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Experimenting with collaboration in the Smart City: Legal and governance structures of Urban Living Labs

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ABSTRACT

Urban Living Labs (ULLs) have been implemented in many cities, but their organizational and legal structure has not often been analyzed. ULLs aim to provide a space for different parties to research, develop, and test solutions to urban problems whilst engaging with local communities. Their experimental approach to urban innovation and to public-private collaboration makes flexibility, openness, and informality important. However, ULLs are also confronted with existing legal frameworks, responsibilities, and liabilities. Whilst they aim at shared decision-making and horizontality, they must navigate public and private interests, and interact with local government as well. To understand these dynamics, this article examines the legal and organizational structures of ULLs, the factors and trade-offs that influence it, and the role municipal government plays in in these structures. This article analyzes the different forms and trajectories of ULLs in practice, through semi-structured interviews held in four labs in Amsterdam. Through qualitative research, we found that 1) ULLs are partnerships that exist on a spectrum of formalization, from informal to highly formal; 2) the degree of formalization is influenced by financial, legal, and organizational factors that change over time; 3) each degree of formalization is associated to trade-offs, even if these trade-offs are not explicitly formulated by the people involved; 4) tensions arise from the municipality's double role as public authority and as partner. We conclude that ULLs could gain from clearly identifying the legal frameworks that condition their structure, actions, and future.

1. Introduction

As part of the 'smart city' movement, many so-called 'urban living labs' (ULLs) have been set up in cities across Europe to experiment with new forms of multi-stakeholder urban innovation (Galič, 2019; Veeckman, Schuurman, Leminen, & Westerlund, 2013). These labs enable different actors to work together in a form of participatory governance (Bifulco, Tregua, & Amtrano, 2017; Voytenko, McCormick, Evans, & Schliwa, 2016). Essentially, Urban Living Labs (ULLs) can be defined as designated physical spaces in cities where different parties research, develop, and test new products or services by engaging with local users to tackle urban problems. For instance, an ULL could be a publicly

accessible location where a company partners with a research institute to try out new crowd monitoring technology on pedestrians.¹ ULLs are characterized by both their experimental and collaborative approach (Nesti, 2018). Indeed, they are fundamentally experimental in scope and in scale: they provide a setting to test new technologies (or new applications of existing technology), they allow for small scale tests to address larger problems, and they have a shorter timescale than traditional urban planning and development (Särkilahti, Åkerman, Jokinen and Rintala, 2022). They also provide a setting for public and private stakeholders to work together in 'public-private technology partnerships' (Taylor, 2020 9). As a result, the technology they produce may be privately owned or scaled by public actors, whilst contributing to both

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¹ This is for instance the case in Amsterdam, with the Public Eye system piloted at a living lab location, see Sarah Wray, 'Why the City of Amsterdam Developed its Own Crowd Monitoring Technology' (ITU Hub, 5 October 2021) <<https://www.itu.int/hub/2021/10/why-the-city-of-amsterdam-developed-its-own-crowd-monitoring-technology/>> accessed 25 October 2022. The company CityFlows is also testing crowd sensing technology in different cities such as Amsterdam (see Dorine Duives and Eelco Thielier, 'COVID-19 Living Lab' (CityFlows Europe) <<https://cityflows-project.eu/covid-19-living-lab/>> accessed 25 October 2022) and Milan (see Carlo Libertò, 'Milan Living Lab' (CityFlows Europe) <<https://cityflows-project.eu/milan/>> accessed 25 October 2022).

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private and public interests.

This blurring of boundaries between public and private is one of the goals of collaborative settings such as ULLs, that build on informal relationships between stakeholders (Ersoy & van Bueren, 2020). These stakeholders test more informal, 'soft' modes of governance whilst interacting with existing 'hard' modes of governance (e.g., formal urban planning, legislation) (Aernouts, Maranghi, & Ryckewaert, 2020; Smas, Schmitt, Perjo, & Tunström, 2016). However, little is known about how labs are formalized (or given form) and which dilemmas they encounter in this process. This exploratory article aims to provide a better empirical understanding of the structure and governance of ULLs. It is guided by the following research question: how is collaboration between public and private parties organizationally and legally structured in ULLs?

To answer this research question, we conducted an in-depth case study of four Dutch ULLs. Due to their experimental nature, ULLs must operate a fundamental tension: create new collaborative relationships between public and private actors whilst navigating existing (legal) frameworks. Hence, they fluctuate between remaining informal and capable of (rapid) change on one hand, and addressing legal obligations, responsibilities, and liabilities on the other hand. To understand these dynamics, we examine the legal and organizational structure of ULLs, the factors and trade-offs that influence it, and the role municipal government plays as a public authority in these structures. By analyzing the different forms and trajectories that ULLs adopt in practice, this article provides a useful contribution to scholarship on public-private collaboration and on ULLs, as well as being useful for living lab practitioners.

The article first provides an overview of the literature on Urban Living Labs, urban experimentation, and public-private collaboration to introduce our research questions (section 2). It will then present the methods used for this study and briefly introduce the ULLs selected for the case studies (section 3). Thereafter, the article gives an overview of the ULLs' legal and organizational structures, the factors and trade-offs that influence these structures, and the role of municipal government in relation to them (section 4). Finally, we discuss the findings from these case studies (section 5), before concluding (section 6).

2. Theoretical background

2.1. Urban Living Labs and urban experimentation

The emergence of ULLs can be connected to the broader phenomenon urban experimentation and experimental governance. Urban experimentation proposes to understand and govern cities as 'laboratories' to test and evaluate new solutions to urban issues (Caprotti & Cowley, 2017). The term does not necessarily refer to a purely scientific context of experimentation (Bulkeley & Castan Broto, 2013), but primarily to small scale interventions that aim at learning by doing (Caprotti & Cowley, 2017). It is particularly used in the context of social and environmental transitions, such as climate change, to test activities in a spatially and temporally bound space (Caprotti & Cowley, 2017; Evans, 2011; Karvonen, 2018; Scholl et al., 2018; van der Heijden, 2016). Experimentation can be used to inform policymaking, but it is also increasingly conceptualized as a method of governance as such (Bulkeley, 2023) leading scholars to speak of a 'city of permanent experiments' (Karvonen, 2018). As with ULLs, experimental (urban) governance involves a wide range of actors, a consensus-based approach to decision-making, and a deliberate effort to use other tools than traditional government instruments (van der Heijden, 2016). It also often comes with legal experimentation, which refers to temporarily exempting an experiment from existing legal frameworks or to creating a temporary, specific, different legal regime to test the effectiveness of the experiment (Ranchordas, 2021). The validity of such regulatory experiments depends on their methodological quality, which is often deficient, leading to criticism from both a scientific perspective (external validity, objectivity) and a legal perspective (lack of transparency, predictability, and proportionality) (Ranchordas, 2021).

ULLs usually are understood to form the territorial setting within which experimentation takes place, while experimentation is considered 'a conscious intervention designed to disrupt the current state of the targeted system' (Bernstein & Hoffmann, 2018), which is not necessarily confined to a particular place or setting. However, overall, the definition of ULLs and their relation to urban experimentation remains contested (Bernstein & Hoffmann, 2018; Chronéer, Ståhlbröst, & Habibipour, 2019; Nesti, 2018). Within the literature, a few key characteristics have been identified to define ULLs, compiled by Steen and van Bueren (Steen & van Bueren, 2017; see also Fuglsang, Hansen, Mergel, & Røhnebak, 2021). They determined the following nine defining characteristics present in literature: urban living labs seek to innovate (1) and learn (2) with a territorial focus on urban sustainability (3); their activities center on product development (4) through processes that involve co-creation (5) and iteration (6); they involve public actors, private actors, knowledge institutes, and citizens (7) with all participants sharing decision-making power (8); and finally, they are set-up in a real-life urban context (9). However, Steen and van Bueren (2017) also observed that many projects that label themselves ULLs do not correspond to (all) these characteristics, whilst projects that do fit all these criteria do not necessarily call themselves (urban) living labs.

