

# From Co-Creation to Circular Cities: Exploring Living Labs in EU Governance Frameworks – A Literature Review

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## ABSTRACT

**Purpose:** This paper provides a comprehensive and integrative literature review of how Living Labs (LLs) are conceptualised, implemented, and evaluated within the European Union's governance frameworks. It aims to trace the evolution of LLs beyond their original innovation rhetoric and to assess their actual contributions to co-creation, participatory governance, and circular transitions.

**Design/Methodology/Approach:** Using a PRISMA-compliant systematic literature review methodology, the study screened 403 peer-reviewed publications from the Web of Science Core Collection. Following the application of rigorous inclusion criteria, 77 eligible studies were analysed. A co-occurrence analysis of 360 keywords was conducted using VOSviewer to identify ten thematic clusters that structure the field. The findings are discussed across four dimensions: institutional anchoring, collaborative learning, socio-economic transition, and methodological consolidation.

**Findings:** The review reveals that LLs function as hybrid governance infrastructures that foster innovation only when they are embedded in stable institutional settings and aligned with multi-level governance systems. While many LLs claim inclusivity, their actual transformative capacity is often constrained by power asymmetries, weak institutionalisation, and methodological fragmentation. Nevertheless, high-performing LLs demonstrate significant value in facilitating systemic learning, promoting circular practices, and enabling democratic experimentation.

**Practical Implications:** The findings emphasise the need for standardised evaluation frameworks, long-term funding mechanisms, and stronger in-

stitutional pathways for LL outcomes to inform policy. Policymakers and practitioners are urged to move beyond pilotism and adopt LLs as embedded tools of governance.

**Originality/Value:** Unlike previous studies that focused narrowly on sectoral applications or isolated urban experiments, this review is the first to systematically map the evolution of Living Labs across four governance-oriented dimensions: collaborative anchoring, democratic learning, circular innovation, and methodological evaluation. By linking these dimensions to the structural conditions of institutional consolidation within EU public policy frameworks, the article provides a novel conceptual synthesis that bridges fragmented scholarship. It advances the field by offering an integrated perspective that captures the multifunctional role of Living Labs as infrastructures for systemic governance innovation.

*Keywords:* co-creation, European Union, Living Labs, participatory governance, public policy, urban experimentation

## Od soustvarjanja do krožnih mest: raziskovanje živih laboratorijev v okvirih upravljanja EU – pregled literature

### POVZETEK

**Namen:** članek ponuja celovit in integrativen pregled literature o tem, kako so živi laboratoriji konceptualizirani, izvajani in vrednoteni znotraj upravljaljskih okvirov Evropske unije. Cilj je slediti razvoju živih laboratorijev onkraj izvorne inovacijske retorike ter oceniti njihove dejanske prispevke k soustvarjanju, participativnemu upravljanju in krožnim prehodom.

**Načrt/metodologija/pristop:** z uporabo sistematične metodologije pregleda literature v skladu s PRISMA je študija pregledala 403 recenzirane publikacije iz zbirke Web of Science Core Collection. Po uporabi strogih vključitvenih meril je bilo analiziranih 77 ustreznih študij. S programom VOSviewer je bila izvedena analiza sopojavljanja 360 ključnih besed za identifikacijo desetih tematskih grozdov, ki strukturirajo področje. Ugotovitve so obravnavane skozi štiri razsežnosti: institucionalna vpetost, sodelovalno učenje, družbeno-ekonomski prehod in metodološka konsolidacija.

**Ugotovitve:** pregled razkriva, da živi laboratoriji delujejo kot hibridne upravljaljske infrastrukture, ki spodbujajo inovacije le, kadar so umeščeni v stabilna institucionalna okolja in usklajeni z večnivojskimi sistemi upravljanja. Čeprav številni živi laboratoriji deklarirajo inkluzivnost, je njihova dejanska transformativna zmožnost pogosto omejena zaradi asimetrij moči, šibke institucionalizacije in metodološke razdrobljenosti. Kljub temu visoko uspešni živi laboratoriji izkazujejo pomembno vrednost pri pospeševanju sistemskega učenja, spodbujanju krožnih praks in omogočanju demokratičnega eksperimentiranja.

**Praktične implikacije:** ugotovitve poudarjajo potrebo po standardiziranih okvirih za vrednotenje, mehanizmih dolgoročnega financiranja ter močnejših institucionalnih poteh, po katerih bi rezultati živih laboratorijev informirali javne politike. Odločevalci in praktiki naj presežejo »pilotizem« (pretirano zanašanje na pilotne projekte) in žive laboratorije sprejmejo kot vgrajena orodja upravljanja.

**Izvirnost/vrednost:** drugače kot pretekle študije, ki so se ozko osredotočale na sektorske uporabe ali osamljene urbane eksperimente, je ta

pregled prvi, ki sistematično mapira razvoj živih laboratorijev skozi štiri na upravljanje usmerjene razsežnosti: sodelovalno vpetost, demokratično učenje, krožne inovacije in metodološko vrednotenje. S povezovanjem teh razsežnosti s strukturnimi pogoji institucionalne konsolidacije znotraj okvirov javnih politik EU članek ponuja novo konceptualno sintezo, ki premošča razdrobljeno znanstveno produkcijo. Področje nadgradi z integriranim vidikom, ki zajame večfunkcijsko vlogo živih laboratorijev kot infrastruktur za sistemske inovacije upravljanja.

*Ključne besede:* soustvarjanje, Evropska unija, živi laboratoriji, participativno upravljanje, javne politike, urbano eksperimentiranje

*JEL:* H83, R58, O35

## 1 Introduction

Over the past two decades, Living Labs (LL) have become a significant reference point in discussions about innovation, participation, and public policy transformation within the European Union. Initially conceptualized as collaborative spaces for user-centred experimentation, Living Labs have gradually evolved into instruments for addressing complex societal challenges through real-world co-creation processes (Bulkeley et al., 2016; Voytenko et al., 2016; Westerlund et al., 2018). Their appeal lies in the capacity to bring together diverse stakeholders – public authorities, citizens, researchers, and businesses – to test and develop context-sensitive solutions that respond to local and regional needs.

Despite their growing diffusion across Europe, the conceptualization and implementation of Living Labs remain highly heterogeneous. While some LLs are embedded in strategic urban governance frameworks (Bifulco et al., 2017; Bradley et al., 2022), others function as short-term pilot projects with limited institutional anchoring or long-term impact (Mukhtar-Landgren, 2021; Muur and Karo, 2023). Moreover, literature often treats Living Labs as a catch-all term, encompassing a wide variety of practices that differ significantly in methodology, purpose, and degree of citizen involvement. This ambiguity has created challenges for both academic inquiry and policy learning, highlighting the need for a systematic synthesis of the knowledge produced to date (Arias et al., 2025; Wehrmann et al., 2023).

In particular, the growing relevance of Living Labs within EU policy frameworks – especially in areas such as sustainability, circular economy, digital transformation, and participatory governance – calls for a deeper understanding of their functions, impact, and the institutional structures that support their implementation. Existing studies often examine particular sectors, cities, or individual cases, but frequently fail to synthesize these findings within a broader theoretical or comparative framework (Backhaus and John, 2025; Bhatta et al., 2025b; Broekema et al., 2023). As a result, the field lacks a consolidated view of how Living Labs contribute to public sector innovation, what thematic patterns structure current research, and where conceptual or empirical gaps persist.

Unlike previous studies that focused narrowly on sectoral or city-specific applications, this review is the first to systematically trace the evolution of Living Labs across four distinct governance dimensions – collaborative anchoring, democratic learning, circular innovation, and methodological evaluation – while also identifying the structural conditions that enable or inhibit their institutional consolidation within EU public policy frameworks.

This literature review examines how Living Labs are positioned as tools for co-creation and experimental governance within the EU. By synthesizing peer-reviewed research, the study highlights four key dimensions. First, it explores how Living Labs foster collaborative governance by engaging diverse stakeholders in shared decision-making. Second, it analyzes their role in promoting learning processes that support institutional adaptation and innovation (Eneqvist et al., 2022). Third, it considers their contribution to circular and socio-economic transitions, aligning local action with broader sustainability goals (Arciniegas et al., 2019; Bouzarovski et al., 2023). Finally, it reviews emerging methodological frameworks that enhance the evaluation and integration of Living Labs into public policy (Furlan et al., 2024; Zingraff-Hamed et al., 2020). Together, these insights clarify the potential and limits of Living Labs as instruments of systemic transformation in EU governance.

This article aims to provide a structured and integrative overview of how Living Labs have been studied in the context of public policy and governance within the European Union. To guide the analysis, the following three research questions were formulated:

**RQ1:** *How are Living Labs integrated into EU governance and public policy innovation frameworks, and what roles are they assigned within these processes?*

**RQ2:** *What forms of co-creation and stakeholder engagement are highlighted in the literature, and how do these practices shape the functioning of Living Labs?*

**RQ3:** *What conceptual clusters and recurring themes emerge in the academic discourse on Living Labs, particularly in relation to their governance structures, implementation challenges, and policy impact?*

By addressing these questions, the article offers a coherent overview of how Living Labs are defined, implemented, and interpreted within EU policy and governance frameworks. It clarifies the ways in which Living Labs are used - as platforms for innovation, as mechanisms for stakeholder participation, and as tools for institutional change. The review also highlights the variety of co-creation practices described in the literature, distinguishing between inclusive, collaborative models and more limited or symbolic approaches. In addition, it identifies common challenges - such as weak institutional integration, unequal power dynamics, and difficulties in evaluating long-term impact. Rather than compiling isolated findings, the article builds an integrated framework that helps researchers and policymakers better understand the potential and limitations of Living Labs and provides a foundation for more systematic future research and practice.

To position this contribution within the broader state of the art, it is necessary to clarify how Living Labs are defined in this study and which conceptual models provide the analytical anchors for our review.

We adopt a governance-oriented definition of Living Labs as real-world, multi-stakeholder infrastructures that organize iterative cycles of co-creation to inform and adjust public decision-making (Westerlund, Leminen and Habib, 2018; Scholl and Kemp, 2016). Two conceptual anchors structure our approach. The first is provided by platform- and function-based typologies, which differentiate product-, service-, process-, and policy-oriented labs and emphasize the contrast between technology-driven and policy-oriented experiments (Westerlund et al., 2018; Scholl and Kemp, 2016). The second anchor stems from transition-oriented taxonomies that classify labs according to their role in exploring, shaping, or institutionalizing systemic change (McCrory et al., 2020; 2022). Building on these perspectives, our review advances the state of the art by systematically mapping ten keyword co-occurrence clusters into four governance dimensions—institutional anchoring, collaborative learning, circular transition, and methodological consolidation—thus offering a novel synthesis that clarifies how Living Labs function as infrastructures for governance innovation in the EU context.

