldian lens of governmentality, some reflections about the dominant motivations for urban experimentation and who the beneficiaries are. Some questions arise on how urban experimentation shapes the approach to sustainability and justice, how experiments engage communities/citizens, and its implications. The author concludes that ULL takes on an exclusionary logic, as the city becomes marketed as a place for large technology companies to test their products and services and as some groups of people are privileged over others.

There are some critiques about the elitist bias of the ULL's pattern of being placed in central areas or in gentrified pockets, making the citizen participation also limited to high-class professionals (OLDENHOF et al., 2020). If ULLs are conducted by companies that pay users for the usage of personal data, normally with tax incentives, the targeted group is usually composed either of young or lower-income people who are already suffering structural discrimination (TAYLOR, 2020).

The "urban data" use and research on ethics and privacy regards are also part of the observations of Taylor (2020) and Veeckman & Temmerman (2021). As pointed out by Baccarne et al. (2014:11) when the human context is lacking, the solution can excessively rely on technology. For the authors, technology should not be an end in itself. Experimentation and innovation must be used in conjunction with traditional urban planning techniques. Thus, the experimentation can gain scale and involve a larger number of participants.

As presented in this SLR, there is still room for discussion regarding the diversity around the ULL debate: its applications, its partners, and its implementation under different local and legal settings.

4 - Conclusions

Although there is no common definition from the literature review, we can conclude that the debate trend shows that an Urban Living Lab is a type of intervention that uses Living Lab

methodology, is hosted in a delimited physical space, has an emphasis on sustainable urban solutions, requires active participation from the local public authorities and has a focus on citizen's participation and validation beyond the role as users of an innovation.

However, this study has some limitations. First, while it adopts the systematic literature review methodology on a set of articles published over the past five years, it does not include publications outside that period. Second, the contextualization of Smart Cities and Living labs drew its findings from the reviews' data and it was not conducted a deeper investigation into the primary studies.

Although the used sample was quite extensive, it does not encompass all urban living lab publications, especially documents that investigate similar interventions named differently (e.g., city lab, urban labs, change labs, urban (sustainability) transition labs, sustainable living labs, city labs, smart city initiative). Therefore, it is urgent to recognize that the subject ULL deserves attention from both academia and institutions that aim to debate the future of cities and climate change impacts (such as governments, think tanks, banks and private companies). Although the growing number of publications on the subject is recognized, there are still many gaps to be addressed in future studies. Hence, the following research avenues are suggested:

- As a partnership model, more studies are needed about the economic value generated by companies, their business model, and the feasibility of the intervention in the long run.
- What are the state capacities needed to implement an ULL? How does the local government's capacity influence the success of ULL?
- Is it possible to make an isomorphism to Global South countries? Is this community-based approach a valuable concept to all kinds of institutional arrangements?
- Flexibility in the legal framework is a key for the successful implementation of an ULL as a platform for urban innovation. Further studies on how different legal arrangements can hinder or boost an ULL are recommended.
- Most of ULLs were financed by public funds. What is the actual cost-benefits of these experimentations? How can it be measured?
- The timing of implementation and outcomes of an ULL are compatible with the urge for sustainable urban solutions to achieve global sustainability agendas, such as the Paris Agreement?
- What are the required adaptations of public administration rules and legislation when contracting and implementing innovations?

Finally, despite being a promising approach to the most pressing urban issues, it is essential to study whether the results can be possibly replicated in a large variety of contexts around the world, whether they will have any significant effect in creating effective adaptation and mitigation

strategies and whether they will contribute to an intelligent city (society) that is, after all, human and inclusive.

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