ULLs display the ambition to experiment with public-private collaboration, citizen participation, and the urban fabric all at once. This gives them a rather ambiguous character. Oldenhof, Rahmawan-Huizenga, Van De Bovenkamp, and Bal (2020) qualify this ambiguity by calling living labs 'liminal spaces' – spaces that exist through the suspension of usual norms, practices, and boundaries. Oldenhof et al. argue that living labs are liminal in (at least) three aspects. Firstly, they have to navigate *organizational* liminality, since they exist between public-private boundaries and stakeholders with different values. ULLs need to reconcile the different expectations, interests, and levels of engagement of these parties to fulfil the potential benefits of multi-stakeholder collaboration (Nguyen & Marques, 2021). Secondly, ULLs combine local and non-local dimensions (Karvonen & van Heur, 2014). They are implemented in unique, physical spaces whilst simultaneously searching for potentially generalizable solutions to widespread problems (Hansen and Fuglsang, 2020). They can have very broad goals (e.g., increasing quality of life, building a circular economy, developing urban sustainability) whilst operating within specific local settings (e.g., a single new building). This renders them *geographically* liminal. Finally, ULLs use temporary regulatory exemptions and try out new business models (Hansen and Fuglsang, 2020). This is a form of *legal* liminality.

This liminality can create a 'positive space' of creativity (Oldenhof et al., 2020 295). It is often assumed to increase efficiency, knowledge-sharing, and innovation – in short, to provide the benefits of a 'new experimental governance form' (Oldenhof et al., 2020 296). At the same time, ULLs as liminal spaces suffer from an 'institutional void'. Due to absent or unclear boundaries, roles, and frameworks, they risk becoming the explicit or implicit battlefield of competing rule regimes that actors need to navigate and shape at the same time (van Bueren & Klievink, 2017). As Hajer describes, in these voids 'actors do not only deliberate to get to favorable solutions for particular problems but *while deliberating* they also negotiate new institutional rules, develop new norms of appropriate behavior and devise new conceptions of legitimate political intervention.' (Hajer, 2003, 175). This void can concern the (temporary) legal regime of an experiment, as well as the relationships between stakeholders, including local government. Whilst ULLs can serve as intermediaries for (public) innovation through their collaborative focus (Schoorman & Tönurist, 2017), public-private collaboration can also be challenging due to the expectations, capabilities, and constraints of different actors (Gascó, 2017).

2.2. Public-private collaboration in urban experiments

The governance of urban experiments, from testbeds to ULLs, and the power dynamics within them are important questions for literature on

urban experimentation (Galway, Levkoe, Portinga, & Milun, 2022). ULLs are often described as ‘public-private-people partnerships’ (Veckman et al., 2013; Westerlund & Leminen, 2011), but these partnerships have rarely been analyzed from a legal perspective. ULL literature shows that the relationships between partners matter: the role and leadership of each actor changes the shape and results of the lab by informing how the lab is financed, how the products are commercialized, and how priorities are defined (Juujärvi & Pessa, 2013). The creation of new forms of triple helix collaboration (public-private-research) has been identified by legal literature as a challenge for public law, especially with regards to accountability and conflicts of interest (Colombo, 2018). However, few studies on the legal and organizational nature of ULL partnerships exist, and Colombo’s account shows the importance of dissecting the legal nature of such hybrid collaboration.

Within the broad category of public-private partnerships (PPPs) (Hodge & Greve, 2005; McQuaid, 2000), different legal and organizational forms exist. These vary depending on the type of partners and the type of agreement between them (van Montfort & Michels, 2020). The European Commission differentiates ‘contractual’ partnerships, based on contractual links between partners, from ‘institutional’ partnerships, when the partners create and become shareholders of a distinct legal entity (Tvarnø, 2010; European Commission, 2004). The formality of contractual partnerships ranges from complex contracts to declarations of intent or memorandum of understanding. Broadly, Klijn (2010) identifies that the organizational form of public-private relationships can be tight (e.g., contract, legal entity) or loosely coupled (e.g., networks).

This prompts our first research question: *what are the legal and organizational arrangements between public and private partners within Urban Living Labs?*

These arrangements are susceptible to vary across labs. Additionally, throughout their lifecycle, ULLs have to deal with different factors that influence their partnership. Although choosing an organizational model is essential to ULLs in the long term, there is currently no research into how this choice is or can be made (Veckman et al., 2013; Westerlund & Leminen, 2011).² To account for diversity within labs and to shed a light on how different arrangements come to be, we ought to look at the factors that impact ULLs’ shape. This leads us to our second research question: *which factors influence the legal and organizational arrangements between public and private partners within Urban Living Labs?*

ULLs’ legal and organizational arrangements are shaped in part by inherent tensions in any collaboration, such as the distribution of risks between partners and the danger of opportunistic behavior (Reeves, 2008; Steijn, Klijn, & Edelenbos, 2011). To deal with these tensions, PPPs mix formal and informal elements. Such tensions can be mitigated through contractual governance and through relational governance (Benítez-Ávila, Hartmann, Dewulf, & Henseler, 2018; Warsen, Klijn, & Koppenjan, 2019). The former operates through formal obligations, based on contractual conditions (e.g., sanctions, Key Performance Indicators). The latter operates through informal aspects, based on relational characteristics (e.g., trust, communication). The balance between contractual and relational governance depends in part on the legal and organizational form of the partnership (e.g., presence of a legally binding contract). This balance also depends on certain trade-offs. Steijn et al. (2011) identify that higher levels of formality are assumed to increase dependency between partners, thus reducing the risk of opportunistic behavior. Contracts offer a tool for control, and a sense of authority and ownership of the project, as well as a reference framework for the projected outcomes and the roles of each party (Benítez-Ávila

et al., 2018). In PPPs, contracts can be used by the public partner to steer and sanction private contractors (Warsen et al., 2019), and to abide to accountability and transparency requirements (Maurya & Srivastava, 2020). Yet an excessively formalized and detailed contract can lack flexibility and be difficult to monitor (Zheng, Roehrich, & Lewis, 2008). Lower levels of formality, on the other hand, increase the freedom of parties whilst reducing transaction costs. Relational and informal aspects of the partnership can foster mutual trust and commitment, reducing the necessity to monitor and control performance (Reeves, 2008).

