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Impacts of urban living labs on sustainability transitions: mechanisms and strategies for systemic change through experimentation

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ABSTRACT

Urban Living Labs (ULL) are considered spaces to facilitate experimentation about sustainability solutions. ULL represent sites that allow different urban actors to design, test and learn from socio-technical innovations. However, despite their recent proliferation in the European policy sphere, the underlying processes through which ULL might be able to generate and diffuse new socio-technical configurations beyond their immediate boundaries have been largely disregarded and it remains to be examined how they contribute to urban sustainability transitions. With this study, we contribute to a better understanding of the diffusion mechanisms and strategies through which ULL (seek to) create a wider impact using the conceptual lens of transition studies. The mechanisms of diffusion are investigated in four distinct ULL in Rotterdam, the Netherlands and Malmö, Sweden. The empirical results indicate six specific strategies that aim to support the diffusion of innovations and know-how developed within ULL to a broader context: transformative place-making, activating network partners, replication of lab structure, education and training, stimulating entrepreneurial growth and narratives of impact.

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1. Introduction

Experimentation has become a key concept for the governance of sustainability transitions (Kuhlmann & Rip, 2014; Loorbach, 2007; Sengers, Wieczorek, & Raven, 2016). The call to find new ways of addressing grand societal challenges such as climate change, resource degradation or ageing society has become louder in politics and academia (OECD, 2015; Schot & Steinmueller, 2016). Research on sustainability transitions has shown that these challenges require system innovation, i.e. deep-structural changes of the socio-technical configurations underlying the respective sectors (Markard, Raven, & Truffer, 2012; Van Den Bergh, Truffer, & Kallis, 2011). It is commonly argued that

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technological innovation or system optimization alone is not enough, but that socio-technical innovations are necessary that affect markets, practices, cultures and policies alike. The general assumption is that transformative change requires current entrenched socio-technical configurations to be de-institutionalized and new ones to be created and diffused. As a consequence, it is claimed that conventional policy interventions, such as R&D investments or targeted subsidies, will most likely not suffice to initiate and foster sustainability transitions. Instead, we need new ways of governing transformative change. In this context, research has increasingly pointed to the importance of experimentation. Scholars call for governance that is built around ‘provisional, flexible, revisable, dynamic and open approaches that include experimentation, learning, reflexivity and reversibility’ (Kuhlmann & Rip, 2014).

One specific type of experimental intervention that has gotten increasing attention recently are urban living labs (ULL) (Evans, Karvonen, & Raven, 2016; Voytenko, McCormick, Evans, & Schliwa, 2016). ULL represent sites in cities that allow stakeholders to design, test and learn from socio-technical innovations in real time. Participation, experimentation and learning are put centre stage. The urban arena is thereby considered to be of particular importance (Bulkeley, Castán, Hodson, & Marvin, 2011; Frantzeskaki, Castan-Broto, Coenen, & Loorbach, 2017; Wolfram & Frantzeskaki, 2016). On the one hand, cities worldwide face some of the most pressing sustainability challenges regarding energy consumption, air and water pollution, urbanization and livability in general and have started to design and deploy localized responses to address these transformative pressures (McCormick, Anderberg, Coenen, & Neij, 2013). On the other hand, latest research has pointed to the importance of cities in transition processes arguing that urban areas may contain the necessary resources, spaces as well as interconnectedness of various sectors and actors that will enable innovation (Frantzeskaki et al., 2017; Wolfram & Frantzeskaki, 2016). ULL combine both, an urban location as well as a focus on experimentation.

However, despite their recent proliferation in the policy sphere (Steen & van Bueren, 2017), it is still largely unstudied whether and how interventions through ULL contribute to sustainability transitions; what is the distinctiveness of ULL as a means of governing sustainability transitions? A particularly crucial aspect concerns the mainstreaming of solutions and know-how, i.e. the institutionalization of a new, potentially more sustainable socio-technical configuration. This begs the question: how do ULL affect broader system change?

Literature in transition studies has discussed various processes through which experiments can have an impact beyond their own boundaries. These include, for instance, processes such as embedding of experiments in local structures, horizontal diffusion through translation or vertical diffusion through internal upscaling of experiments. However, the intentional strategies and practices that enable such processes have not yet been specified. Do ULL have specific strategies in place to initiate a wider impact and if yes, how do they manifest themselves? Through what kind of practices, such as for instance networking, symbolic use of artifacts, lobbying, cultural practices, business models, etc. are processes of diffusion enabled? This paper takes up these questions and investigates if and how four different ULL in two cities (Malmö, Sweden and Rotterdam and the Netherlands) intend to impact wider sustainability transitions.

The paper continues as follows. In Section 2, we review relevant literature in the realm of sustainability transitions as well as urban studies with a specific focus on the role of

experimentation for transformative, systemic change, in particular, also in regard to questions of diffusion and institutionalization of their respective outcomes. Section 3 describes our method and gives an overview of our four cases. In Section 4, we present our results, which are subsequently discussed in chapter five. We conclude with a summary of the insights of this paper and offer ideas for future research.