## **2 Methodology**

### **2.1 Methodological Design**

This study follows a systematic literature review (SLR) approach designed to synthesize existing knowledge on the use of Living Labs in public policy innovation and experimental governance within the European Union. The review was conducted according to the PRISMA 2020 (Haddaway et al., 2022) guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), ensuring methodological transparency, replicability, and academic rigor.

### **2.2 Inclusion and Exclusion Criteria**

To ensure consistency and relevance, only peer-reviewed articles and proceedings papers published between 2008 and 2025 were considered. These documents had to be written in English, Spanish, French, Portuguese, and accessible through Open Access, allowing for full-text analysis. The studies were required to explicitly address Living Labs (including terms such as “urban living labs” or “territorial living labs”) and to link these to at least one core theme: public policy, governance, co-creation, policy experimentation, public sector innovation, or regional development. All studies had to be situated within the geographical boundaries of the European Union or refer specifically to EU institutions or programs.

Publications that did not meet these criteria were excluded. Book chapters ( $n = 15$ ) and early access articles ( $n = 8$ ) were removed due to lack of definitive peer-review status at the time of screening. Additionally, thematic exclu-

sion was applied based on Web of Science categories. Technical fields such as Computer Science, Engineering, Medical Informatics, and Telecommunications were filtered out, as they do not address the participatory, institutional, or governance dimensions that are central to the Living Lab concept. Conversely, thematic categories relevant to governance, sustainability, policy design, urban planning, and social innovation were retained. After applying these criteria, 193 eligible studies remained.

## 2.3 Data Source and Database Selection

The literature search was performed exclusively in the Web of Science Core Collection. This database was selected for its comprehensive coverage of high-impact peer-reviewed journals and its robust filtering tools that enable precise refinement by discipline, publication type, and geographic focus. Web of Science is particularly suited for interdisciplinary research combining political science, sustainability, urban studies, and innovation policy - disciplines at the heart of the Living Lab framework.

## 2.4. Search Strategy

The search strategy employed a structured Boolean logic to combine thematic, conceptual, and geographical dimensions. The final query was:

*TS = ("living lab\*" OR "urban living lab\*" OR "territorial living lab\*")*

*AND*

*TS = ("public polic\*" OR "policy innovation" OR "governance" OR "policy experimentation" OR "co-creation" OR "public sector innovation" OR "regional development")*

*AND*

*ALL = ("European Union" OR "EU" OR "European Commission" OR "Austria" OR "Belgium" OR "Bulgaria" OR "Croatia" OR "Cyprus" OR "Czech Republic" OR "Denmark" OR "Estonia" OR "Finland" OR "France" OR "Germany" OR "Greece" OR "Hungary" OR "Ireland" OR "Italy" OR "Latvia" OR "Lithuania" OR "Luxembourg" OR "Malta" OR "Netherlands" OR "Poland" OR "Portugal" OR "Romania" OR "Slovakia" OR "Slovenia" OR "Spain" OR "Sweden")*

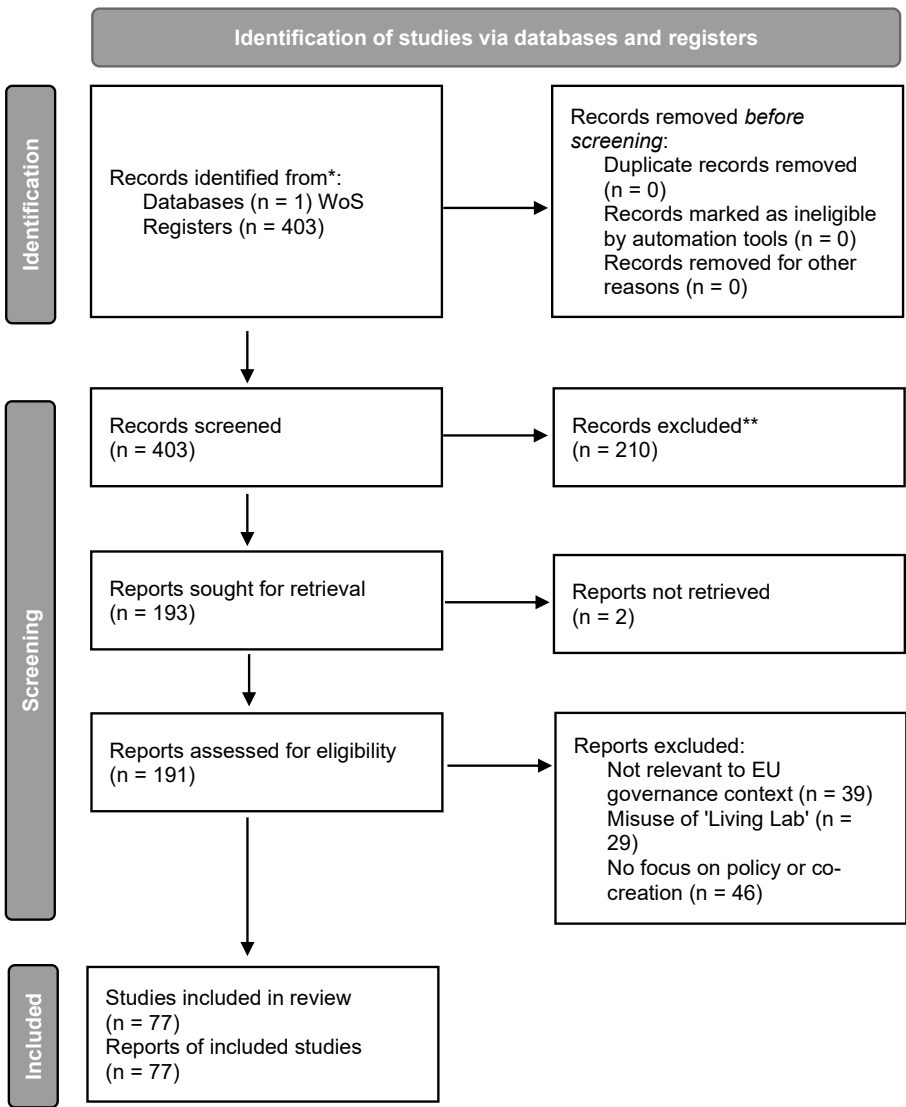
*This formulation ensured thematic relevance (Living Labs and public governance), conceptual focus (innovation, co-creation, experimentation), and geographical delimitation (EU-specific cases).*

## 2.5 Study Selection Process

The initial search in the Web of Science database identified 403 records. No duplicates or automation-based exclusions were necessary. All titles and abstracts were manually screened, leading to the exclusion of 210 studies that were either unrelated to the EU context, misused the term "Living Lab," or

lacked a focus on policy or co-creation. From the 193 full-text articles selected for eligibility assessment, 2 could not be retrieved. Of the remaining 191, a further 114 were excluded for similar reasons, resulting in a final selection of 77 studies that met all inclusion criteria. The stages of this selection process are detailed in Figure 1.

Figure 1. PRISMA flow diagram illustrating the selection process of studies on Living Labs within the EU context

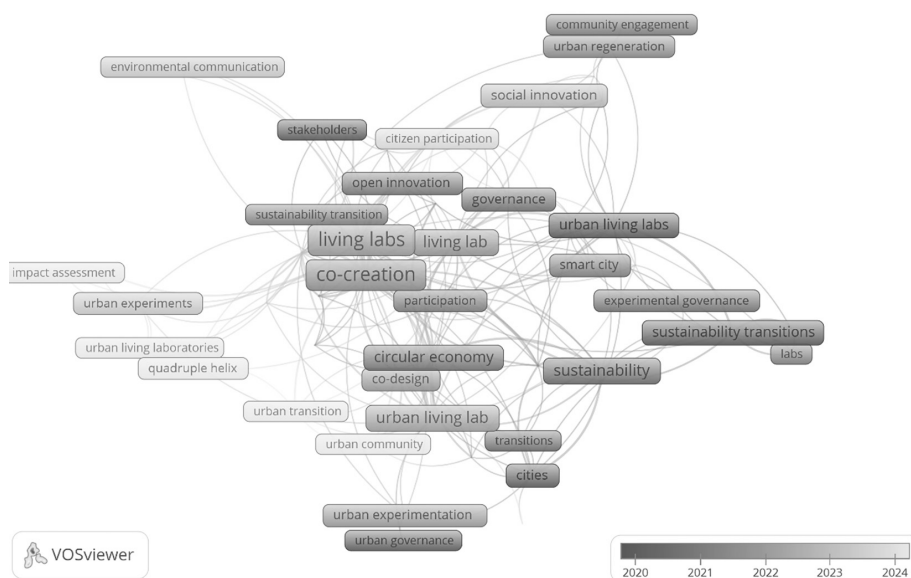


Source: Authors' own elaboration.

## 2.6 Keyword Co-occurrence and Cluster Analysis

To deepen the understanding of conceptual patterns emerging from the selected studies, a co-occurrence analysis of author keywords was conducted using VOSviewer. From the 77 retained articles, a total of 360 unique keywords were extracted. Applying a minimum occurrence threshold of two, 56 keywords met the criteria and were included in the analysis. The resulting semantic network, illustrated in Figure 2, identified ten thematic clusters that offer a structured analytical framework for organizing the literature and understanding the key conceptual dimensions of Living Lab research.

**Figure 2.** Keyword co-occurrence network generated with VOSviewer, illustrating ten thematic clusters that structure the conceptual landscape of Living Lab research



Source: Authors' own elaboration.