Moreover, collaboration in the context of open innovation is particularly challenged by the balance between control and openness between parties. Contracts can be used to formalize relationships and create legal obligations to bind parties. At the same time, open innovation literature calls for more trust and flexibility (Hagedoorn & Zobel, 2015). However, it is unclear how these dilemmas appear and are dealt with within ULLs. This leads to our third research question: *which trade-offs are made in the process of structuring Urban Living Labs?*

Finally, the boundaries between public and private sector increasingly blur in hybrid forms of governance (Karsten, Colombo and Schaap, 2020). Municipalities derive their legitimacy (i.e., the acceptance of their power and decisions) from democratic institutions (e.g., elections) (Häikiö, 2007). With the rise of experimental and hybrid governance, both the role and position of municipalities has been changing (Häikiö, 2007). ULLs illustrate how new forms of collaboration challenge municipalities. When a municipal government participates to ULLs, its bureaucratic, hierarchical and siloed procedures and organization may conflict with the informal, horizontal, and hybrid nature of experimental governance (Eneqvist, Algehed, Jensen, & Karvonen, 2021). However, experimental urban governance has not yet developed its own procedures to safeguard legitimacy outside of democratic institutions, for instance by ensuring transparency, and fairness (Eneqvist et al., 2021). The public sector logic and the logic of experimentation can sometimes be contradictory, with different priorities and modes of action (Berglund-Snodgrass & Mukhtar-Landgren, 2020). New rules and frameworks are still negotiated in the ‘institutional void’ in which ULLs operate. ULLs do need to grapple with legal and ethical questions since they experiment with human subjects in a living space (Maas, 2019; Taylor, 2020). In this regard, municipalities retain a regulatory and a representative function that can be a source of influence and a challenge in the operation of living labs (Kronsell & Mukhtar-Landgren, 2018). Because ULLs’ interaction with municipal governments is especially important to understand, our fourth research question is: *what is the role, interaction, and perception of municipal government within ULLs?*

3. Research design

We chose an empirical approach to answer the research questions for several reasons. Firstly, the phenomenon of ULLs is still rather recent and nebulous, as with the smart city movement. Secondly, to the best of the authors’ knowledge, very little (empirical) scholarship on ULLs has focused on legal issues. Thirdly, access to information about ULL structures through desk-based research is difficult, since very few agreements, contracts, partnerships, or internal documents are publicly available. Fourthly, material from the ground about the creation and management of ULLs provides useful data to better understand the interaction between parties and existing legal frameworks. To gain practical, concrete, and valid information from a new, undefined research topic, qualitative research provides valuable methods (Leeuw & Schmeets, 2016).

3.1. Case selection

We conducted four case studies of four ULLs in Amsterdam, given the maturity, success, and recognition of the smart city program in the Dutch capital city. The city is regularly referenced in literature on ULLs

² On the importance of an organizational model and exploratory research therein, see Marit Sprenkeling and others, ‘Deliverable 3.1: The PED Innovation Atelier Organization Document’ (Atelier 2020) <<https://smartcity-atelier.eu/wp/uploads/D3.1-The-PED-Innovation-Atelier-Organisation-Document.pdf>> accessed 16 August 2022.

(Cuomo, Ravazzi, Savini, & Bertolini, 2020; Nesti, 2018; Voytenko et al., 2016) and counts dozens of projects (Steen & van Bueren, 2017). Additionally, the Dutch context provides useful insights on multi-stakeholder collaboration due to the commonly used ‘polder model’ governance style, driven by consensus and cooperation across actors and interests (Raven et al., 2019).

The four ULLs were chosen both for their relevance and their accessibility. Concerning the latter, the four labs were still active at the time of research (providing recent data), and they involved a research institute to which two of the authors are affiliated (the AMS Institute). This choice allowed us to have access to data (interviews, partnership agreements, internal process documents, meetings) and to have a more detailed understanding of the history and challenges of each ULL. The third author is not affiliated with the research institute and conducted and coded all the interviews. Regarding relevance, these projects all used the label (urban) living lab in their documentation and (public) communications. This self-proclaimed label can be confronted with the defining characteristics set by Steen and van Bueren (2017).

The first urban living lab (ULL1) is a publicly accessible area within the city where different companies can test their products or prototypes. The location offers different test facilities, on land and on water. It was started by four partners: two knowledge institutions, a semi-public, semi-private organization, and the temporary team in charge of managing the location. The public-private organization is a program focused on smart city development and funded by public and private parties. It exists within a regional foundation that is a private body, but chaired by the Mayor and partially funded by the municipality. The location is publicly accessible, and is currently in transition between two public owners (the Ministry of Defense and the municipality). During this transition, one person has received a mandate to develop, manage, and operate the location as the head of a team of freelancers. The ULL was started in 2019 as part of the temporary occupation of the terrain. It runs experiments with innovations such as autonomous vehicles, crowd-sensing sensors, and bio-building materials. The experiments are generally proposed and deployed by testers, meaning companies or researchers. These testers wish to use the ULL’s location and enter into a rent and user agreement with the lab to do so.

The second living lab (ULL2) regroups individual projects on sustainable energy in an existing neighborhood. At the start, there were three projects. The first one concerns smart energy systems, the second project centers on sustainable buildings, and a third one on reusing heat from datacenters. In 2022, a fourth project was started to research energy poverty through case studies in the neighborhood. The first three projects started independently of one another, and the overarching collaboration began in 2019. The ULL primarily aims to share information between the individual projects and enable networking. It brings together five partners: the municipality and four knowledge institutes (including three universities). Within each individual project, other parties are involved as well, such as energy companies and companies working on sustainable infrastructure and energy transition.

The third living lab (ULL3) is developed by a knowledge institute and three commercial parties (real estate developers). These commercial parties formed a limited partnership after they won a tender with the municipality in 2017 to develop the urban renovation project (to be completed in 2026). They started collaborating with the research institute to fulfil sustainability goals that were part of the tender. The collaboration had already started while physical space was still being built. The lab is a space within an urban renovation project where residents, visitors, and pupils can learn and try out innovations. These tests center on themes such as sustainable building materials and circular food systems.

The fourth living lab (ULL4) is part of a large European project involving multiple cities that implement sustainable energy systems to help urban areas to become positive energy districts. In Amsterdam, this project has been implemented in one neighborhood. It tests technologies such as electricity exchange systems, green roofs, and local waste

treatment. One work package specifically focuses on creating a living lab community to support a local ecosystem of innovation. It does so by sharing information between participants of the larger project and by organizing thematic sessions. It also researches how to remove legal, financial, or social barriers encountered by partners within the project, for instance by mediating discussions with the municipality or between stakeholders. Within a larger consortium of thirty parties for the EU project, this ULL is driven by a core team composed of the municipality, one company, and three knowledge institutes.

All four ULLs thus explicitly aim at innovation and urban sustainability. Their ability to formalize learning outcomes varies, as they all struggle with how to shape learning and replication, but they are all involved in learning sessions with the knowledge institute and share knowledge between participants and networks. ULL1 and ULL2 work on different products or solutions that are currently developed or tested. ULL3 has not physically opened at the time of writing (2023), and ULL4 focuses more on network than on product development. User involvement, in both co-creation, iteration, and decision-making, remains a challenging point for each lab, often due to a lack of citizen participation. Finally, projects within ULL2 are anchored in a real-life setting, as well as the larger project to which ULL4 is attached. ULL1 and ULL3 function more as a publicly accessible test center, although ULL3 has not yet opened. Co-creation and user involvement is a recurring issue with ULLs, despite being central to their definition (Lund, 2018; Steen & van Bueren, 2017). Consequently, this case study does not examine the involvement of citizens (or users), but focuses on the relationship between active, professionally involved stakeholders (municipality, private actors, knowledge institution). It does not aim to qualify or disqualify (urban) living labs from this label, but rather to examine the dynamics present in projects that claim this term. The fact that not all labs fit all these characteristics is part of these dynamics.

The size of the sample is not aimed at representativeness, but allows us to compare, contrast, and draw similarities between these four examples. With these case studies, our aim is threefold: describe the (different) legal and organizational structure of ULLs; understand the impact of different factors and dilemmas on these structures over time; and shed light on the interaction between these experimental, collaborative settings and the municipal government.

3.2. Data collection

Qualitative data was retrieved as follows:

- (a) Twelve semi-structured expert interviews with practitioners from four ULLs were held between May and September 2021 (Table 1). Certain practitioners were involved in more than one lab, with networking ties between each project. This relatively small sample size is in part due to the small size of the ULLs’ teams. We prioritized interviews with team members who had a dedicated position as coordinator within a lab (usually one person), who worked on multiple labs (providing comparative insights), or

Table 1
Interviews.