2. Theory

To accelerate transformative change, sustainability transition approaches emphasize the importance of purposive experimentation, often in the context of socio-technical niches (Kemp, Schot, & Hoogma, 1998; Raven, 2005). The rationale for such experiments is to provide a vehicle for the ‘translation’ of long-term visions and socio-technical pathways into more short-term and concrete action and practices (Karvonen & van Heur, 2014). Experimentation refers to collective search and exploration processes in which a broad suite of stakeholders like firms, universities and actors from government and civil society are navigating, negotiating (and ideally) reducing uncertainty about new socio-technical innovations through real-world experiments, gaining knowledge and experience along the way in an iterative learning-by-doing and doing-by-learning iterative process (Ansell & Bartenberger, 2016).

Understandings of what is meant by urban experiments, though, go beyond a socio-technical focus and are increasingly concerned with and seen as a strategy of urban governance. Particularly, in response to climate change, cities are increasingly experimenting with ‘purposive interventions designed to respond to the imperative for climate change responses in the city, and with a more or less explicit attempt to innovate, learn or gain experience’ (Bulkeley & Castán Broto, 2013, p. 362). Such governance experiments serve to reconfigure capacities, resources and agency of actors in urban contexts (Bulkeley et al., 2016; Bulkeley & Betsill, 2013; Bulkeley & Castán Broto, 2013; McGuirk, Dowling, Brennan, & Bulkeley, 2015). By providing a space to negotiate problem definitions and understandings, claims to resources, authority or dominant ideologies, experiments restructure the local institutions and through that have the potential to contribute to deep-structural change, i.e. sustainability transitions (Hodson, Geels, & McMeekin, 2017).

A standing assumption regarding experimentation is that it is possible, or even desirable, to scale up from an individual local niche experiment to achieve broader system change (Geels, Hekkert, & Jacobsson, 2008). However, Evans et al. (2016), for instance, warn against black-boxing the complexity of such change by simplistically referring to a linear suit of processes of trialing, learning and rolling out (Brown & Vergragt, 2008 and Pesch, 2015). Rather, they suggest that ‘focusing on experiments directs attention to the specific social and material context in which urban change is embedded and through which it literally “takes place” (Evans et al., 2016, p. 4). At the same time, such celebration of place-specificity runs the risk of treating each and every experiment as idiosyncratic with little scope nor insight about which lessons can be drawn from specific, often local experiments and applied more broadly (Hansen & Coenen, 2017). In this context, the literature on grassroots innovations suggests that community action draws directly on contextualized knowledge and implies a better ‘fit’ of solutions compared to top-down targets and procedures (Frantzeskaki et al., 2016). Grassroots groups have

experience and knowledge about what works in their localities, and what matters to local people. They can be well placed to present sustainability issues in ways more meaningful, personal and directly relevant, and which ‘goes with the grain of people’s lives’ (Seyfang & Smith, 2007, p. 593). Conversely, the literature on policy mobilities highlights the ‘local globalness’ of policy transfer (McCann, 2008). The focus is on the global transfer of policy measures through the mobile lives and mundane practices of a particular set of individuals, including urban planners, architects, members of ‘the global consultocracy’ and other mobile knowledge workers (Sengers & Raven, 2015).

The question thus becomes whether and how place-specific experiments create an impact on a broader scale, i.e. how solutions and experiences developed in one place will diffuse more widely. Literature in the realm of sustainability transition provides various examples of processes through which experiments can have systemic effects (Bennett et al., 2016; Ehnert et al., 2018; Gorissen, Spira, Meynaerts, Valkering, & Frantzeskaki, 2017; Van den Bosch and Rotmans, 2008). We argue that there are three ideal-typical types of diffusion processes currently discussed in the literature: *embedding*, *translating* and *scaling*. We will briefly describe all of them in more detail.

The *embedding* of an experiment implies the adoption and integration of its design, approach or outcomes into existing local structures (institutions, regulations, planning) and/or communities of practice. Embedding of experiments has been studied partially in transition studies and more extensively in urban planning and governance literatures. Across these bodies of literature, there are a few commonly recognized characteristics of embedding. Heiskanen et al. (2017) refer to the deployment of outcomes of experimentation as a form of embedding, defining it as ‘processes of combining and adapting technologies, integrating them into existing structures, as well as processes of giving these technologies meaning’ (p. 2). According to their conceptualization for the embedding of experimental solutions, learning is a mediating process catalyzing knowledge creation and ‘adapting new technologies to existing regulations and infrastructures’ (p. 3). Williams (2017) aligns with this when examining the impact of urban experiments. When embedded, an experiment becomes contextualized, providing bespoke local solutions but implying trade-offs for replication in other cities or sectors. Cultural and discursive concepts from experiments are first embedded in local governance narratives, (sometimes) followed by the adoption of the design and approach of the same experiments (Williams, 2017).