The co-occurrence analysis of keywords reveals ten interconnected thematic clusters that map the conceptual landscape of Living Lab research. At the core lies the urban and institutional embedding of Living Labs, where concepts such as collaboration, governance, and sustainability reflect their role as experimental platforms within smart cities and public innovation ecosystems. This is closely linked to their function as adaptive governance tools anchored in municipal structures. A second thematic dimension emphasizes learning and scaling processes, where frameworks such as impact assessment, the quadruple helix, and urban experiments highlight the iterative nature of knowledge co-production and policy refinement. In parallel, Living Labs emerge as catalysts for economic and social innovation, promoting circular economies, co-design, and urban transitions that respond to local development challenges. Reinforcing their participatory nature, another cluster points to democrat-



ic governance practices, with terms like citizen participation and stakeholder engagement underlining their inclusiveness and legitimacy. The spatial dimension is further elaborated through place-based experimentation, as Living Labs adapt to community needs and urban regeneration efforts. Additional clusters explore their institutional architecture, particularly the role of collaborative and multi-level governance in coordinating diverse actors and sustaining innovation. A transdisciplinary perspective complements this, recognizing Living Labs as hybrid spaces that merge pragmatic intervention with systemic learning across disciplines. Methodological concerns are also evident, with emphasis on tools such as interpretive structural modelling and structured experimentation to guide participatory processes and policy evaluation. Finally, a distinctive cluster emphasizes the role of Living Labs in connecting scientific research with societal needs through citizen science and inclusive forms of knowledge co-production. Altogether, these clusters portray Living Labs as complex, context-sensitive instruments for innovation, capable of simultaneously addressing urban challenges, fostering societal engagement, and reshaping governance through co-creative, evidence-based practices.

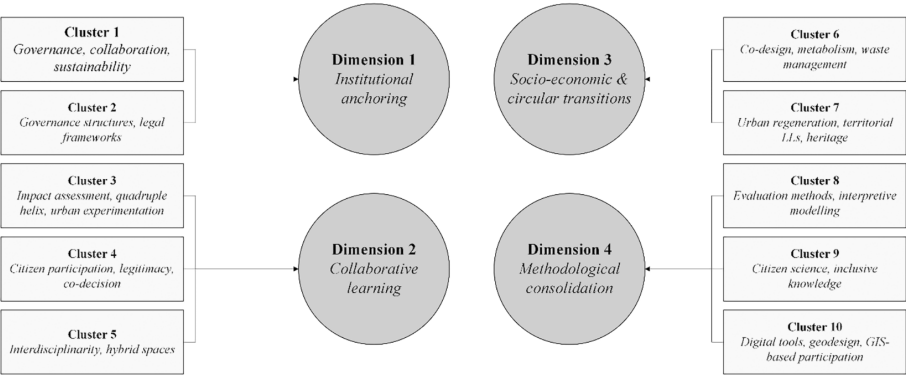
## **2.7 From Keyword Clusters to Governance Dimensions**

To move from descriptive co-occurrence clusters to an interpretive governance framework, a structured sense-making procedure was applied. The ten clusters generated through VOSviewer (Figure 2) were first reviewed independently by two coders with expertise in governance and policy analysis. Each cluster was provisionally assigned to one of four overarching mechanisms identified in the state-of-the-art literature: (i) institutional anchoring (Westerlund, Leminen, and Habib, 2018; Scholl and Kemp, 2016), (ii) collaborative learning (McCrory et al., 2020; Bhatta, Vreugdenhil, and Slinger, 2025a), (iii) socio-economic and circular transitions (Amenta et al., 2019; Obersteg et al., 2020), and (iv) methodological consolidation (Broekema, Bulder, and Horlings, 2023; Sarabi et al., 2021).

In the second step, coders compared and reconciled their classifications through iterative discussion, producing a consensual mapping of the ten clusters into four governance dimensions. This process ensured that no empirical content was lost: all ten clusters are presented descriptively in the Results section, while their aggregation into four dimensions forms the analytical lens developed in the Analysis section. This procedure follows best practices in systematic reviews, where inductive clustering is combined with deductive theoretical anchoring to enhance transparency and comparability across studies. This approach allowed us to move beyond descriptive mapping and to generate an integrated governance-oriented framework, which constitutes the main conceptual contribution of this review.

The outcome of this procedure is summarized in Figure 3, which visualizes the mapping of the ten keyword clusters into four governance-oriented dimensions.

**Figure 3.** Mapping of the ten keyword clusters into four governance-oriented dimensions of Living Lab research in EU contexts



Source: Authors' own elaboration.

3 Results

The keyword co-occurrence analysis of the 77 eligible studies generated a semantic network of ten thematic clusters, each representing a distinct but interconnected strand of Living Lab scholarship within the European Union. These clusters reveal how the literature has evolved from localized case studies toward a complex research landscape structured around governance, learning, circularity, participation, methodological sophistication, and digital innovation.

The first cluster highlights the institutional embedding of Living Labs in smart-city governance frameworks. Keywords such as governance, collaboration, and sustainability dominate this group, reflecting how municipal structures integrate experimental methods into urban policy-making. Early studies in cities such as Amsterdam, Helsinki, and Barcelona demonstrated that policy impact depends less on technological novelty and more on the density of cross-sectoral collaboration (Bulkeley et al., 2016; Bifulco et al., 2017; Voytenko et al., 2016). These findings underline the centrality of institutional anchoring in ensuring that Living Labs transcend isolated pilot status.

A second cluster emphasizes learning and scaling processes, with keywords including impact assessment, quadruple helix, and urban experimentation. This stream of literature conceptualizes Living Labs as arenas for iterative knowledge co-production and organizational learning. Frameworks such as the Living Lab Learning Framework (Bhatta et al., 2025a) illustrate how capacities are built across individual, organizational, and systemic levels, while follow-up studies identify pathways through which experimental insights become embedded into policy structures (Bhatta et al., 2025b; Fuglsang and Hansen, 2022).

The third cluster captures the role of Living Labs in circular economy transitions. Terms such as co-design, metabolism, and waste management domi-

nate this group, underscoring the relevance of LLs as catalysts of systemic innovation in urban sustainability. Projects such as REPAiR and related initiatives in Hamburg and Ghent show how participatory experimentation can translate European waste directives into neighborhood-specific planning scenarios and policy indicators (Amenta et al., 2019; Obersteg et al., 2020; Acke et al., 2020).

A fourth cluster is oriented toward democratic governance and stakeholder participation. Keywords such as citizen participation, legitimacy, and co-decision point to the political dimension of Living Labs as sites of power redistribution and democratic renewal. Studies stress that LLs can only achieve legitimacy when participation is inclusive and when decision-making authority is effectively shared with citizens (Eneqvist et al., 2022; Campos and Marin-Gonzalez, 2023).

The fifth cluster focuses on place-based experimentation and territorial anchoring, where the spatial dimension of LLs shapes both design and outcomes. Literature on urban regeneration and territorial living labs highlights how local identities, cultural heritage, and rural–urban linkages condition experimental trajectories and policy uptake (Falanga and Nunes, 2021; Oedl-Wieser et al., 2020). This perspective situates Living Labs as embedded infrastructures that mediate between place-specific needs and broader policy frameworks.

The sixth cluster examines collaborative and multi-level governance architectures, reflecting how institutional design and legal frameworks determine the sustainability of Living Labs. Here, the focus is on coordination mechanisms, contractual arrangements, and risk allocation between municipalities, private actors, and civil society. Research shows that the degree of legal formalization and political oversight directly influences both legitimacy and long-term viability (Voorwinden et al., 2023; Mukhtar-Landgren, 2021).

The seventh cluster identifies the transdisciplinary character of Living Labs, with keywords such as co-production, interdisciplinarity, and hybrid spaces. These studies conceptualize LLs as knowledge infrastructures that connect academic, civic, and professional perspectives, producing both pragmatic interventions and systemic learning (Brons et al., 2022; Kalinauskaite et al., 2021). The emphasis lies on LLs as hybrid arenas where knowledge integration fosters transformative capacity.

The eighth cluster addresses methodological innovation and evaluation frameworks. Literature in this group advances tools such as interpretive structural modelling, structured experimentation, and narrative analysis to assess co-creation processes and outcomes. Rather than focusing solely on outputs, these approaches evaluate the quality of interactions, learning dynamics, and governance transformations enabled by LLs (Sarabi et al., 2021; Broekema et al., 2023).

The ninth cluster explores citizen science and inclusive knowledge production, extending the participatory scope of Living Labs into environmental monitoring and civic epistemologies. By incorporating citizens as co-research-

ers, these initiatives democratize data production and expand legitimacy in governance processes (Slingerland and Overdiek, 2023).

Finally, the tenth cluster highlights the role of digital and geodesign toolkits in hybridizing spatial simulation with participatory dialogue. These studies emphasize how GIS-based visualization and digital negotiation platforms accelerate consensus-building and translate abstract scenarios into actionable policies (Arciniegas et al., 2019; Furlan et al., 2024).

Taken together, these ten clusters provide a comprehensive map of the conceptual terrain of Living Lab research in the EU context. They illustrate the field's diversity, ranging from institutional and participatory perspectives to circular transitions, methodological refinement, and digital innovation. This descriptive mapping lays the empirical foundation for the subsequent analysis, where the clusters are aggregated into four overarching governance dimensions that clarify how Living Labs function as infrastructures for experimental governance and policy innovation.

The ten clusters reported above constitute the descriptive outcomes of the co-occurrence analysis (Results). In the next section (Analysis), we interpret these clusters through the two state-of-the-art anchors, integrating case evidence to derive four governance-oriented dimensions: institutional anchoring (A), collaborative learning (B), socio-economic/circular transitions (C), and methodological consolidation (D).

## 4 Analysis

### 4.1 Collaborative Governance and the Urban-Institutional Anchoring of Living Labs

Initially emerging in Northern Europe as arenas for user-centred innovation, Living Labs (LLs) rapidly evolved into instruments for smart-city governance and evidence-based policymaking. This transformation, driven by municipal actors, reflects the integration of experimental methods into urban administrative routines (Bulkeley et al., 2016; Munteanu et al., 2024; Voytenko et al., 2016). Comparative studies in Amsterdam, Helsinki, and Barcelona have demonstrated that the policy impact of LLs depends less on the novelty of technologies and more on the density and quality of cross-sectoral collaboration (Bifulco et al., 2017), indicating the centrality of institutional embedding.

Nevertheless, as the concept proliferated across Europe, its meaning became diluted. Arias et al. (2025), analysing 95 cases, found that only 15% conformed to the canonical criteria of co-creation, testing, knowledge exchange, and real-life experimentation. Nearly half operated in controlled environments that marginalised citizen agency, illustrating a "semantic drift" that enables conventional testbeds or showcase pilots to adopt the LL label without participatory substance (Wehrmann et al., 2023).