Urban Living Lab	ULL1	ULL2	ULL3	ULL4
Interviewee and position	1 project coordinator 1 program and business developer 2 directors (from different parties) 2 civil servants	1 project coordinator	1 program and business developer 1 project coordinator 1 civil servant	1 project coordinator and civil servant 1 monitoring researcher

who had access to the full history of a lab (a couple of people, due to turn-over rate). The interviews were all held online, lasting from 45 to 60 min, and were transcribed based on a recording or on notes. The first round of interviewees was contacted through the AMS Institute. The next round of interviewees was selected through snowball sampling, an effective technique for specific and small populations such as key actors in transformative projects (Scupola & Mergel, 2022). Follow up questions were asked to three interviewees in August 2022 for updates on specific aspects of their ULL. The interviews were semi-structured in nature, leaving room for the interviewees to provide insights guided by their own experience as well as to steer towards topics they deemed important and relevant. The interviews were then analyzed on ATLAS.ti using the deductive category assignment method (Mayring, 2014).

- (b) Documents (partnership agreement, shared vision, internal documents) were provided by the interviewees of the selected ULLs. These documents were coded on ATLAS.ti to better understand the governance structures and agreements in each ULL and to triangulate the observations from the interviews.
- (c) A workshop was organized during the Urban Living Lab Summit in June 2021. During this workshop, preliminary findings were shared with a focus group of 13 living lab practitioners, researchers, and experts from different European cities. Through 3 participation rounds, participants were asked to share the legal and governance structures of the ULLs they encountered, to rank the factors that influenced these structures, and to share the dilemmas and challenges surrounding them. The result of these rounds was coded on ATLAS.ti.
- (d) Participation to two learning sessions about two ULLs involved in the study. During these learning sessions, practitioners shared difficulties and reflections stemming from the first year(s) of their ULL. Notes and minutes from these sessions were coded on ATLAS.ti to triangulate the observations from the interviews.

The relatively small sample of interviews used as primary data was thus completed with secondary data have a deeper and more layered understanding of the ULLs' structure and lifecycle. The data has been pseudonymized (Weerakkody, Janssen, & Dwivedi, 2011) to ensure a level of anonymity that allowed interviewees to speak more openly on ongoing issues (Tangi, Benedetti, Gastaldi, Noci, & Russo, 2021) and to compare the ULLs as ideal-types (Yin, 2014).

3.3. Data analysis

To answer the first research question, we identified the type of partner and the type of arrangement. Interviewees were asked to describe the structure of the ULL, the relationship between partners, the internal decision-making process, and the role of formal agreements in the operation of the ULL. Whilst coding, we observed that the ULLs relied on different combinations of formal and informal elements within the collaboration. Formal elements are written rules, structures, or engagements that are (legally) binding to parties. In the interviews and the ULLs' documents, we identified the following formal elements: a signed partnership agreement, a defined governance structure, financial provisions (e.g., shared budget), legal liabilities (e.g., responsibility in case of accidents), a framework for location use, a user agreement, and the creation of a hybrid role (employed or financed by more than one partner). If an ULL displays all or most these elements, we labeled it as formal. Informal elements structure the collaboration based on relational aspects (i.e., contact between parties). They do not provide binding rules or sanctions and they can be changed easily. We identified the following informal elements: a (broadly formulated) shared vision, internal process documents (e.g., flowcharts), regular meetings between partners, and networking through platforms or events within and outside of the partnership. ULLs that relied on informal elements whilst

displaying few or no formal elements were labeled as informal.

To answer the second research question, the interviewees were asked to explain their ULL's history and (potential) future, their source of funding, their approach to risk management, legal issues they wanted to address, and any other choices that structured their ULL. The answers were coded to identify factors that influenced ULLs to be more or less formal or informal. It appeared that temporality (the ULL's lifecycle) provided important context for these factors. Therefore, they were regrouped in short term, mid-term, and long-term factors, as well as legal, financial, and organizational factors.

For the third research question, interviewees were asked which advantages the structure of the ULL offered, and which challenges or problems they encountered. Answers to other questions were used as well to label the advantages and disadvantages of formal and informal ULLs. We summarized this data in the form of trade-offs. The interviewees rarely explicitly formulated these trade-offs themselves, but this synthesis gives an insight into the dilemmas that other ULLs might face as well.

For the fourth research question, interviewees were asked which role the municipality plays in their ULL, what their experience with the municipal government was, and whether they encountered any (legal) problems. Answers to other questions were also used in order to identify the role, interaction, and perception of municipal government across labs. We crossed this data with the partnership documents and the source of financing of ULL partners.

4. Findings

4.1. Legal and organizational structure of ULLs

In terms of partners, research institutions are involved in all four ULLs and represent the majority of partners in half of the ULLs (Table 2). This is in part due to our selection bias, since we studied ULLs to which the AMS Institute participates. The municipality takes part of two ULLs directly. It is also a partner in the location management of ULL1, which is an entity created by the Ministry of Defense and the municipal government, and it funds the research institute in ULL3. Commercial companies are involved in two out of four ULLs, ranging from real estate developers to a technology company. Citizens are not explicitly involved in any of the partnerships, although ULL4 counts a non-profit research organization that focused on civic engagement with technology.

In terms of agreement, Table 3 no ULL has resorted to the creation of a separate legal entity (institutional partnership) from the start.³ Three ULLs have made a partnership agreement. In ULL1, two of the four partners (location manager and research institute) have signed an agreement. ULL2 does not have a formal partnership, but a short 'action plan' which defines the shared goals and the role of each party. Otherwise, it relies on the operational agreements between parties within each individual project. In ULL3, a partnership agreement was made from the start, but has yet to be signed by the commercial party. According to the interviews, this delay is due to the fact that the ULL is a low priority for the commercial parties in the context of the much larger urban renovation project. ULL4 stems from a working package within a formalized consortium of thirty partners that have signed an elaborate agreement. An institutional or contractual partnership at lab level is currently discussed for the long term, but has not been written or signed.

Additionally, each ULL has a governance structure Table 3. ULL1, ULL2 and ULL3 have a direction team (or steering group) and a project team. The latter is generally in charge of operational tasks and meets weekly or bi-weekly, whilst the former is in charge of strategic and financial decisions and meets multiple times per year. In ULL1 and ULL3, the direction team has decision-making powers: it establishes the framework to select which projects to host, decides who to partner with,

³ Long term options will be discussed hereafter.

Table 2
Type of partners and type of agreement.

Urban Living Lab	ULL1	ULL2	ULL3	ULL4 ^a
Type of partners	Research (2) ^b Government (1) Public-private (1)	Research (4) Government (1)	Company (1 (3)) ^c Research (1)	Company (1) Research (3) Government (1)
Type of agreement	Partnership agreement (two partners)	Informal collaboration	Partnership agreement	Partnership agreement (consortium)

^a The partners of the larger project are not counted.

^b In a learning session, one participant noted that the fact that research institutes are key partners in this lab decreases the risk of legal issues and the need for detailed contracts, since two universities were unlikely to sue each other.

^c In this lab, three commercial actors have formed a separate private entity (limited partnership). This is noted as “1 (3)”.

Table 3
Structure of ULLs.