Translation refers to horizontal diffusion. It addresses the process through which constitutive elements of an experiment are being replicated and reproduced elsewhere. Translation deals explicitly with changing the context of an experiment. Often this involves a different spatial context, e.g. when an experiment is replicated in a different city, but this could also involve a different organizational or institutional context, e.g. when an experiment is being replicated by different actors within the same locality. Translation of an experiment may also entail the repetition and transfer of its design and approach within and across sectors e.g. energy, water, mobility. Translation of experiments has been studied not only in transition studies but also in urban planning and evidence-based policy making literatures (Ansell & Bartenberger, 2016). Translation often involves multiple actors and actor-networks to be supported and facilitated and requires new forms of collective learning across these networks (Tsvetkova, Hellström, Gustafsson, & Sjöblom, 2015). These actors need to be willing to transfer the experiment, perceiving it

as an opportunity and fitting it to the particular ‘requirements’ and challenges in their contexts (Crowe, Foley, & Collier 2016; Tsvetkova 2015). To become effective through translation, experiments require becoming visible and exemplary at sectoral debates (Van der Heijden, 2016; Williams, 2017).

Counter to horizontal diffusion, *scaling* refers to the internal development and growth of niche experiments (Liedtke, Baedeker, Hasselkuß, Rohn, & Grinewitschus, 2015). It thus seeks to capture the ways in which an experiment becomes bigger in terms of content and remit. One could distinguish between spatial scaling (geographical growth), content scaling (extending across domains and practices), actor scaling (extending towards different partnerships and actors involved), and resource scaling (expansion of funding). Importantly, scale effects are distinct from the challenges associated with horizontal diffusion as ‘a new scale dictates establishing an entirely new set of boundaries and relations’ (Yasuda 2018, p. 26) due to fundamental differences in organizational structures and institutions (Coenen, Benneworth, & Truffer, 2012). These differences require the presence and involvement of ‘multiple stakeholders and their power positions’ for scaling (up) (Wellstead, Howlett, Nair, & Rayner, 2016, p. 54). Scaling addresses the learning processes involved in transforming knowledge, practices or technologies produced at one scale (e.g. a precinct) and making them applicable at another scale (e.g. an entire city). Van den Bosch and Rotmans (2008) have conceptualized scaling as the emergence of ‘a new or deviant constellation of cultures (e.g. values, perceptions), practices (e.g. routines, behavioral habits) and structures (e.g. institutional, physical)’, which then over time ‘attains more influence and stability and increases its share in meeting a societal need’ (p. 34). The outcomes of scaling (up) experiments from ULL then would be ‘fundamental changes in the dominant way societal needs are fulfilled, which extend the scale of the initial’ experiment (p. 34).

The different diffusion processes discussed here give some indication as to how experiments might have an impact beyond their immediate lab boundaries (Figure 1). However, the current literature largely neglects the concrete strategies and associated practices through which processes of embedding, translating or scaling are enabled and achieved. Thus, it remains unclear whether processes of embedding, translating or scaling have been intentionally organized or should be considered as unintended consequences. Such unexamined assumptions of causality are problematic for designing and governing ULL effectively (Sheldrick, Evans, & Schliwa, 2017). In this paper, we seek to further substantiate the different diffusion processes at play in a specific type of experimental setting (i.e. ULL), by investigating how they are implemented in practice. Consequently, this study was guided by the following main research question: *Through which strategies and practices do ULL seek to diffuse their socio-technical innovations and know-how beyond their immediate spatial and sectoral boundaries?*

With *strategies*, we refer to purposeful plans for action including the formulation of goals and envisioned patterns of implementation. By *practices*, we mean human activities and the way these activities are habitually performed in relation to different elements of socio-spatial contexts. In this study, we conceive practices as human activities by which the implementation of a strategy can manifest. By providing answers to the guiding research question, we aim at contributing to an analytical framework to assess the broader impact of experimentation out of ULL and settings alike.