This dilution is often associated with imbalances of power within LL configurations. Backhaus and John (2025) identify three archetypes - optimizers, tailors, and co-creators – highlighting that only the latter meaningfully redistribute decision-making authority beyond technical experts. In the CLEVER Cities programme, nine Urban Living Labs (ULLs) in London, Milan, and Hamburg progressed through three stages - partnership formation, governance modelling, and institutional consolidation – allowing for a gradual expansion of citizen influence over agenda-setting (Bradley et al., 2022). Trust-building, as shown in South Thamesmead, required intermediaries and “safe contact points” before residents transitioned from consultation to co-decision-making (Bradley and Mahmoud, 2024). However, the Swedish cases of Stockholm and Göteborg reveal an ongoing tension between the demand for quick, visible outcomes and the slower deliberative processes that confer democratic legitimacy; in the absence of strong political oversight, such labs risk bypassing public scrutiny (Eneqvist et al., 2022).

The relevance of LLs is especially pronounced when they are designed to address social justice issues. Energy-justice laboratories in Manchester, Metsovo, and Nyírbátor demonstrate that the success of energy retrofitting projects depended not merely on technical fixes, but on “intermediation of justice” by facilitators who aligned technical interventions with residents’ rights and recognition (Bouzarovski et al., 2023). A similar conclusion emerges from Campos and Marin-Gonzalez (2023), who show that LLs incorporating Responsible Innovation principles – anticipation, reflexivity, inclusiveness, and responsiveness - are better equipped to prevent socio-technical conflicts.

The territorial and spatial anchoring of Living Labs significantly shapes their ability to influence policy outcomes. In Hamburg-Altona, a circular economy LL managed to translate European waste directives into neighbourhood-specific planning scenarios, but only by aligning its experimental outputs with statutory governance frameworks through coordinated multi-level mechanisms (Obersteg et al., 2020). Similarly, Ghent’s bio-waste LL succeeded in promoting behavioural change and redefining performance metrics, yet this impact materialised only after its outcomes were formally validated within the Flemish Vision 2050 strategy (Acke et al., 2020). These cases highlight an important condition for the effectiveness of LLs: their integration into established institutional structures that can absorb and legitimise innovation. Indeed, as Stan and Tasente (2023) argue, the capacity of public actors to foster transparency and engage meaningfully with citizens through digital communication is contingent upon the extent to which such practices are supported by stable governance arrangements and embedded routines. This reinforces the view that LLs yield sustainable impact not merely through experimentation, but through their alignment with broader systems of accountability and decision-making.

Empirical validation of these patterns is offered by Dignum et al. (2020), who conducted a meta-analysis of 520 urban experiments across Europe. Their findings confirm that factors such as network density, existing intersectoral collaborations, and supportive political climates play an essential role in de-

termining whether LLs deliver incremental improvements or support more transformative change.

Transnational, peri-urban, and rural–urban configurations introduce further complexity. The REPAiR labs in Naples and Amsterdam exemplify how district-level territorial anchoring and community identity can enhance adherence to circular economy principles (Amenta et al., 2019). By contrast, Madrid’s seven ULLs, although aligned with the Spanish Urban Agenda, lacked both citizen engagement and political uptake, limiting their systemic impact (Diaz-Sarachaga and Sanchez-Canete, 2024). At the rural–urban interface, territorial LLs in Styrian municipalities highlight the importance of flexible horizontal coordination to avoid reinforcing centre–periphery hierarchies (Oedl-Wieser et al., 2020).

Beyond spatial and participatory dimensions, the legal-institutional infrastructure of LLs proves critical for their long-term sustainability. Voorwinden et al. (2023), analysing four smart-city LLs in Amsterdam, show how varying degrees of contractual formalisation shape risk allocation, stability, and the evolving role of municipalities – as both regulators and co-investors – raising dilemmas of compliance and legitimacy. This perspective is deepened by Llanccce et al. (2025), whose research on Rotterdam’s climate-resilient infrastructure identifies 19 governance factors – ranging from human capacity and finance to culture and communication – that determine whether pilot projects outlive their funding cycles. In Sweden, legal rigidity in smart-city initiatives has curtailed local autonomy and shifted LL experimentation toward technocratic goals (Mukhtar-Landgren, 2021). However, when municipalities assume active roles – as innovators or mediators – LLs are more likely to gain social legitimacy and upscaling potential (Mukhtar-Landgren et al., 2019).

Taken together, these findings underscore that the legitimacy and effectiveness of Living Labs rest on three foundational pillars: clear role allocation among actors, equitable power-sharing mechanisms, and robust institutional embedding. When these criteria are fulfilled, LLs can transcend their experimental status and act as constitutional devices that renegotiate the social contract of urban governance. In their absence, LLs risk reducing citizens to passive “beta-testers,” while innovation remains confined to peripheral demonstration zones.

#### **4.2 Collaborative Learning, Democratic Legitimacy and Citizen Participation**

Beyond their institutional anchoring, Living Labs (LLs) are increasingly conceptualized in the literature as educational arenas where actors acquire new skills, reframe problems, and co-produce shared imaginaries. Drawing from constructivist and transformative learning theories, Bhatta et al. (2025a) develop a Living Lab Learning Framework that categorizes learning by type (content, capacity, network), process (intentional vs. incidental), and level (individual, team, organizational). Applying this framework to a water governance

project, they trace improvements in systems thinking and policy deliberation. A follow-up study identifies seven post hoc learning pathways - from knowledge integration to institutional norm change - emerging from a climate adaptation lab (Bhatta et al., 2025b).

These theoretical insights are supported by empirical studies emphasizing the value of experiential learning and informal storytelling in co-creative nature-based LLs. Aniche et al. (2024) find that exposure to real-life contexts and openness to local narratives are key predictors of successful engagement. In Hamburg's CLEVER Lab, sustained participation across phases was facilitated by clearly defined institutional structures, credible local facilitators, and methods adapted to civic literacy levels (Arlati et al., 2021). Knowledge continuity also plays a pivotal role: in Turin's proGireg Lab, the long-term viability of green corridors depended on community ownership, leadership stability, and shared responsibility (Battisti et al., 2024). A comparative survey of public-sector LLs reveals that a balance of process learning, bounded experimentation, and genuine democratic engagement yields the most transformative results (Fuglsang and Hansen, 2022).

At the core of these dynamics lies trust. Dupont et al. (2019), using the Cocon Trust Matrix, show that transparency, reciprocity, and recognition of actors' contributions prevent superficial or tokenistic participation. Brons et al. (2022) distinguish between two complementary LL modes: embedded laboratories rooted in everyday routines (breadth) and reflective spaces that generate critical foresight (depth). Sequencing these dimensions supports equitable stakeholder engagement, particularly in food system transitions. Istanbul's Edible City projects further illustrate how informal environments, empathic facilitation, and flexible governance structures nurture creativity and strengthen ownership (Massari et al., 2023). Similar participatory mechanisms have been reported in coastal regions, where trust was built through shared environmental awareness and strong place-based identities (Aivaz and Vancea, 2009; Stan et al., 2021).

LLs do not only foster skill-building but also reshape collective meaning-making processes. Longitudinal research in Rotterdam's Carnisse neighborhood demonstrates how the Resilience Lab co-produced a renewed sense of place through symbolic reinterpretation, visionary storytelling, and reimagined human-environment relations (Frantzeskaki et al., 2018, 2019). In Lisbon, the ROCK Lab mobilized cultural heritage in marginalized districts, but only when memory work was institutionally anchored and aligned with social cohesion strategies (Falanga and Nunes, 2021). In Barcelona, the Library Living Lab transformed a conventional public library into a co-creation hub through challenge-action-return cycles, fostering civic empowerment (Vilarino et al., 2018). Similarly, dream-based visioning exercises in Swedish mobility labs enabled participants to resist path dependency by unlocking new aspirational frames (Ebbesson, 2022).

Yet inclusivity is far from guaranteed. The FIT4FOOD2030 project, which involved 25 LLs across Europe, exposed four persistent design dilemmas: rep-

resentation vs. deliberation, diversity vs. directionality, marginal vs. dominant actor dynamics, and challenges in defining participatory boundaries (Kok et al., 2021). Kalinauskaite et al. (2021) respond by proposing a transdisciplinary collaboration framework that emphasizes joint goal-setting, clearly defined roles, and iterative feedback loops to overcome fragmentation. In South-Eastern Europe, Belgrade's NbS Lab shows how multi-level translation between niche innovation, urban regimes, and political landscapes is essential for inclusive participation (Mitic-Radulovic and Lalovic, 2021). Similar tensions are reported in Catalonia's smart-city LLs, where citizens engage in slow "power banking" to rebalance institutional dominance (Nguyen et al., 2022). University-anchored LLs offer a promising alternative: the EPIC-WE hubs, for instance, integrate students, cultural institutions, and creative industries, simultaneously enhancing legitimacy and innovation (Norgard and Holflod, 2025).

Learning processes yield systemic impact only when integrated into formal policy cycles. Ehnert (2025) documents how Dresden's City of the Future lab reoriented public officials from top-down planners to facilitators of change, but only after learning outcomes were strategically embedded into municipal structures. Nordic experiments on autonomous buses underscore that process documentation, decision-maker engagement, and reflexive evaluation are key to scaling lessons beyond the pilot phase (Muur and Karo, 2023). This is echoed in platforms from Rotterdam, Leuven, and Malmö, which foster institutional change by aligning design, learning, and governance capacities (Rehm et al., 2021). These findings are further supported by evidence from consultations with students in urban planning and related disciplines, who associate hands-on, community-based learning with more active involvement in public life and increased trust in institutions (Stan et al., 2023). Additional insights from participatory urban planning reveal that meaningful citizen engagement emerges especially when public consultations enable the articulation of concerns related to green spaces, cultural identity, and procedural legitimacy - suggesting that democratic learning is most effective when institutions acknowledge and integrate community priorities into planning frameworks (Slave et al., 2023).

Conversely, in the absence of deeper institutional integration, Living Labs tend to result in limited learning outcomes. In the Swedish case studies, including the Uddevalla Living Lab, collaborative efforts generated individual-level insights but fell short of triggering broader organizational or systemic change, largely due to the disconnect between voluntary engagement and formal planning structures (Pettersson et al., 2018).