Urban Living Lab		ULL1	ULL2	ULL3	ULL4	
Formal elements	Signed partnership agreement	X		X	X	
	Defined governance structure	X	X	(X) (projected)	X	
	Financial provisions	X		(X) (projected)	X	
	Liabilities			X	X	
	Framework for location use	X		(X) (projected)		
	User agreement	X		X		
	Hybrid position	X	X			
	Informal elements	Internal process	X	X	X	X
		Shared vision	X	X	X	X
		Regular meetings	X	X	X	X
Networking platform or events			X		X	
Degree of formalization		Moderately formal	Informal	Formal	Highly formal	

and carries legal and financial responsibility for the project. In ULL2, the team has less formal responsibilities, but meets to share information and discuss strategy for future projects. ULL4 has a governance structure for the entire consortium, and a core team at lab level. The consortium agreement defines regular meetings, voting rights, operational procedures, committees, and decision-making powers. At lab level, the core team decides where to focus the lab and which problems within the EU project it wants to remediate. This team has been subject to change over the past year, with a citizen initiative leaving and a research institute joining. An advisory ‘sounding board’ was supposed to provide an additional link with the municipality, but it remained unmanned due to internal reorganizations in city government and has since been abandoned. ULL3 projects to create an ‘innovation board’ with experts as well. ULL1 has a sounding board which involves the ‘program partners’, the two partners that are not part of the signed agreement and the direction team.

Among these ULLs, the collaboration combines formal and informal elements, leading to different degrees of formalization. In ULL1, the formal agreement sets out the shared goals and expected outcomes in broad terms. It defines the governance structure within the ULL and its finances. It grants the direction team the power to decide which projects to host and whether to accept new partners. Topics such as liability, intellectual property rights, or data access are not part of the agreement. In ULL2, the ‘action plan’ mainly describes shared goals and internal processes. It does not address liabilities or financial aspects. Monitoring happens independently at project level. Collaboration functions primarily through informal channels, via weekly meetings and a few bigger events over the year. Both ULL1 and ULL2 have also appointed a hybrid coordination role, which is financed or employed across partnering institutions. In ULL3, the original agreement included the goal to write a detailed ‘plan’ as a deliverable of the first year. The draft version of this more detailed agreement addresses governance structures, financing, planning, roles, and responsibilities within the ULL. However, it has not been accepted by both partners yet. Finally, ULL4 depends on a detailed consortium agreement which defines the responsibilities and liabilities

of parties towards each other, accountability channels, the distribution of financial contributions and costs, the ownership of the results and of access rights, as well as the settlement of disputes through arbitration. At lab level, developing a formal structure is the goal of the working package, rather than its starting point.

As a result, the four ULLs could be labeled on a spectrum from informal (ULL2) to highly formal (ULL4) Table 3. However, the level of formalization that can be drawn from the partnership agreements has to be nuanced with the ULL’s operation in practice. In particular, ULL3 and ULL4 are still in a process of formalization. In ULL3, the proposal worked out by the research institute during the first year contains many formal elements, from governance structure and a proposed framework for experiments to liabilities and financial provisions. It has yet to be signed by the commercial party and implemented. In ULL4, the lab exists in a very formalized context (EU consortium) but is more informal in its daily practice, as it is still developing which structure it will adopt in the long term. Moreover, based on the data from the interviews, the relationship between partners in all four ULLs appears rather horizontal. Decisions are made through consensus at management level, which involves all the (core) partners. Disagreements at direction level are usually handled through informal channels, instead of through differentiated decision-making powers.

4.2. Factors influencing the structure of ULLs

To answer our second research question, we observed three types of factors informing the ULLs’ structure and degree of formalization. We differentiated financial incentives (e.g., funding), organizational incentives (e.g., goals, team composition), and legal incentives (e.g., legal nature of partners). These factors either pushed labs to seek formal agreements or encouraged them to prefer more informal collaboration. Furthermore, temporality appeared to play an important role. Multiple interviewees or participants to focus sessions mentioned the start phase was crucially influential to the way the partnership unfolds. The labs’ structures changed over time as new challenges emerged, participating

parties changed, or misunderstandings arose. Factors that made informality beneficial during the starting phase (first year) sometimes became less important during the first couple of years (short term), whilst other factors emerged in the future (long term). As all the studied labs are relatively new, the long-term incentives were derived from questions about how the practitioners projected the future of their lab, or which issues they expected to (continue to) run into in the coming years.

In ULL1 (*moderately formalized*), the balance between informal and formal elements stems from a unique location and partner. Indeed, the location is in a transition phase and not subject to a zoning plan. From the start, the research institute wanted to secure this room for experimentation which led to a rent contract with the location manager. At the same time, the lack of legal personhood of the location manager meant it was not possible to create a separate legal entity together, although this was considered. The location manager has a particular status in this ULL: it was appointed through a mandate by the Ministry of Defense, the landowner, with a team is composed of freelance workers independent from the municipality.⁴ The limited public mandate of the location manager does not allow it to found a legal entity or to apply for subsidies. The municipality (future location owner) did not intervene either, which one interviewee explained as a general aversion from municipal government to becoming shareholder in a joint venture. At the same time, the mandate itself was rather novel, which granted the temporary location management team with a lot of freedom. From the start, the two core ULL partners focused on developing the informal, relational aspect of their collaboration by creating more trust and mutual understanding. The interviewees from the research institute stressed that they wanted to 'integrate the primary process' of the location manager. During this starting phase, different governance structures were considered, but command and control-oriented ones were deliberately cast aside. In the user agreement, the initial security deposit was changed to an ex-ante bill in case of problems. Interviewees observed that although these frameworks were necessary, they were rarely referenced and were considered as 'a pile of paper'. The relational focus was supported by the absence of financial incentives to formalize the collaboration, since neither partner had commercial goals tied to the lab. This lack of business model was also a product of the partners' search to clarify their core mission.

In the next phase, during the first two years of the ULL, the creation of a shared budget moderately formalized the partnership. According to the interviewees, the shared budget was needed to cover costs, strengthen shared commitment, and provide legal clarity to the public partner by avoiding cross-financing. Partners developed a project selection procedure as well. During this phase, the issue of security and liability emerged. The partners appear to disagree who carries responsibility if accidents happen on site, and neither wants to cover all risks and legal responsibility for the experiments. They are currently still working on formalizing this aspect of their relationship. Meanwhile, they remain focused on integrating each other's primary process by strengthening their informal relationship, mutual trust, and openness. In the long term, the specificity of the location will continue to play a role. The ULL emerged from a temporary, exceptional circumstance, but both partners have the ambition of integrating the lab to the location's permanent use and to their organizations. For now, this ambition relies on strong informal ties, but the parties have to formally secure the future use of the location in a zoning plan. Financial factors affect this outcome too: one interviewee indicated that structural partnerships with

companies for larger projects are a potential business model for the long term.

In ULL2 (*informal*), the focus lies strongly on informal interactions between parties. At the start, formal aspects of the lab only existed at project level, where such agreements were necessary for financial reasons (e.g., subsidies, investments). At management level, the only formal aspect was the creation and funding of a fixed management role through two partners, which has since been renewed. The other contributions are provided *in kind*, meaning that employees from partners work on the ULL for a given amount of their working time. The fact that the ULL itself does not run experiments lowered risks for the direction team.

Throughout its first two years, the lab has focused on sharing information between projects and learning from one another. This has centered the collaboration on trust, enthusiasm, shared interest, and intrinsic motivation from all partners, rather than specific, set outcomes. An explicit preference for flexibility and informality was formulated throughout the interviews. One interviewee considered that bringing parties together and dialoguing between different fields are the most fundamental aspects to the lab's existence. Besides, the individual projects are independent from one another in their daily functioning. Therefore, monitoring depends on the format of each subsidy and is not overseen by the direction. Throughout its lifecycle, this ULL is centered on growing 'organically'. A potential driver for formalization in the future would be the creation of a shared budget or finding subsidies for research projects in the name of the lab, rather than for individual projects. A more formal structure could also grant the ULL more visibility, as it currently struggles with a lack of communication budget and allotted time.