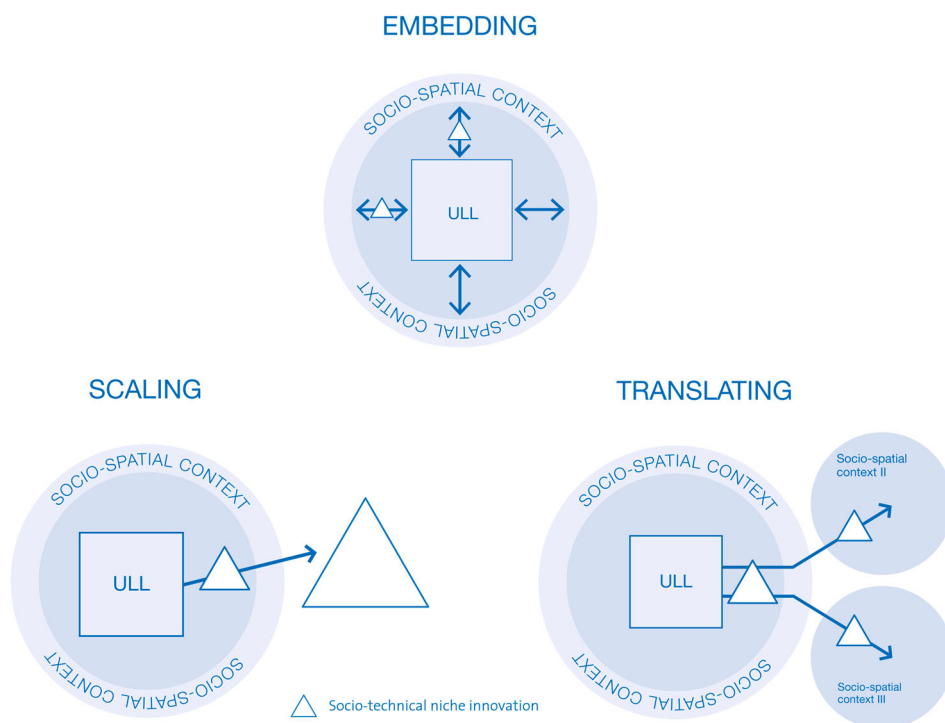


Figure 1. Three processes of diffusion between ULL and its socio-spatial contexts.

3. Method

We explored diffusion processes of ULL as an emerging phenomenon following a qualitative case study design. Such study designs are particularly appropriate to study novel phenomena in an explorative manner and to find answers to ‘how’ and ‘why’ questions (Creswell & Poth, 2017, Yin, 2014). We aimed at exploring ‘how’ experimenting with and learning from new socio-technical configurations in ULL seek to contribute to wider system change. Our analysis uncovers the strategies and practices involved in such processes (i.e. identifying actions and planned procedures intending to influence the diffusion processes from ULL).

After a thorough review of the literature in the realm of sustainability transitions, innovation studies and urban governance, we selected two case study cities with four in-depth case studies of ULL for further analysis. A multiple case study approach is appropriate when exploring and comparing different characteristics of a phenomenon (Shakir, 2002). Selecting multiple cases is supposed to increase the methodological rigour of the study through increasing the validity and robustness of the results (Miles & Huberman, 1994; Yin, 1994). Key to the methodological rigour in multiple case study research is the process of case selection, i.e. the logic of replicating cases in the study design. The literature suggests two main logics of replication, namely the literal replication and the theoretical replication (Yin, 1994). Literal replication ‘entitles choosing cases that have similar settings’ (Shakir, 2002, p. 193). The theoretical replication approach is applied when ‘cases have different settings and are expected to achieve different results’ (Shakir,

2002, p. 193). First, in this study, we followed the literal replication idea for choosing the two case cities of Rotterdam and Malmö. Second, we then applied the theoretical replication concept in order to select our ULL cases from these two cities.

The European cities of Rotterdam and Malmö show several contextual similarities with respect to our guiding research questions. Some of the key characteristics of the two cities are summarized in Table 1. Both are harbour cities of different size that had configured their local economies around traditional industry sectors (ship building, chemical industry) and trade services. When considering demographics, they show a moderate, but constant growth in population over the last decade, with Malmö being the faster-growing city. Both city populations have a high multiethnic and multicultural diversity. While 50.3% of the population of Rotterdam are of non-Dutch origins (Dutch Federal Statistical Office, 2017); about 43% of the Malmö population have a foreign background (Statistics Sweden, 2017). Rotterdam and Malmö faced a post-industrialization period that marked spaces in the city with deterioration, abandonment and need for new functions. These developments have led to substantial demands for urban regeneration and revitalization in both cities. Regeneration activities followed initially top-down planning approaches with interventions mainly for improving infrastructures (e.g. mobility options, pavements and urban furniture) that were ineffective over time in addressing

Table 1. Characteristics of the selected ULL in the cities of Rotterdam, NL and Malmö, SE.

City	Rotterdam, The Netherlands		Malmö, Sweden	
Inhabitants (2016)	629.606		328,000	
Population growth (2010–2016)	+4%		+10.1%	
City area (sqkm)	324.2		156.6	
Local Economy: Current key sectors	Logistics, Trade & Business Services, Chemical Industry, Agro Food, Health		Digital media, Clean tech, Life sciences, Logistics and Tourism	
Key sustainability governance strategies	e.g. Rotterdam Resilience Strategy, Rotterdam Climate Initiative		e.g. Malmö Comprehensive Plan for Sustainable Urban Planning; Malmö Environmental Program	
Urban Living Lab	Blue City Lab 010	Concept House Village Lab	Malmö Innovation Platform	Stapeln
Geographic location	Maasboulevard, Central Rotterdam	Heijplaat, South-West Rotterdam	South-East Malmö	Western Harbour, Malmö
Main theme	Circular Economy Entrepreneurship	Sustainable Housing and building retrofit	Renovation of housing for socio-economic development	Sustainable consumption and production
Funding scheme	Funding from private investor, rental and event space fees	Research funding (EU Interreg program)	Vinnova–Swedish Innovation Agency	Membership fees and funding from the municipality of Malmö
Running time	2015–present	2010–present	2013–present	2011–present
Actively involved partners	Private investor, entrepreneurs, start-ups	Academia, building industry, branch organizations	Local and regional government, academia, business	NGO's, local government, academia, SME's, individual activists
Leading actor	Entrepreneurs	Universities	Municipality of Malmö	NGO and activists
Weblink	Bluecity.nl	Concepthousevillage.nl	Innovationsplattform.se	Stpln.se