Institutional capacity proves essential. Freiburg's e-mobility lab required a mix of technological expertise, participatory facilitation, risk management, and reflexive learning; failure in any area stalled progress (Teko and Lah, 2022). In Allgäu, a tourism-focused LL relied on continuous feedback loops to balance resident needs with destination development strategies (Thees et al., 2020). Some labs even go beyond anthropocentric participation. Biodiversity sensing labs incorporate plants and animals as epistemic actors, broadening



both the scope and legitimacy of environmental monitoring (Slingerland and Overdiek, 2023). When there are no clear mechanisms to integrate outcomes into existing institutional structures, Living Labs risk remaining ethereal and temporary initiatives, lacking the capacity to generate concrete results or long-term sustainable change (Soeiro, 2021).

### **4.3 Socio-Economic Innovation, Circular Transitions and Rural–Urban Convergence**

A third stream of research frames Living Labs (LLs) as key enablers of systemic transitions across critical sectors such as waste management, water, energy, mobility, and food. This perspective emphasizes the role of LLs not just as experimental zones, but as embedded infrastructures capable of guiding complex socio-technical change. The REPAiR project exemplifies this approach, integrating the Geodesign Decision Support Environment into regional labs that visualized the spatial impact of waste flows and facilitated the co-design of circular land-use scenarios (Arciniegas et al., 2019). The labs in Naples and Amsterdam, through cycles of co-exploration and co-governance, showed that meaningful collaboration between experts and citizens can generate enforceable strategies for regenerating degraded wastescapes (Amenta et al., 2019). Hamburg’s circular-economy lab highlighted the need for continuous multi-level negotiation to align land-use planning with resource metabolism (Obersteg et al., 2020), while Ghent’s bio-waste lab reframed policy indicators to reflect lifecycle thinking (Acke et al., 2020).

In response to crisis conditions, LLs have also demonstrated rapid prototyping capacities. The FURNISH project, developed during the COVID-19 lockdown, deployed mobile urban elements and used an iterative LOOP Scheme to monitor their spatial and social impacts (Aquilue et al., 2021). Berlin’s Sustainable Living Lab applied urban design thinking to co-create last-mile cycling logistics hubs, showing that early-stage end-user engagement reduces resistance to adoption (Alexandrakis, 2021). Similarly, Freiburg’s e-mobility labs conducted capacity-needs assessments to synchronise training programmes with infrastructural investments (Teko and Lah, 2022). Pilot initiatives such as Munich’s City2Share, Barcelona’s Superblocks, and Austria’s Digibus Koppl reveal five discursive strategies – from quick wins to momentum-building narratives – that justify project continuation even in the absence of immediate quantitative outcomes (Jung and Wentland, 2024).

The integration of participatory digital tools is another key strength. Participatory geodesign in Amsterdam, Hamburg, and Naples demonstrated how combining spatial simulation with stakeholder dialogue can yield strategies that balance ambition with feasibility (Furlan et al., 2024). In Greece, Karditsa’s regional energy lab successfully aligned spatial concepts, business models, and community alliances, reinforcing that integrated planning outperforms siloed sectoral approaches (Giannouli et al., 2018). In Lucca, food policy labs bridged rural–urban divides by envisioning peri-urban agricultural

parks, highlighting that systemic change depends on policy coherence and multi-scalar partnerships (Galli et al., 2024).

In this regard, agroecological LLs in Italy, the Netherlands, and the United Kingdom operate as transdisciplinary platforms for rethinking food systems. These labs facilitate sustained collaboration among farmers, researchers, NGOs, and local governments through participatory activities such as workshops, collaborative mapping, and knowledge-sharing processes. By connecting grassroots knowledge with scientific and policy frameworks, they foster context-specific, inclusive solutions aimed at ecological resilience and food sovereignty (Rastorgueva et al., 2025).

LLs have also been pivotal in the logistics sector. Gatta et al. (2017) combine desk research, participatory engagement, and simulation modelling to design urban freight policies that reflect behavioral, financial, and operational constraints. A comparative study of cycling innovation in four European cities identifies 16 recurring dilemmas - ranging from vision alignment to monitoring limitations – and concludes that reflexive governance and clear scale-up pathways are essential for LL success (van Waes et al., 2021). Nordic pilots with autonomous buses further show that technical viability is insufficient without institutional learning infrastructures (Muur and Karo, 2023), while studies of Swedish mobility interventions reveal that economic nudges often fail without supportive urban design (Sjoman et al., 2020).

Cultural and heritage-led labs introduce an additional dimension of socio-spatial justice. In Split, a regional LL reconciled post-pandemic tourism with sustainability by promoting low-volume, high-value cultural routes and treating heritage authenticity as a form of economic capital. A Mediterranean comparative analysis confirms that resilience in cultural LLs requires agenda co-definition among small operators, local authorities, and residents (Mandic et al., 2025). In Salerno, the “Hack the City” initiative gamified heritage revitalization through micro-interventions and co-created cultural indicators that localized the broader vision of the New European Bauhaus (Cerreta et al., 2021). Meanwhile, Bremen’s biodiversity lab mainstreams more-than-human sensing by positioning plants and insects as co-researchers, thereby reframing urban ecosystem governance (Slingerland and Overdiek, 2023).

However, the question of scaling remains a persistent challenge. The Edible City Solutions initiative, across cities like Andernach, Berlin, Oslo, and Rotterdam, proposes five complementary scaling modes – scaling up, deep, wide, across, and soft – demonstrating that long-term success depends on policy integration and dedicated funding streams (Plassnig et al., 2022). Survey-based research in six European capitals shows that LLs with direct access to decision-making levers are significantly more impactful than peripheral demonstrators (Prendeville et al., 2018). A typology of institutional ecosystems for climate resilience identifies community-decentralized and hybrid-partnerial models as the most adaptive, provided financing strategies are diversified and context-responsive (Llancce et al., 2025). On the commercial side, Med-Tech Living Labs illustrate four collaboration archetypes – exploration, incuba-

tor, integrator, and impact – mapping the trajectory from research to market while underscoring the need for alignment between technological maturity and market demand (Saad and Agogue, 2024).

In sum, socio-economic perspectives position Living Labs as transitional nodes that translate circular, mobility, energy, and cultural aspirations into territorially grounded innovation trajectories. Their effectiveness depends on integrative design methodologies, multi-level governance alignment, adaptive financing mechanisms, and strategic pathways for upscaling. These findings are further supported by the recent techno-ecological model proposed by Kerboua et al., (2025), which demonstrates that transitioning from uncontrolled landfilling to energy recovery can reduce greenhouse gas emissions by up to 99.87%, while simultaneously generating electrical power.

#### **4.4 Methodological Consolidation and Transdisciplinary Evaluation**

The rapid proliferation of Living Labs (LLs) has prompted an equally urgent need for methodological consolidation. Responding to this, DeLosRios-White et al. (2020) propose the *Life-Cycle Co-Creation Process* - a cyclical framework encompassing five iterative phases: *Co-Explore*, *Co-Design*, *Co-Experiment*, *Co-Implement*, and *Co-Manage*. This model serves as a procedural blueprint for nature-based urban interventions. Complementing this, Broekema et al. (2023) advanced a process-oriented evaluation method that moves beyond output metrics by analysing narrative dynamics, actor configurations, and emergent learning. They caution that a “tick-box exercise” approach to co-creation risks undermining the legitimacy of EU-funded social innovation programmes.

To reduce conceptual ambiguity, several taxonomic efforts have emerged. McCrory et al. (2020) introduce a classification of four LL families - Living, Transition, Real-World, and Innovation Labs - subsequently extended into six functional modes ranging from Fix and Control to Explore and Shape (McCrory et al., 2022). Westerlund et al. (2018) offer a platform-based typology based on whether the lab focuses on products, services, processes, or policies, warning that unstructured diversity can lead to evaluative confusion. In a related vein, City-Lab research distinguishes policy-oriented labs from technology-driven ones, suggesting that success in the former should be measured through governance transformation rather than prototype adoption (Scholl and Kemp, 2016).

New analytical methodologies further refine the understanding of co-creation dynamics. Using Interpretive Structural Modelling (ISM), Sarabi et al. (2021) map causal hierarchies across 15 co-creation factors in nature-based LLs, identifying local learning and openness to informal contributions as systemic drivers. A systemic barrier model applied in Tampere, Eindhoven, and Genoa reveals that institutional capacity deficits are a key constraint in mainstreaming nature-based solutions. To avoid elite capture by technical actors, Zingraff-Hamed et al. (2020) introduce an actor-mapping framework that cat-

egorizes stakeholders into four distinct roles: initiators, facilitators, influencers, and beneficiaries.

Digital tools play a central role in today's hybrid LL methodologies. Geodesign exemplifies digital–dialogic hybridity by combining GIS-based visualization with stakeholder negotiation, accelerating consensus-building and enabling tangible planning outcomes (Arciniegas et al., 2019; Furlan et al., 2024). In higher education, digital platforms similarly function as infrastructural enablers of innovation and participation, facilitating institutional change and stakeholder engagement (Du et al., 2023).

In parallel, data collaboratives emerging from Dutch city deals illustrate how co-governed data sharing requires clear legal frameworks addressing privacy, access, and accountability (Ruijter, 2021). Expanding the epistemic toolkit, “more-than-human citizen sensing” incorporates plants and insects as legitimate contributors to urban knowledge systems (Slingerland and Overdiek, 2023). Within the cultural domain, the Play ReCH project combines gamification, participatory mapping, and design thinking to co-create locally validated monitoring indicators (Cerreia et al., 2021).

However, methodological sophistication does not automatically translate into institutional uptake. University networks such as Italy's RUS demonstrate that campus-based LLs can model SDG-oriented governance, but only if their findings are integrated into strategic institutional planning (Marchigiani and Garofolo, 2023). Comparative research between Dutch and Indonesian LLs highlights that performance criteria - such as co-creation depth, public impact, and financial sustainability - must be calibrated to local contexts (Witteveen et al., 2023). These findings reinforce the need for digitally competent administrations capable of leveraging citizen feedback and social media platforms for policy learning and adaptive governance (Stan and Taseuțe, 2024).

In rural contexts, socio-ecological LLs require long-term institutional infrastructures beyond project-based cycles. The integration of Theory of Change workshops into groundwater governance initiatives across Italy, Greece, Tunisia, and Turkey has proven to be an effective model for institutional continuity (Ceseracciu et al., 2025). Moreover, transition typologies suggest that “empower-and-govern” and “explore-and-shape” models demand flexible funding schemes and iterative evaluation to avoid reabsorption by dominant regimes (McCrory et al., 2022).