In ULL3 (*formal*), the type of partner (commercial) and the type of location (private) had a deciding influence on the lab's structure. At the starting phase, the commercial partners entered the partnership with the research institute in order to fulfil 'innovation requirements' for the municipal tender they won. As manager of the location, the commercial parties expected clear agreements on the duties and responsibilities of the parties. They remain in charge of applying for permits, of ensuring that security standards are met, and of signing user agreements within each individual experiment.⁵ They wanted to clarify IP rights, which are now projected to be managed at project level depending on how an experiment is financed. During the first year, the research institute worked on a process document, as it became clearer which issues need to be addressed in a partnership agreement. The partners also experience a need to develop a stronger mutual understanding and to collaborate more deeply. The research institute insisted that the commercial partners share information and windows of opportunities more proactively. During 2021, a shift occurred as the commercial parties positioned themselves as 'problemeigenaar' ('problem owner') responsible for the ULL instead of mere host. Developing a closer collaborative relationship remains therefore a goal for the years to come.

Finally, ULL4 (*highly formal*) was shaped by EU funding requirements at the start. This financial and legal factor structured the broader project. The project is composed of defined working packages, a calendar, and a monitoring structure through Key Performance Indicators (KPIs). The size of the project plays an organizational factor as well, due to the necessity of distributing tasks clearly among thirty of partners with different specialties. Finally, the municipality was an active initiator of the project and a formal partner in the core team of the ULL. At the same time, the ULL itself aims to develop more informal collaboration through networking and events. In the short term, the lab therefore seeks organic development. It struggled with embedding citizen participation in its core team (e.g., citizen project left) and with connecting more deeply

⁴ To be precise, the location manager was appointed following an agreement between the municipality and the Ministry of Defense, which represented the state. According to interview data, the team is composed of freelancers in order to avoid having the team on the municipal payroll; further administrative matters are handled through the municipality, and financial questions (e.g., rent contracts) are handled by the state.

⁵ As stated in the partnership agreement, the commercial party is responsible for the physical location, the buildings, the infrastructure, for security, as well as for the implementation and execution of experiments. The latter is explicitly not the responsibility of the project team.

with the municipal government (e.g., no sounding board). In the short term, the ULL has therefore sought to solidify its position within the EU project through informal settings (e.g., regular meetings, workshops) that raise awareness about its methods and capacities. In the long term, ULL4 is looking at how to create a structure and a culture of transmission that survives the EU subsidy term. One interviewee explained that the choice between structures depends primarily on the ULL's local embedding (e.g., political priorities), the nature of participating partners (e.g., network organizations), and the source of funding.

4.3. Trade-offs in the structure of ULLs

To answer our third research question, we observed that different degrees of formalization come with trade-offs in each ULL Table 4. These trade-offs stem from the advantages and disadvantages of each structure. The current structure of a ULL does not preclude that these inherent tensions will not be solved differently in the lab's future.

ULL1 (*moderately formalized*) navigates a tension between horizontality and control, between trust and legal certainty, and between an exceptional start and long-term viability. It operates rather horizontally, but lacks a formal monitoring framework. This diminishes the commitment of some testers, who are not updating the project team on their experiments or abruptly leave the location. The responsibilities and liabilities of the core partners are also not entirely clear, especially when it comes to security on the location in relation to the experiments. On the other hand, the small direction team has made consensus easier. Interviewees underline as an important advantage that core partners have come to mutual understanding, trust, and openness over time. Finally, the ULL's unique location and rent agreement provides it with room for experimentation. However, in the long term, the lack of legal personhood of one partner limits the possible structures. The benefits of informal ties are challenged as the management team will end up leaving when the location has been transferred to the municipality, its final owner.

ULL2 (*informal*) operates a trade-off between individual motivation and structural means, between informality and clear goals, and between organic, small-scaled development and larger visibility. This ULL is structured mainly on enthusiasm and individual motivation, as partners are participating in kind and voluntarily. The participants' intrinsic motivation and their learning ability is heightened by this informal focus. Yet this high dependence on individuals raises questions for the long-term viability and structural means to sustain the collaboration. One interviewee expressed the concern that the value and mission of the ULL are not understood well enough by all the partners beyond the directly involved individuals, which can jeopardize the collaboration when these individuals leave. This can be observed in relation to the municipality, which is part of the core team but has not dedicated a structural part of its budget to sustaining this ULL. The ULL's value remains difficult to translate and to demonstrate since the partnership is very new, and no monitoring or evaluation structure has yet been established. Because the ULL centers on informal learning, it has not set clear, measurable goals, which we identify as the second trade-off the lab has to navigate. The third trade-off exists between organic development and larger visibility. One interviewee regretted the absence of a (communication) budget. The project manager had to combine different financial sources from every partner in order to fund a launch event. This hampers the ULL's visibility and its longevity in the long term. At the same time, interviewees indicated they do not wish to resemble bigger, more structural ULLs either, valuing their flexibility and organic collaboration.

In ULL3 (*formal*), the main trade-off results from the relationship dynamic between partners, having to balance separate and shared responsibilities, individual and shared interests, and the current partnership conditions with long term collaboration. Initially, the commercial parties perceived the knowledge institute as a supplier of innovation rather than as a co-creator. Although the parties signed shared vision at

the beginning of the project, the research institute indicate that the commercial parties do not appear to have integrated its content. Instead, they positioned themselves in a client/provider relationship (or principal-agent). They remained responsible on paper for many legal issues (e.g., applying for permits), and this clear distribution of tasks speeds up certain processes. However, this lab struggled with expressing shared goals and ambitions. The knowledge institute experienced difficulties in communicating the value of the living lab method and the collaborative nature of innovation in this context. This raised the risk that commercial parties would hold on to their existing methods and structures, rather than entering an open collaboration with a sense of shared responsibility. After its first year, ULL3 arrived at a crucial stage where the research institute feared the commercial parties would 'pull the plug'. Although the commercial partners shifted their position to taking more ownership for the content of the ULL instead of only its formal elements, delays on the broader renovation project still put pressure on the amount of time and resources dedicated to the ULL. Thirdly, the fact that one partner is a limited partnership raises a challenge in the long term, according to interviewees. The parties' agreement will end when the limited partnership ends (i.e., when the renovation is over), which narrows the scope and longevity of the partnership.

Finally, ULL4 (*highly formal*) faces a trade-off between separate and shared responsibilities, between focusing on execution or on interconnection, and between prioritizing horizontal relationships or monitoring frameworks. The formalized structure of the EU project makes it more difficult for the various partners to engage with each other beyond their individual task. Most parties focus on execution, which lessens the sense of shared responsibility and limits the possibility of true 'co-creation'. Thus, the networking potential of the ULL has not been put in practice yet. One interviewee observed that the formalization of the partnership and the nature of the parties involved made it more difficult to discuss the form of the lab (i.e., enable co-creation), rather than its content (i.e., finish a product, solve a problem). The initial goal of the lab (i.e., further interconnection between parties of the EU project and overcome obstacles in collaboration) might thus be overshadowed by a focus on executing separate tasks. Moreover, this ambition of interconnection is difficult to translate into measurable targets and to monitor, since it focuses on 'soft' elements. The interviewees observed that the monitoring framework (i.e., Key Performance Indicators) of the EU project were produced by an international partner, based in another location, due to the funding requirements. They consider this monitoring framework too broad and out of touch with the dilemmas on the ground.

4.4. Interfacing with municipalities

To answer our fourth research question, we looked at the role of the municipality in each ULL. We drew information from the interviews about the interaction with municipal departments and the perception of municipal government by ULL partners.