the changing demographic and related social needs of the residents. Over time, a policy need for new approaches found fertile ground in emerging and planned experimentation. Experiments for urban regeneration focused primarily on establishing connections between residents of the areas (social capital), surfacing social needs (Chu, 2016) and ideas for refurbishing public areas, as well as concepts for repurposing left-behind or underused infrastructure. Rotterdam and Malmö have opened up for new experimental forms of city governance and sustainable urban development. Among these recent developments, the implementation of ULL has proliferated in both cities.

However, there exist significant differences between the two cities, not only in size. While Rotterdam port is the largest port of Europe and functions as a key transit point within global logistic chains for commodities and goods, the Malmö harbour is only of regional relevance today. Instead, Malmö underwent a significant change regarding its economic activities. The large industrial sites have been replaced by a range of small and medium enterprises in knowledge-intensive and service-oriented areas such as digital media, clean tech, life sciences, logistics and tourism. Furthermore, Malmö's unique geographical location within the cross-border Öresund region also influences its prospects. The Öresund region, which comprises parts of Denmark and Sweden, has set out to become one of Europe's most competitive regions, in which cross-border collaboration and governance have shaped Malmö's perspective on its local development.

In terms of identifying ULL within the two cities, we used the theoretical replication approach. The explorative character of this study demanded for a broad sampling of ULL in different settings, expecting them to illustrate different diffusion mechanisms. Based on our research interests and the general definition of what constitutes ULL (Voytenko et al., 2016), we specified the following criteria for selecting the ULL: *Geographical contextualization* – the ULL have a physical location in Rotterdam or Malmö.¹ *Experimenting* – the ULL are constituted with the purpose of experimenting with and testing future (urban) sustainability solutions. *Learning* – about sustainability challenges is an explicit goal of the labs' operations. *Co-Design* – several actors from different societal domains actively collaborate in the ULL (e.g. knowledge institutions, private sector, civil society). *Lab themes* – the lab activities do address both, societal sustainability challenges and a particular local urban challenge (e.g. urban regeneration efforts). *Maturity* – the ULL are operating for a minimum duration of two years. *Access* – the leading actors and managing representatives of the ULL are identifiable and accessible. The aforementioned set of criteria was developed in the course of the 'Governance of Urban Sustainability Transitions' (GUST) project based on a comparative snapshot analysis of 50 ULL across Europe (Kronsell & Mukhtar-Landgren, 2018; Voytenko et al., 2016).

We have then chosen to study four lab cases with an in-depth analysis. Four cases were chosen in order to incorporate sufficient diversity and differences in the set-up and practices of ULL (e.g. key actors, particular lab themes; see Table 1) while at the same time accounting for a manageable in-depth case analysis. Following the theoretical replication approach described earlier, we then selected the ULL with different lab themes, varying actor constellations and different location characteristics in their (micro-) contexts. All ULL also differ in their main funding sources. We were aiming at illustrating the diversity in lab models while maintaining a feasibility of conducting the in-depth analysis of exploring different strategies and practices for diffusion out of ULL. The subsequent data collection and analysis included structured interviews with a minimum of two case representatives per lab. The interviews

followed a standardized guideline and lasted between 50 and 80 min. Twelve interviewees were recruited. Each of the interviewees was directly involved in setting up or actively managing one of the ULL. For each lab, at least two representatives from different actor groups (e.g. Researcher, Lab manager, Start-up entrepreneur) were interviewed to capture a plurality of perspectives on the lab related processes at work. Interviews covered the lab history, scope and distinctive characteristics. Further aspects were the type of innovation and experimentation conducted in the ULL and the collaboration among the involved lab actors and with external partners. Moreover, the interview included questions on the lab impacts, its evaluation and future development strategies. All interviews were audiotaped with the interviewees' consent and transcribed in full.