Taken together, these methodological advances converge on three foundational pillars for the next generation of Living Labs: cyclical evaluation, explicit taxonomy, and hybrid digital–participatory toolkits. Standardizing these elements is essential to prevent semantic drift and ensure that LLs contribute verifiably to public sector innovation.

## 5 Discussion

The results of this review demonstrate that Living Labs in the European Union cannot be understood solely as experimental spaces or pilot projects; rather, they must be framed as dynamic infrastructures of governance that connect actors, resources, and institutional logics. In this sense, the four governance-oriented dimensions distilled from the co-occurrence analysis—institutional anchoring, collaborative learning, socio-economic and circular transitions, and methodological consolidation—advance the conceptual field by showing how Living Labs evolve beyond isolated initiatives and acquire systemic relevance.

From a theoretical perspective, these findings refine existing typologies. Previous studies distinguished between product-, service-, process- and policy-oriented labs (Westerlund et al., 2018; Scholl and Kemp, 2016) or classified them according to their role in transitions (McCrory et al., 2020; 2022). Our synthesis contributes by demonstrating that the *effectiveness* of these categories depends on governance conditions. For example, policy-oriented labs are impactful only when they are institutionally embedded, legally recognized, and supported by political accountability. Without such conditions, the promise of co-creation risks collapsing into what Wehrmann et al. (2023) call “semantic drift,” where the Living Lab label is applied without substantive participatory substance. Thus, this review does not merely reproduce existing classifications but reinterprets them through the lens of governance infrastructures.

The analysis also illuminates how Living Labs recalibrate democratic legitimacy. While inclusivity is frequently claimed, genuine participation remains uneven. Studies reviewed here indicate that trust-building, procedural fairness, and recognition of citizen agency are decisive for moving from consultation toward co-decision (Bradley et al., 2022; Campos and Marin-Gonzalez, 2023). These insights align with frameworks of responsible innovation, which stress anticipation, reflexivity, and responsiveness (Owen et al., 2013), but they extend them by emphasizing the institutional routines that enable trust to be embedded in governance systems. In this respect, Living Labs should not be seen as parallel arenas to formal policymaking, but as boundary infrastructures that strengthen democratic accountability within existing institutions.

The socio-economic and circular transitions dimension further clarifies the role of LLs in addressing systemic challenges. Projects such as REPAiR or CLEVER Cities demonstrate that Living Labs can translate abstract sustainability goals into territorial grounded strategies (Amenta et al., 2019; Obersteg et al., 2020). Yet, the evidence also reveals that circular pilots remain vulnerable when policy alignment and financing are absent. Here, our contribution to the state of the art lies in demonstrating that systemic impact arises not from the novelty of tools—be they GIS, geodesign, or participatory mapping—but from their integration into multi-level governance architectures that ensure continuity beyond project cycles.

Equally important is the recognition that methodological diversity, while often celebrated, has generated fragmentation. The clusters identified in this review show that evaluation approaches vary from interpretive modelling (Sarabi et al., 2021) to narrative analysis (Broekema et al., 2023), with little convergence. This lack of consolidation impedes comparative research and policy learning. By foregrounding methodological consolidation as a governance dimension, our review moves beyond descriptive cataloguing and calls for standardized reporting criteria that capture co-creation depth, learning outputs, and scale-up trajectories. Such criteria would help to preserve analytical clarity and prevent the Living Lab concept from becoming a diffuse metaphor.

Taken together, these findings have three implications. First, they reframe Living Labs as *evolving governance ecologies* rather than static models of innovation delivery. Their value lies not in isolated outputs, but in their ability to connect experimental practices to institutional norms, thereby shaping the capacity of public administrations to act under conditions of uncertainty and contestation. Second, they show that democratization within Living Labs is not automatic; it requires explicit mechanisms for redistributing power, establishing procedural fairness, and embedding trust. Third, they underscore that methodological rigour is a political issue: without standardized evaluation, Living Labs risk serving as symbolic showcases rather than engines of systemic change.

For practitioners, the discussion highlights several managerial lessons. Municipalities and funders should move beyond “pilotism” and ensure that Living Labs are structurally linked to decision-making routines. This requires legal frameworks (sandbox clauses, contractual clarity), long-term financing strategies, and dedicated roles for intermediaries who facilitate trust and translation. It also requires that scaling is planned as a multi-modal process—scaling up, deep, wide, across, and soft—so that experiments do not remain isolated but diffuse their impact across governance layers. Finally, digital tools should be deployed not merely for efficiency, but for democratization, ensuring that technological infrastructures expand rather than restrict participation.

In summary, this discussion positions Living Labs as infrastructures for governance innovation in the EU context. By linking our empirical clusters to established typologies and transition theories, we demonstrate how LLs contribute to recalibrating institutions, fostering democratic learning, and enabling systemic transitions. This interpretive framework advances the state of the art by moving beyond descriptive accounts and by proposing a governance-oriented model that clarifies both the promises and the limits of Living Labs in contemporary public administration.

## 6 Conclusion

The systematic review of Living Labs (LLs) within the European Union governance context reveals that their transformative potential cannot be assumed based on format alone. While Living Labs are frequently presented as inno-

vative arenas for co-creation and public experimentation, their actual impact depends on how deeply they are embedded in institutional structures, how effectively they distribute agency, and how consistently they facilitate long-term learning across governance layers.

What emerges most clearly is that LLs function not as standalone interventions, but as boundary infrastructures - interfaces through which institutions, citizens, and knowledge systems are reconfigured. Their contribution to public sector innovation stems from the extent to which they are integrated into formal decision-making routines, regulatory frameworks, and institutional memory. Labs that remain disconnected from these systems, even when methodologically sophisticated, tend to remain marginal or symbolic.

Participation within LLs remains a contested and uneven practice. Many initiatives claim inclusivity and co-creation yet fail to establish procedural mechanisms that shift the locus of decision-making beyond technical or administrative actors. Genuine collaboration is often undermined by tokenistic consultation formats and unaddressed power asymmetries. The review shows that only those configurations that explicitly enable shared ownership, iterative feedback, and the institutionalization of trust dynamics succeed in generating democratic legitimacy.

The spatial and territorial positioning of LLs significantly influences their effectiveness. Labs situated within well-connected governance ecosystems – with existing intersectoral partnerships and adaptive policy cultures - are more likely to evolve into catalysts for systemic change. In contrast, projects isolated from political uptake or implemented through rigid institutional logics frequently result in stalled innovation, regardless of their local relevance.

As LLs expand into peri-urban, rural, and transnational domains, the necessity of context-sensitive design becomes increasingly apparent. Flexible governance architectures and participatory tools that adapt to local conditions - notably through co-design, narrative-based engagement, and transdisciplinary mediation - are crucial to navigating the complexity of multi-scalar transitions. Where such tools are absent, LLs risk reproducing existing inequalities or reinforcing centre-periphery divides.

A major challenge lies in the methodological landscape of LL research itself. Although numerous frameworks and typologies exist, their adoption remains fragmented, and comparative insights are often impeded by the absence of standardized reporting criteria. Methodological consolidation is not merely a technical need - it is essential to ensure that the LL concept retains analytical clarity and evaluative integrity. Without this, the risk of conceptual inflation remains high, and so too the danger of policy misuse.

The hybrid character of LLs - spanning digital infrastructure, civic facilitation, and institutional experimentation - introduces both strengths and vulnerabilities. Digital tools can support transparency, dialogue, and scenario-building, but can also marginalize participants without technological access or fluency.

The effective governance of LLs thus requires not only technical sophistication, but sustained investment in civic literacy and epistemic pluralism.

From a theoretical standpoint, the review invites a shift in how LLs are framed - not as fixed models of innovation delivery, but as evolving governance ecologies. They should be assessed based on their capacity to recalibrate administrative norms, bridge fragmented knowledge regimes, and support adaptive institutions capable of responding to complexity and contestation. This repositioning situates LLs within broader trajectories of democratic governance renewal and sustainability transition.

The future relevance of Living Labs will depend on how convincingly they can be institutionalized without losing their experimental vitality; how meaningfully they can democratize the production of knowledge and policy; and how responsibly they can navigate the tensions between openness, accountability, and innovation. Only under such conditions can LLs serve not as symbolic containers, but as generative spaces where new forms of collective intelligence and governance take root.

## **7 Limitations and Future Research Directions**

Despite its systematic scope, this review is constrained by several structural limitations inherent to the Living Lab literature. A major challenge stems from the lack of standardized methodologies for defining, documenting, and evaluating Living Labs across different institutional and territorial contexts. The heterogeneity of conceptual frameworks – often varying between technological, participatory, and policy-driven interpretations – complicates both comparative analysis and cumulative knowledge building. Furthermore, the absence of consistent reporting standards across case studies limits the ability to assess depth of co-creation, governance integration, or long-term policy impact. While the co-occurrence analysis provides a structured overview of thematic clusters, it does not substitute for a critical appraisal of the quality or replicability of individual studies. Future research should prioritize the development of harmonized evaluation metrics, longitudinal monitoring of LL outcomes, and cross-national typologies that account for local policy ecosystems. Advancing the field requires not only conceptual synthesis but also institutional mechanisms for methodological convergence.