Although it does not steer any ULL, the municipality takes on different roles, such a partner, financier, location owner, and initiator. In ULL1, it acts as the future location owner and an indirect partner, as it is administratively responsible for the current location manager and it co-finances the research institute and the public-private development program for the location. In ULL2 and ULL4, the municipality was an initiator and remains an active partner. In both labs, city government was involved from the start and public servants participate in the direction team. Within ULL2, the municipality manages or takes part in some individual projects, and it is labeled as 'problem owner' within the direction team. It partially finances the project manager and has financed communication efforts ad hoc. In ULL4, the municipality initiated Amsterdam's participation to the EU project. In ULL3, it has a background role, as it does not participate actively or directly but does support the research institute involved.

Furthermore, interviewees underlined the municipality's role of

Table 4
Trade-offs in the structure of ULLs.

	ULL1	ULL2	ULL3	ULL4
Degree of formalization	<i>Moderately formal</i>	<i>Informal</i>	<i>Formal</i>	<i>Highly formal</i>
Trade-off	<ul style="list-style-type: none"> - Horizontality vs monitoring framework - Mutual trust vs clear liabilities - Unique situation vs long term partnership 	<ul style="list-style-type: none"> - Individual motivation vs structural means - Informality vs clear goals - Organic development vs lack of visibility 	<ul style="list-style-type: none"> - Separate responsibilities vs shared responsibility - Individual interests vs shared interests - Limited partnership vs long term partnership 	<ul style="list-style-type: none"> - Separate responsibilities vs shared responsibility - Execution vs interconnection - Horizontality vs monitoring framework

competent public authority (e.g., security, safety) and as administrative body (e.g., zoning plans, public policy on innovation). For instance, both partners in ULL1 preferred relying on the local bylaw rather than setting house rules for the location themselves, so that enforcement would come from the municipality. For permits needed in ULL1 and ULL3, municipal safety and security standards are in force. As an administrative body, the municipality establishes land use plans and delivers permits to allow constructions or to grant exemptions to land use plans. It also formulates public policies that affect ULLs, such as subsidies to support sustainable projects or legal exemptions to support innovative projects. Overall, municipal government was recognized by interviewees as primarily responsible for the public interest. Multiple actors pointed out they rely on the municipality to set conditions and limits to living labs and innovation). Across ULLs, the municipality is therefore primarily recognized in its role of a democratically legitimated public authority. It is perceived as being responsible for safety, security, and safeguarding the public interest, but its regulatory frameworks to fulfil this role are contested when they create delays or obstacles for experimentation.

Indeed, this double position as partner and public authority is visible in the interactions with ULLs. Interviewees note that city government shows interest as a partner by visiting premises, financing research projects, and being involved in boards. With certain civil servants, ULL employees can interact regularly to explain their methodology and their specificity. However, these interactions depend largely on finding the ‘right’ person to talk with, and possibilities are still limited by legal frameworks. Indeed, ULL participants experience a disconnect in relation to the municipality on multiple levels. Firstly, individual public servants might be enthusiastic but often lack decision-making power or the capacity to influence their hierarchy. Secondly, departments involved in urban innovation (e.g., Chief Technology Office) are separate from the departments in charge of the built environment, permits, or procurement.⁶

This can lead to frustrations and misunderstandings. For instance, the partners in ULL1 deliberately chose a location that did not have a zoning plan, which should have made it more flexible for diverse uses. However, the parties are still required to ask for permits for constructions, which interviewees criticized as illogical and burdensome. The ULL left this task to individual testers who were often unfamiliar with Dutch legislation and procedures. In multiple projects, this requirement was a source of confusion for practitioners and of delay for tests. According to an interviewee, the absence of a zoning plan has made the municipality more cautious about safety requirements when delivering permits too. There have also been tensions with city government as it argued that entrance to location should be controlled rather than open due to safety concerns. This conflicts with the identity of the ULL as a public and participatory testing ground. The fact that the municipality handles the administrative matters for the location manager leads to misunderstandings on applicable procurement frameworks, because the location manager selects partners and negotiates rent contracts whilst

⁶ Over time, interviewees from ULL1 observed that as the lab matured, it increasingly developed relationships with operational departments, such as waste management, rather than departments focused on innovation.

the municipality handles them administratively. Finally, the creation of a legal entity was ruled out in ULL1 in part due to the municipality’s caution to become a shareholder as a public body. In ULL2, issues arose with the Fauna and Flora Act. The act creates a duty to make an inventory how construction work affects specific species. This inventory was considered very time consuming and inefficient due to its limited scope in time (five years) and space (one street).

Thus, the municipality cannot act as a partner independently from its role and status of public authority. Several interviewees expressed their frustration about these disconnections to the municipality and suggested changes in public policy in order to better support innovation. They reported that the municipality views the ULLs as responsible for ‘implementation’, not for policy making. ULLs still unilaterally depend on the recognition from city government for their longevity. City government is a key player and vital to maintain ULLs’ unique situations (e.g., zoning exemption). ULLs recognize a strategic interest in involving the municipal council and the executive, for instance by inviting them on their locations. Nonetheless, they find it difficult to access structural budgets and to obtain commitment beyond the electoral cycle.

Interviewees’ perception of municipal government reflects this paradoxical position. Municipal frameworks (e.g., permits, procurement) were experienced as a constraint and a negative influence on projects. Interviewees pointed out the municipality was hard to talk with, frustrating, slow, risk averse, unpredictable (due to political cycles), and that it needed to catch up with innovative practices on the ground. Although the municipal government was considered curious and interested, it lacks resources and institutional embedding to carry this interest further. Project managers often have insufficient mandate and room to impact decision chains within the municipal organization. Whenever it became necessary for public servants to justify investing time or means into a project, practitioners struggle to translate the value of the living lab method within the municipal framework. Interviewees also struggled with the complexity of the municipal organization, its internal divisions, and reorganizations over time that severed ties with individual public servants or left boards unmanned.

Overall, according to interviewees, the municipality still has to learn how to manage the unique nature of ULLs, how to embed their value within its organization, and how to fulfil its role within an innovative, horizontal context. The siloed nature of city government, the disparate involvement of different departments, repeated internal reorganizations, and the limited resources and powers of individual public servants create problems in communication, delays, and disappointments within ULLs.

5. Discussion

5.1. Practical implications

Our data shows different degrees and trajectories of formalization taken by ULLs. All ULLs display elements of informality and of formality, and their balance can change overtime. If an ULL starts based on shared enthusiasm and informal collaboration, it will encounter the necessity of formalization at later stages of its development (e.g., appoint project

manager, apply for funding) and to safeguard its long-term existence (e.g., secure location, develop business plan). If an ULL starts within a formal context, it will grapple with the need to move beyond initial written agreements to generate mutual trust and shared ambitions throughout its lifetime.

We argue that three factors primarily lead to differences in the legal and governance structures of these labs. Firstly, ULLs require funding or financing. Their choice of revenue model has different structuring effects. By applying for funding, they often have to formulate clear goals and monitoring frameworks. By creating a shared budget, partners need to agree on financial risks and proportional investments. By paying for project management, parties need to embed the ULL within their own organization or at least formally relate to it. The presence of commercial interests increases the need to allocate tasks and clarify risks. ULLs that have no commercial goal or partner, or that operate with little to no budget, can remain more informal. Secondly, many ULLs are set up on a physical location.⁷ Whether this location is public or private impacts the priorities, actions, and expectations of partners. Both the location owner and the municipal government condition how the location can be used, through contractual documents (e.g., user agreement, rent agreement) and through permit procedures. The third important factor is the necessity to bridge the interests of different parties. Although formal elements such as contracts or monitoring frameworks could be used to this effect, the most formalized ULLs struggled with the interconnection between partners. We saw that ULLs focused on informal tools of collaboration (e.g., frequent meetings, shared vision) arrived at a strong sense of trust and mutual understanding earlier in their lifecycle.