The analysis of the interview transcripts followed the template analysis technique (Crabtree & Miller, 1999; King, 2004). This technique involves defining a coding template that comprises codes representing themes identified in the data through careful reading and rereading of the text (i.e. the interview transcripts). In template analysis, codes are structured hierarchically so that the highest level codes represent broad themes in the data (e.g. 'ULL diffusion process'), while lower levels indicate more narrowly focused themes within these broad topics (e.g. 'upscaling') (King, Carroll, Newton, & Dornan, 2002). Distinct from some forms of phenomenological analysis, it is common in template analysis to define a priori themes that reflect key topics identified as particularly salient to answering the guiding research question. They often do reflect major topic areas in the structured interview guide (King et al., 2002). The initial coding for the main themes was carried out by two of the authors independently. By this, the concordances and differences in data coding between the two researchers were identified. The identified differences were subjected to further evaluations among the authors, or additional categories for a lower level code were added to the coding scheme. This procedure guaranteed a reasonable inter-coder reliability for the exploratory study design (Morse, Barrett, Mayan, Olson, & Spiers, 2002). We describe the four-selected ULL and their contextual embedding in more detail below.

3.1. BlueCity Lab 010, Rotterdam

BlueCity Lab (BCL) is a living lab in the city of Rotterdam, located at an iconic site in the former Tropicana indoor swimming pool since 2015. The purpose of BCL has been to be a platform for the Circular Economy. Being a platform for innovative approaches to enhanced material flows is established by providing spaces for co-creation and co-working, hosting (waste free) events and meetings as well as offering lectures, hack parties and space for experimentation including a real wet and dry laboratory. This living lab particularly aims at facilitating trials and demonstration projects for successful business models of the Circular Economy. As a whole, the BCL is supposed to develop into an example of the circular city of the future that has no equal yet elsewhere in the world. That means the management board and the lab entrepreneurs are enacting how a circular city would work by operating zero waste and recycle every material used within the building. This includes, among other facilities, a bar and a restaurant. The lab integrates diverse place-related functions such as recreation, food, offices, food production, meeting, and living. Within this multi-functional context, entrepreneurs develop business cases with closed-loop material flows. BCL was initiated by obtaining the building at a prominent location within the city by a private investor for the purpose of

conducting sustainability experiments. Lab operations draw on further revenues from renting out office, laboratory and event spaces. BCL is already the head office for several start-up entrepreneurs in the domain of circular economy (e.g. Rotterzwam in the food sector).

3.2. Concept House Village Lab, Rotterdam

Concept House Village Lab (CHV) is a test-bed for sustainable building technologies and new building retrofitting approaches in the Heijplaat area of the city of Rotterdam. This area was constructed in the beginning of the twentieth century for the workers of the RDM shipyard. Following the bankruptcy of the shipyard in the 1980s, this area became vacant. The old shipyard (23,000 square metres) has been renovated and two knowledge institutions were established (e.g. the University of Applied Sciences RDM campus). The arrival of the RDM Campus has blown new life into Heijplaat area, which today remains subject of several urban renewal efforts. The focus of CHV activities is not only on being a user-oriented test-environment for building practices but also for sustainable urban development. The lab offers the possibility to test and experiment with concept houses within a realistic residential setting; it is designed with a longitudinal perspective and incorporates the full construction cycle including the demolition. It is a place, where innovative houses, products and systems are tested together with and by the occupants. The occupant is seen as key in designing the development and using the houses. Two knowledge institutions, the building industry, branch organizations, the local community and at a later stage also the municipality of Rotterdam joined into an experiment of constructing and living in newly built prototype houses and of renovating some of the existing houses in a mixed-use neighbourhood. The lab now became a platform for sharing and speeding up innovations in the sustainable building sector by participating in shared education and research. Research within the living lab is conducted at three levels: urban, building and product level and is focused on three themes: usability, technical functioning and the feasibility of demolition and (re-)construction. Further information on the evolution of Concept House Village Lab is documented by Silvester et al. (2017).

3.3. Malmö Innovation Platform, Malmö

The Malmö Innovation Platform (MIP) brings together creative forces in business, academia and the community to build a joint innovation capacity in the renovation of existing apartment buildings in South-East Malmö. The platform joins key players in a partnership to focus on the renovation of the apartment buildings from the Million Homes Program (which involved the extensive construction of housing in the 1960s and 1970s in Sweden, mostly multi-story apartment buildings) as well as the associated socio-economic development of these areas. It is, therefore, a new format of addressing housing renovation and neighbourhood regeneration. The aim is to use physical regeneration as a motor for socio-economic development, long-term environmental goals and business opportunities. Much of the innovation platform concerns social learning, in a number of projects, for example about recycling, energy savings in apartments, or sharing gardening. The long-term goal of the platform is to extend the number of partnerships both formally and informally, but

more importantly to deepen the partnerships and generate more innovations. The work includes piloting and developing new technologies, new services, business concepts and local jobs. At the same time, the platform aims to lead to organizational development and better collaboration between partners. MIP is not focused on results immediately. Instead, the focus is on identifying the key questions for local, socio-economic development in Malmö and experimenting with possible solutions among the involved partners. The main leadership for the MIP is situated at the City of Malmö. At the project level, participation goes beyond the partners on the platform to encompass residents and local organizations, like schools, community groups and housing associations.