## References

- Acke, A., Taelman, S. E., and Dewulf, J. (2020). A multi-stakeholder and interdisciplinary approach to waste management and circular economy: The case of Flanders and Ghent, Belgium. *European Spatial Research and Policy*, 27(2), pp. 43–57. <https://doi.org/10.18778/1231-1952.27.2.04>
- Aivaz, K. A., and Vancea, D. P. C. (2009). A study of the Black Sea tourism companies efficiency using envelope techniques. *Transformations in Business and Economics*, 8(3), pp. 217–230.
- Alexandrakis, J. (2021). Cycling towards sustainability: The transformative potential of urban design thinking in a sustainable living lab. *Transportation Research Interdisciplinary Perspectives*, 9, p. 100269. <https://doi.org/10.1016/j.trip.2020.100269>
- Amenta, L. et al. (2019). Managing the transition towards circular metabolism: Living labs as a co-creation approach. *Urban Planning*, 4(3), pp. 5–18. <https://doi.org/10.17645/up.v4i3.2170>
- Aniche, L. Q. et al. (2024). Boosting co-creation of nature-based solutions within living labs: Interrelating enablers using interpretive structural modelling. *Environmental Science and Policy*, 161, p. 103873. <https://doi.org/10.1016/j.envsci.2024.103873>
- Aquilue, I. et al. (2021). A methodology for assessing the impact of living labs on urban design: The case of the FURNISH project. *Sustainability*, 13(8), p. 4562. <https://doi.org/10.3390/su13084562>
- Arciniegas, G. et al. (2019). A geodesign decision support environment for integrating management of resource flows in spatial planning. *Urban Planning*, 4(3), pp. 32–51. <https://doi.org/10.17645/up.v4i3.2173>
- Arias, A. et al. (2025). Application of living lab concept: Where, how and for what is being used in Europe to support energy, social and environmental transition. *Sustainability*, 17(6), p. 2727. <https://doi.org/10.3390/su17062727>
- Arlati, A. et al. (2021). Stakeholder participation in the planning and design of nature-based solutions. Insights from CLEVER Cities project in Hamburg. *Sustainability*, 13(5), p. 2572. <https://doi.org/10.3390/su13052572>
- Backhaus, J., and John, S. (2025). Generalization as local and translocal embedding: Interrogating governance and deconstructing democratization in living labs. *Sustainability: Science, Practice and Policy*, 21(1), p. 2450856. <https://doi.org/10.1080/15487733.2025.2450856>
- Battisti, L., Cuomo, F., and Manganelli, A. (2024). Collaborative governance arrangements: What makes nature-based solutions endure? *Territory, Politics, Governance*. <https://doi.org/10.1080/21622671.2024.2355317>
- Bhatta, A., Vreugdenhil, H., and Slinger, J. (2025a). Harvesting living labs outcomes through learning pathways. *Current Research in Environmental Sustainability*, 9, p. 100277. <https://doi.org/10.1016/j.crsust.2024.100277>
- Bhatta, A., Vreugdenhil, H., and Slinger, J. (2025b). A living lab learning framework rooted in learning theories. *Environmental Impact Assessment Review*, 114, p. 107894. <https://doi.org/10.1016/j.eiar.2025.107894>
- Bifulco, F., Tregua, M., and Amitrano, C. C. (2017). Co-governing smart cities through living labs. Top evidences from EU. *Transylvanian Review of Administrative Sciences*(50E), pp. 21–37. <https://doi.org/10.24193/tras.2017.0002>

- Bouzarovski, S. et al. (2023). Energy justice intermediaries: Living Labs in the low-carbon transformation. *Local Environment*, 28(12), pp. 1534–1551. <https://doi.org/10.1080/13549839.2023.2238747>
- Bradley, S., and Mahmoud, I. H. (2024). Strategies for co-creation and co-governance in urban contexts: Building trust in local communities with limited social structures. *Urban Science*, 8(1), pp. 9. <https://doi.org/10.3390/urbansci8010009>
- Bradley, S., Mahmoud, I. H., and Arlati, A. (2022). Integrated collaborative governance approaches towards urban transformation: Experiences from the CLEVER Cities project. *Sustainability*, 14(23), p. 15566. <https://doi.org/10.3390/su142315566>
- Broekema, P. M., Bulder, E. A. M., and Horlings, L. G. (2023). Evaluating co-creation in social innovation projects: Towards a process orientated framework for EU projects and beyond. *Research Evaluation*, 32(2), pp. 286–298. <https://doi.org/10.1093/reseval/rvad017>
- Brons, A. et al. (2022). A tale of two labs: Rethinking urban living labs for advancing citizen engagement in food system transformations. *Cities*, 123, p. 103552. <https://doi.org/10.1016/j.cities.2021.103552>
- Bulkeley, H. et al. (2016). Urban living labs: Governing urban sustainability transitions. *Current Opinion in Environmental Sustainability*, 22, pp. 13–17. <https://doi.org/10.1016/j.cosust.2017.02.003>
- Campos, I., and Marin-Gonzalez, E. (2023). Renewable energy living labs through the lenses of responsible innovation: Building an inclusive, reflexive, and sustainable energy transition. *Journal of Responsible Innovation*, 10(1). <https://doi.org/10.1080/23299460.2023.2213145>
- Cerreta, M. et al. (2021). Triggering active communities for cultural creative cities: The “Hack the City” play ReCH mission in the Salerno historic centre (Italy). *Sustainability*, 13(21), p. 11877. <https://doi.org/10.3390/su132111877>
- Ceseracciu, C. et al. (2025). Innovative governance for sustainable management of Mediterranean coastal aquifers: Evidence from Sustain-COAST living labs. *Environmental Science and Policy*, 167, p. 104038. <https://doi.org/10.1016/j.envsci.2025.104038>
- DeLosRios-White, M. I. et al. (2020). Mapping the life cycle co-creation process of nature-based solutions for urban climate change adaptation. *Resources*, 9(4), p. 39. <https://doi.org/10.3390/resources9040039>
- Diaz-Sarachaga, J. M., and Sanchez-Canete, F. J. M. (2024). Boosting the Spanish Urban Agenda through urban living labs: The case study of Madrid. *Sustainable Development*, 32(5), pp. 5019–5030. <https://doi.org/10.1002/sd.2950>
- Dignum, M. et al. (2020). Nurturing nature: Exploring socio-spatial conditions for urban experimentation. *Environmental Innovation and Societal Transitions*, 34, pp. 7–25. <https://doi.org/10.1016/j.eist.2019.11.010>
- Du, R., Grigorescu, A., and Aivaz, K.-A. (2023). Higher educational institutions’ digital transformation and the roles of digital platform capability and psychology in innovation performance after COVID-19. *Sustainability*, 15(16), p. 12646. <https://doi.org/10.3390/su151612646>
- Dupont, L. et al. (2019). Living lab as a support to trust for co-creation of value: Application to the consumer energy market. *Journal of Innovation Economics and Management*, 28, pp. 53–78. <https://doi.org/10.3917/jie.028.0053>

- Ebbesson, E. (2022). Towards a co-creation framework based on citizens' dreams of future mobility. *Transportation Research Interdisciplinary Perspectives*, 16, p. 100686. <https://doi.org/10.1016/j.trip.2022.100686>
- Ehnert, F. (2025). Sustainability transitions as contextual reconfiguration: Governance innovation through local experimentation. *Earth System Governance*, 23, p. 100237. <https://doi.org/10.1016/j.esg.2025.100237>
- Eneqvist, E. et al. (2022). Legitimacy in municipal experimental governance: Questioning the public good in urban innovation practices. *European Planning Studies*, 30(8), pp. 1596–1614. <https://doi.org/10.1080/09654313.2021.2015749>
- Falanga, R., and Nunes, M. C. (2021). Tackling urban disparities through participatory culture-led urban regeneration. Insights from Lisbon. *Land Use Policy*, 108, p. 105478. <https://doi.org/10.1016/j.landusepol.2021.105478>
- Frantzeskaki, N. et al. (2019). Nature-based solutions for urban climate change adaptation: Linking science, policy, and practice communities for evidence-based decision-making. *BioScience*, 69(6), pp. 455–466. <https://doi.org/10.1093/biosci/biz042>
- Frantzeskaki, N., van Steenbergen, F., and Stedman, R. C. (2018). Sense of place and experimentation in urban sustainability transitions: The resilience lab in Carnisse, Rotterdam, the Netherlands. *Sustainability Science*, 13(4), pp. 1045–1059. <https://doi.org/10.1007/s11625-018-0562-5>
- Fuglsang, L., and Hansen, A. V. (2022). Framing improvements of public innovation in a living lab context: Processual learning, restrained space and democratic engagement. *Research Policy*, 51(1), p. 104390. <https://doi.org/10.1016/j.respol.2021.104390>
- Furlan, C. et al. (2024). Exploring a geodesign approach for circular economy transition of cities and regions: Three European cases. *Cities*, 149, p. 104930. <https://doi.org/10.1016/j.cities.2024.104930>
- Galli, F. et al. (2024). Integrating local food policies and spatial planning to enhance food systems and rural-urban links: A living lab experiment. *Land*, 13(12), p. 2014. <https://doi.org/10.3390/land13122014>
- Gatta, V., Marcucci, E., and Le Pira, M. (2017). Smart urban freight planning process: Integrating desk, living lab and modelling approaches in decision-making. *European Transport Research Review*, 9(3), p. 32. <https://doi.org/10.1007/s12544-017-0245-9>
- Giannouli, I. et al. (2018). A methodological approach for holistic energy planning using the living lab concept: The case of the prefecture of Karditsa. *European Journal of Environmental Sciences*, 8(1), pp. 14–22. <https://doi.org/10.14712/23361964.2018.3>
- Haddaway, N. R. et al. (2022). PRISMA2020: An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. *Campbell Systematic Reviews*, 18(2), e1230. <https://doi.org/10.1002/cl2.1230>
- Jung, M., and Wentland, A. (2024). Beyond scalable impacts: Roles of mobility experiments in local transition governance. *GAIA – Ecological Perspectives for Science and Society*, 33(1, SI), pp. 80–86. <https://doi.org/10.14512/gaia.33.S1.12>
- Kalinauskaite, I. et al. (2021). Facing societal challenges in living labs: Towards a conceptual framework to facilitate transdisciplinary collaborations. *Sustainability*, 13(2), p. 614. <https://doi.org/10.3390/su13020614>