We observed that in developing their structure, ULLs face trade-offs. They have to reconcile seeking openness, flexibility, co-creation, and trust with defining responsibilities, accountability channels, and monitoring tools. Whilst ULLs strive for horizontality and co-governance, they must also address liabilities between partners. Within ULLs that function largely on trust, interrogations surfaced years after the initial partnership has been signed: is the tester, who deploys a given technology or installation, responsible for asking a permit for a construction? Or should it be up to the ULL, as an overarching structure or party? Is the location owner or the research team responsible if an individual gets hurt by the activities of an ULL (e.g., a physical installation that falls or malfunctions)? These issues require to engage with legal frameworks earlier on in the partnership.

Finally, the municipality can be perceived as a hurdle for ULL projects. However, the municipality is also referred to as a legitimate source for constraints. City government has to navigate its double role of partner and regulator. The ULLs are not centrally piloted by the municipality, but municipal government could develop a more cohesive approach to the way its services interface with labs to avoid incomplete or contradictory information. This would require ULLs to become a part of municipalities' strategy, in their budgets and within their organization.

Overall, public-private collaboration in ULLs has specific characteristics and challenges. The most important challenge faced by ULLs regards temporality. ULLs are often initiated within a short-term project context aiming to pursue long-term goals and values (e.g., urban sustainability). At the same time, all four ULLs shared concerns about their survival beyond a few years (e.g., end of a grant). Partnerships are often built on small scale agreements that gradually evolve and are constantly readjusted. Monitoring and evaluation of projects pose problems because ULL goals are often implicit, intangible and difficult to translate into tools such as KPIs. The (lack of) legal nature of partners can form an

⁷ Virtual labs also exist. In this case study, we have examined four ULLs with a physical aspect, although ULL2 does not operate on one location (but three projects in three different locations instead) and ULL4 does not have a physical location for testing (instead, it focuses on mediation, workshops, research, and dialogue).

additional limitation to longer term collaboration. Meanwhile, the level of understanding and trust required for horizontal collaboration between partners demands to work together for a longer period of time. Interviewees showed a sense of urgency, a wish to act now, even if existing legal frameworks are not adapted. To this effect, certain ULLs benefit from tolerance for non-compliance ('gedoog' in Dutch) and exemptions (e.g., temporary absence of a land use plan). However, these exceptional circumstances change and do not provide legal certainty for ULLs to develop in, making them dependent on electoral cycles. Finally, the issue of temporality presents itself in the creation of roles and teams based on individual enthusiasm. Multiple projects question how they will survive beyond the individuals who started them. In this regard, collaboration within ULLs contrasts with more traditional PPPs in urban infrastructure, which involve financing, planning, and monitoring over decades, and which demand a formal basis from the start.

5.2. Theoretical contribution and limitations

The observations in this study confirm and further develop the liminal character of ULLs. Firstly, labs indeed have to navigate organizational liminality. Partners within the observed ULLs are constantly looking to and struggling to reconcile their values and levels of engagement. Secondly, although geographic liminality was less centered in the study, we can still observe clashing dimensions in labs such as ULL4, where the size of the partnership and the size of the lab differ. Additionally, the local circumstances of a lab have been shown to highly impact the development of these spaces beyond liminality in the longer run. Finally, ULLs do experience legal liminality, and make use temporary regulatory exemptions.

Moreover, this liminality does provide ULLs with some open space to create new interactions and new forms of governance. However, these interactions are characterized by informality. Strategies used to navigate the liminality at the local level are difficult to formalize, as they will run into conflict with more formalized structures and legal liminality is only granted temporarily.

These observations are limited by the scope of the study. Four ULLs were compared, and more legal and organizational forms certainly exist in other cases. The study focused on the city of Amsterdam, which is the biggest municipality of the Netherlands and, as other capital cities, strongly involved in urban experimentation. Smaller municipalities might encounter other challenges and avoid some of the issues observed in these cases, whilst cities in other countries (e.g., with other public law regimes) would face different challenges as well, inviting more comparative case studies on ULL governance. The interviewees were primarily practitioners, aside from two civil servants, which gives a relatively unilateral perspective on the interaction between lab and municipality. Moreover, the lack of citizen involvement in the governance of all four labs makes it essential to extend the inquiries in this study to other power dynamics and organizational structures. Challenges linked to legal personhood and structural commitment are likely to emerge with user participation to decision-making.

Considering these limitations, this case study aims to contribute one empirical testimony which insights can be contrasted and compared with other case studies. Future research could study the perspective of public servants on how municipalities react to and participate in urban experiments with uncertain trajectories and outcomes.

6. Conclusion

This article examined how urban living labs structure public-private collaboration. The use of theory on liminal spaces has been informative in the analysis, to help understand how liminality of temporary spaces influences the development of their structure. Through empirical research, we found that ULLs exist in different degrees of formalization, from informal to highly formal. This formalization is influenced by the need for funding, the nature of the physical location, and the interests of

the different parties. ULLs that rely on EU funding or involve commercial partners tend to be more formalized, whilst ones that center on networking and the development of mutual interests depend on more informal tools. Legal factors, such as IP rights and data protection, do not appear to play an important role in these choices, with the exception of clarifying partners' liabilities. As a consequence of these degrees of formalization, ULLs are faced with different challenges over time. Formal and highly formal ULLs experience difficulties with connecting partners and expectations. These ULLs are currently taking up the challenge of moving their partnership beyond a client/provider relationship, and of making their working process more interdependent. Informal and moderately formal ULLs, on the other hand, are trying to establish clearer responsibilities and higher commitment from users or partners.

Urban innovation also challenges public actors. Municipal government has to navigate its role as partner and as public authority. ULLs expect their experimental nature to be better understood and recognized by the municipality, whilst municipalities have to handle their own internal communication, accountability channels, and decision-making processes.

For ULLs, three recommendations can be formulated based on this article. Firstly, the choice of a purely informal collaboration based on trust and (individual) enthusiasm can only be considered for labs that do not depend on a physical location, where security and liabilities need to be addressed.⁸ Secondly, formalization moments, such as the renewal of an investment or the creation of a management role, should be used to catalyze shared ambitions and commitment and clarify mutual expectations in order to avoid misaligned interests later in the process. Finally, ULLs ought to give more attention to the legal frameworks that condition their structure and actions. In multiple ULLs, the legal personhood of parties limited the partnership options throughout the lab's lifecycle, whilst no lawyer was involved in the early phases of the partnership agreement to anticipate these issues. ULLs need flexibility: their form depends on the partners involved and their end goal is not fixed from the start. Their structure should therefore not be standardized. However, the external frameworks they will encounter are known from the start. Practitioners should more clearly identify these frameworks to protect the viability of the lab in the long term. Given the temporality, dynamic and evolutionary character of ULLs observed in this study, a meta-governance of ULLs (cf. Bernstein & Hoffmann, 2018; Kivimaa & Rogge, 2022) could be a promising way forward to continued learning and implementation for practitioners, and a perspective for future research.

CRedit authorship contribution statement

Astrid Voorwinden: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Ellen van Bueren:** Conceptualization, Resources, Writing – review & editing, Supervision, Project administration. **Leendert Verhoef:** Conceptualization, Resources, Writing – review & editing, Supervision, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

⁸ This does not mean there are no potential security and liability issues for ULLs without a physical location. In our case study, ULL2 managed these issues at project level, but other set-ups, such as virtual living labs, can raise issues that need to be addressed at lab level.

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