3.4. Stapeln Open Maker-Space – Malmö, Sweden

Stapeln (Stpln) is a living lab that hosts a co-working facility, a venue for performing arts, a space for exhibitions, performances and workshops and several do-it-yourself-workshops for textile printing, sewing, carpentry, digital production, bicycle service and construction, and creative reuse/recycling of waste materials from industry. It is targeted at people active within the arts, technology/innovation, design education or crafts. In most cases, one may use Stpln for free, but in return, one pays with one's time and knowledge. The building where Stpln operates is owned by the City of Malmö, which also provides financial support. The City of Malmö provides the premises for STPLN and basic financial support to cover its operations and the salaries of several employees. Stpln provides new solutions for work and leisure for all citizen groups in Malmö, which would encourage more sustainable lifestyles among citizens, enhance social cohesion, and allow for new ways of interaction, learning and exchange of skills. STPLN is a local lab initiative, placed in the new development area called Western Harbor. This area used to be the centre of the shipbuilding and automobile industry until the 1990s. Initiating Stapeln (Stpln) as a living lab in this context is considered as one effort among others in transforming and regenerating this city area. Further case information about Sspln lab can be found in Hult and Bradley (2017).

4. Results

4.1. Identified strategies and practices of ULL for impacting systemic change

In this study, we have investigated the strategies and the respective practices through which ULL engage in wider impact creation on urban sustainability transitions through processes of *embedding*, *translating* and *scaling*. By designing and implementing these strategies, ULL intend to activate the diffusion and thereby institutionalization of know-how and sustainable practices that could help to build a new socio-technical configuration and thus impact upon a sustainability transition. We report the results of our empirical analysis in two steps. We first describe the different strategies we observed that facilitated the embedding, translation or scaling of lab activities and outcomes. In a second step, we exemplify how these strategies (are planned to) play out in concrete practices. That means, we report exemplary practices by which the ULL (plan to) put the strategy into practice. Our findings are collected and summarized in Table 2.

Table 2. Strategies and exemplary practices of initiating wider sustainability transitions out of ULL.

Strategies	Embedding		Translating		Scaling	
	Transformative place-making	Activating network partners	Replication of lab structure	Education and training	Stimulating entrepreneurial growth	Narratives of impact
Exemplary Practices	<ul style="list-style-type: none"> Integrating lab in press tours of city marketing agency; providing space for local sustainability initiatives and community meetings. Create social incentives by allocating resource savings from lab experiments to local infrastructure (e.g. a school building) 	<ul style="list-style-type: none"> Actively demonstrating lab effects on social integration, knowledge exchange and creative city-making to the city administration and further partners. Practicing new local collaborations between STPLN, Malmö University and the waste water utility, for implementing up-cycling stations. 	<ul style="list-style-type: none"> Establishing an international learning network on how to replicate Blue Economy Experiments in ULL elsewhere. Observational visits and 'how to do it' meetings have initiated Spin-offs of bicycle kitchen in other Swedish cities and other countries. 	<ul style="list-style-type: none"> Implementing Lab studies in educational curricula of local knowledge institutions. Training of coordinators to set up and run 'co-labs'; collaborative spin-offs that replicate one of the lab innovations under university supervision. 	<ul style="list-style-type: none"> Supporting business models of circular economy start-ups. Flexible growth in container units and other decentralized locations. Active partnering with European business accelerator initiative to identify and upscale profitable business models. 	<ul style="list-style-type: none"> Continuously produce and discuss stories about alternative futures in line with the goals of the ULL Conducting a series of community meetings and setting the Lab activities into a 'bigger narrative'.
ULL	Blue City Lab 010, Concept House Lab Malmö Innovation Platform	Malmö Innovation Platform, Stpln Lab	Blue City Lab 010, Stpln Lab	Blue City Lab 010, Concept House Lab, Malmö Innovation Platform	Blue City Lab 010, Concept House Lab,	Blue City Lab 010, Concept House Lab, Stpln Lab
Exemplary quotes	<p>'Part of the concept is that we do everything in this iconic building. That helped these companies to be on the radar, which also helps them finding investors and clients to grow.'</p> <p>(BlueCity Lab, Lab founder)</p>	<p>'Another spin off from STPLN is the upcycling station (...), which is now developed in a new collaboration between STPLN, Malmö University and the water utility VASYD.'</p> <p>(Stpln Lab, Lab Designer & Senior Researcher)</p>	<p>'The STPLN organizational model is easy to be transferred to any geographical context, if there is an interest of actors, supporting infrastructure and access to initial funding.'</p> <p>(Stpln Lab, Lab Designer & Senior Researcher)</p>	<p>'In all our building related programs at the University of Applied Science, active work of students in the ULL is a regular part of the curriculum.'</p> <p>(Concept House Village Lab, Academic initiator/Lab manager)</p>	<p>'For impact you need scale and for scale, you need a solid business model. So we really try to be an incubator that focuses on scale.'</p> <p>(BlueCity Lab, Lab founder)</p>	<p>'(...) the habit of a radical story-telling culture to continuously produce and discuss stories about alternative futures is a means to achieve these forms of more active participation.'</p> <p>(Malmö Innovation Platform, Lab initiator, Senior Researcher)</p>