- Kerboua, K. et al. (2025). A Techno-Ecological Transformative Approach of Municipal Solid Waste Landfill in Upper-Middle-Income Countries Based on Energy Recovery. *Sustainability*, 17(4), Article 4. <https://doi.org/10.3390/su17041479>
- Kok, K. P. W. et al. (2021). Unraveling the politics of ‘doing inclusion’ in transdisciplinarity for sustainable transformation. *Sustainability Science*, 16(6), pp. 1811–1826. <https://doi.org/10.1007/s11625-021-01033-7>
- Llanccce, A. O. et al. (2025). From silos to synergy: Conceptualizing an integrated infrastructure design for climate resilience in Rotterdam. *Climate Risk Management*, 47, p. 100691. <https://doi.org/10.1016/j.crm.2025.100691>
- Mandic, A., Petric, L., and Pivcevic, S. (2025). Harmonizing sustainability and resilience in post-crisis cultural tourism: Stakeholder insights from the Split metropolitan area living lab. *Tourism Management Perspectives*, 55, p. 101331. <https://doi.org/10.1016/j.tmp.2024.101331>
- Marchigiani, E., and Garofolo, I. (2023). Italian universities for territorial sustainable development and responsible communities – The case study of the University of Trieste. *Sustainability*, 15(3), p. 2325. <https://doi.org/10.3390/su15032325>
- Massari, S. et al. (2023). Co-creativity in living labs: Fostering creativity in co-creation processes to transform food systems. *JCOM – Journal of Science Communication*, 22(3), A03. <https://doi.org/10.22323/2.22030203>
- McCrory, G. et al. (2022). Sustainability-oriented labs in transitions: An empirically grounded typology. *Environmental Innovation and Societal Transitions*, 43, pp. 99–117. <https://doi.org/10.1016/j.eist.2022.03.004>
- McCrory, G. et al. (2020). Sustainability-oriented labs in real-world contexts: An exploratory review. *Journal of Cleaner Production*, 277, p. 123202. <https://doi.org/10.1016/j.jclepro.2020.123202>
- Menny, M., Palgan, Y. V., and McCormick, K. (2018). Urban living labs and the role of users in co-creation. *GAIA – Ecological Perspectives for Science and Society*, 27(1), pp. 68–77. <https://doi.org/10.14512/gaia.27.S1.14>
- Mitic-Radulovic, A., and Lalovic, K. (2021). Multi-level perspective on sustainability transition towards nature-based solutions and co-creation in urban planning of Belgrade, Serbia. *Sustainability*, 13(14), p. 7576. <https://doi.org/10.3390/su13147576>
- Mukhtar-Landgren, D. (2021). Local autonomy in temporary organizations: The case of smart city pilots. *Administration and Society*, 53(10), pp. 1485–1511. <https://doi.org/10.1177/00953997211009884>
- Mukhtar-Landgren, D. et al. (2019). Municipalities as enablers in urban experimentation. *Journal of Environmental Policy and Planning*, 21(6), pp. 718–733. <https://doi.org/10.1080/1523908X.2019.1672525>
- Munteanu, I. et al. (2024). Corruption perceptions in the Schengen Zone and their relation to education, economic performance, and governance. *PLOS ONE*, 19(7), e0301424. <https://doi.org/10.1371/journal.pone.0301424>
- Muur, J., and Karo, E. (2023). Learning from public sector innovation pilots: The case of autonomous bus pilots. *Innovation: The European Journal of Social Science Research*. <https://doi.org/10.1080/13511610.2023.2286438>
- Nguyen, H. T., Marques, P., and Benneworth, P. (2022). Living labs: Challenging and changing the smart city power relations? *Technological Forecasting and Social Change*, 183, p. 121866. <https://doi.org/10.1016/j.techfore.2022.121866>

- Norgard, R. T., and Holflod, K. (2025). Meeting in the middle: Cultural co-creation, transformative partnerships, and ecosystems for public good. *Educational Philosophy and Theory*, 57(2, SI), pp. 112–127. <https://doi.org/10.1080/00131857.2024.2384722>
- Obersteg, A., Arlati, A., and Knieling, J. (2020). Making cities circular: Experiences from the Living Lab Hamburg-Altona. *European Spatial Research and Policy*, 27(2), pp. 59–77. <https://doi.org/10.18778/1231-1952.27.2.05>
- Oedl-Wieser, T. et al. (2020). Formal and informal governance arrangements to boost sustainable and inclusive rural-urban synergies: An analysis of the metropolitan area of Styria. *Sustainability*, 12(24), p. 10637. <https://doi.org/10.3390/su122410637>
- Owen, R., Bessant, J., and Heintz, M. (Eds.). (2013). *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*. John Wiley and Sons. <https://doi.org/10.1002/9781118551424>
- Pettersson, F., Westerdahl, S., and Hansson, J. (2018). Learning through collaboration in the Swedish public transport sector? Co-production through guidelines and living labs. *Research in Transportation Economics*, 69(SI), pp. 394–401. <https://doi.org/10.1016/j.retrec.2018.07.010>
- Plassnig, S. N. et al. (2022). Successful scaling of Edible City Solutions to promote food citizenship and sustainability in food system transitions. *Frontiers in Sustainable Cities*, 4, p. 1032836. <https://doi.org/10.3389/frsc.2022.1032836>
- Prendeville, S., Cherim, E., and Bocken, N. (2018). Circular cities: Mapping six cities in transition. *Environmental Innovation and Societal Transitions*, 26, pp. 171–194. <https://doi.org/10.1016/j.eist.2017.03.002>
- Rastorgueva, N. et al. (2025). Agroecological living labs as entry points for transition towards sustainable food systems: A novel framework for the evaluation of living labs at different scales. *Agroecology and Sustainable Food Systems*. <https://doi.org/10.1080/21683565.2025.2477215>
- Rehm, S.-V., McLoughlin, S., and Maccani, G. (2021). Experimentation platforms as bridges to urban sustainability. *Smart Cities*, 4(2), pp. 569–587. <https://doi.org/10.3390/smartcities4020030>
- Ruijter, E. (2021). Designing and implementing data collaboratives: A governance perspective. *Government Information Quarterly*, 38(4), p. 101612. <https://doi.org/10.1016/j.giq.2021.101612>
- Saad, E. A., and Agogue, M. (2024). Living labs in science-industry collaborations: Roles, design, and application patterns. *Technovation*, 135, p. 103066. <https://doi.org/10.1016/j.technovation.2024.103066>
- Sarabi, S. et al. (2021). Barriers to the adoption of urban living labs for NBS implementation: A systemic perspective. *Sustainability*, 13(23), p. 13276. <https://doi.org/10.3390/su132313276>
- Scholl, C., and Kemp, R. (2016). City labs as vehicles for innovation in urban planning processes. *Urban Planning*, 1(4), pp. 89–102. <https://doi.org/10.17645/up.v1i4.749>
- Sjoman, M., Ringenson, T., and Kramers, A. (2020). Exploring everyday mobility in a living lab based on economic interventions. *European Transport Research Review*, 12(1), p. 5. <https://doi.org/10.1186/s12544-019-0392-2>
- Slave, A. R. et al. (2023). Assessing public opinion using self-organizing maps. Lessons from urban planning in Romania. *Landscape and Urban Planning*, 231, p. 104641. <https://doi.org/10.1016/j.landurbplan.2022.104641>

- Slingerland, G., and Overdiek, A. (2023). Beyond human sensors: More-than-human citizen sensing in biodiversity urban living labs. In *Proceedings of the 11th International Conference on Communities and Technologies – Humanization of Digital Technologies*, pp. 27–38. <https://doi.org/10.1145/3593743.3593753>
- Soeiro, D. (2021). Smart cities and innovative governance systems: A reflection on urban living labs and action research. *Fennia – International Journal of Geography*, 199(1), pp. 104–112. <https://doi.org/10.11143/fennia.97054>
- Stan, M.-I., Aivaz, K.-A., Vintilă, D.-F., and Lonițiu, L. (2021). Assessing the perception of stakeholders regarding the impact of coastal tourism on the environment in the Romanian Black Sea coastal area. *Journal of Eastern European and Central Asian Research*, 8(4), pp. 628–639. <https://doi.org/10.15549/jeecar.v8i4.695>
- Stan, M.-I., and Tasente, T. (2023). Examining information, consultation, and communication in Romanian local public administrations within the online sphere: A case study of Constanta and Cluj-Napoca. *Revista de Comunicaci3n de la SEECI*, 56, pp. 357–376.
- Stan, M.-I., and Tasente, T. (2024). Citizen-centric smart cities: Empowering public administration through social media and citizen engagement. *Hrvatska i Komparativna Javna Uprava*, 23(4), pp. 529–558. <https://doi.org/10.31297/hkju.23.4.5>
- Stan, M.-I., Ţenea, D.-D., Vintilă, D.-F., and TaseŃe, T. (2023). Curricular relevance and workforce preparedness: Student perspectives on practical experiences in urban planning and construction courses. *Studies in Business and Economics*, 18(3), pp. 261–280. <https://doi.org/10.2478/sbe-2023-0058>
- Teko, E., and Lah, O. (2022). Capacity needs assessment in transport innovation living labs: The case of an innovative e-mobility project. *Frontiers in Future Transportation*, 3, p. 799505. <https://doi.org/10.3389/ffutr.2022.799505>
- Thees, H. et al. (2020). The living lab as a tool to promote residents' participation in destination governance. *Sustainability*, 12(3), p. 1120. <https://doi.org/10.3390/su12031120>
- van Waes, A., Nikolaeva, A., and Raven, R. (2021). Challenges and dilemmas in strategic urban experimentation: An analysis of four cycling innovation living labs. *Technological Forecasting and Social Change*, 172, p. 121004. <https://doi.org/10.1016/j.techfore.2021.121004>
- Vilarino, F., Karatzas, D., and Valcarce, A. (2018). The Library Living Lab: A collaborative innovation model for public libraries. *Technology Innovation Management Review*, 8(12), pp. 17–25. <https://doi.org/10.22215/timreview/1202>
- Voorwinden, A., van Bueren, E., and Verhoef, L. (2023). Experimenting with collaboration in the smart city: Legal and governance structures of urban living labs. *Government Information Quarterly*, 40(4), p. 101875. <https://doi.org/10.1016/j.giq.2023.101875>
- Voytenko, Y. et al. (2016). Urban living labs for sustainability and low carbon cities in Europe: Towards a research agenda. *Journal of Cleaner Production*, 123, pp. 45–54. <https://doi.org/10.1016/j.jclepro.2015.08.053>
- Wehrmann, C., Pentzold, C., Rothe, I., and Bischof, A. (2023). Introduction: Living labs under construction. *JCOM – Journal of Science Communication*, 22(3), p. 22030501. <https://doi.org/10.22323/2.22030501>

- Westerlund, M., Leminen, S., and Habib, C. (2018). Key constructs and a definition of living labs as innovation platforms. *Technology Innovation Management Review*, 8(12), pp. 51–62. <https://doi.org/10.22215/timreview/1205>
- Witteveen, L. et al. (2023). Reflecting on four living labs in the Netherlands and Indonesia: A perspective on performance, public engagement and participation. *JCOM – Journal of Science Communication*, 22(3). <https://doi.org/10.22323/2.22030201>
- Zingraff-Hamed, A. et al. (2020). Stakeholder mapping to co-create nature-based solutions: Who is on board? *Sustainability*, 12(20), p. 8625. <https://doi.org/10.3390/su12208625>