4.1.1. Embedding

4.1.1.1. Observed strategy 1: transformative place-making. This strategy refers to the socio-spatial embedding of ULL. The ULL aim at shaping place meanings and the socio-spatial identity with its activities. That means, the labs make use of urban artefacts to establish a symbolic locality of change. Becoming a location of change may entail preserving (parts of) the previous place identity and/or reframing previous place meanings while building up new place narratives but also promoting the collective benefits from the lab activities for the respective neighbourhood. This strategy intends to create visibility for the lab activities beyond its boundaries by putting the innovative and visionary character and the potential benefits of local experimenting for the socio-spatial context centre stage.

Exemplary practices: One of the practices for transformative place-making is intentionally using an iconic building for the lab activities. The BlueCity Lab in Rotterdam is a good example of this. It is situated at a prominent location within the city, in a former tropical swimming pool ('Tropicana') that was constructed with a mono-functional purpose. The indoor water park had been known citywide as a local leisure attraction for decades. An essential element of the lab development in this building was to transform the well-known, existing infrastructure into a symbol for more sustainable ways of living. Creating a circular-economy ecosystem within the Tropicana building as well as making it again accessible to the public was part of such a strategy. Making use of an iconic building helps drawing attention to the lab activities in the neighbourhood and within the whole city. In combination with outreach and participatory activities in the neighbourhood, it creates a strong visibility for the area in transformation. The interest of the neighbouring community was therefore acknowledged early-on in the labs' planning processes. Expectations and needs of community members were included into the plans to carefully adapt the building. The concept promised to retain many of the building's original features (and its inherent place memories), while carefully transferring the building into a place of innovation, collaboration and sustainability principles. Today, the lab provides space for local sustainability initiatives and community meetings. In addition, the building is also integrated into innovation tours offered by Rotterdam city marketing. City tours are organized for journalists, investors and the interested public with a specific focus on innovative places and initiatives in Rotterdam. BlueCity Lab has become a stop within these tours, which lead to national and international press coverage, which further attracted new start-ups and collaborating partners.

'The spread will be through both the building (...), it is an iconic building that can draw attention to stimulate imagination. It would be different if it would be in a new office building.' (BlueCity Lab, Board member)

A place-related practice was also reported from the MIP lab in Malmö, where place-specific, collective benefit schemes are created that promote the neighbourhood development, such as incentives to participate in an experiment on changing water and energy consumption ('Varje Droppe'). The planned process was driven by a collaboration between MIP, the local housing company MKB, and local communities in Malmö (Holma and Rönneby neighbourhoods). The collective benefit scheme stipulated that the money saved by residents through a reduction in hot water consumption would be allocated to renovations and improvements in the local school building. Promoting this

collective benefit scheme helped to increase participation and uptake of water saving practices in the community. Hence, the practice contributed to the socio-spatial embedding of the respective lab.

4.1.1.2. Observed strategy 2: activating network partners. With this strategy, ULL aim at actively embedding their work into broader networks of urban actors. ULL seek to explicitly highlight and promote the ways in which the lab is able to serve the agendas of existing and new partners in the city. In this way, the new partner coalitions that emerge in the ULL complement rather than compete with existing networks of urban change agents. Additionally, in ULL, new partner coalitions within the city are fostered and arranged, in order to demonstrate the lab work across sectors and actor groups. The promotion of the lab activities and their embedding in urban governance discourses are supposed to build fertile ground for the uptake of experiments and practices from the lab.

Exemplary practices: Practices of activating network partners were observed at MIP, where the beneficial lab effects for example on social integration and knowledge exchange within the city of Malmö were regularly and intentionally highlighted to the city administration and further partners. While this may read as an obvious interaction between the reporting of effects from ULL and their valuation on the side of the (co-)funding municipality, the process illustrates the importance of constantly creating visibility and communicating lab activities and outcomes among change agents in cities. Transparency and communication of actions and activities create openness to the innovation process and to change in the making itself. Similarly, Stpln lab revealed that the uptake of the lab activities within the city administration of Malmö was intensified by explicitly illustrating and reporting the lab effects in urban partner networks and the municipality itself. Stpln lab illustrated a concrete process in which an innovative up-cycling process and new facility in the Malmö neighbourhood of Lindängen served as the model that was later spread through a new coalition of partners between Stpln, Malmö University and the local wastewater utility VASYD. Within this new collaborative partnership, further up-cycling stations were planned to be implemented following the example of the initial experiment within the lab. A set of network partners of the initial experiment proofed the usefulness and its technical and financial feasibility. Following this proof of concept, new partners teamed up (including some of the initial actors) to extend the experiment into other city areas, which then might lead into a process of translating the experiment into an entirely new context (see below).

4.1.2. Translation

4.1.2.1. Observed strategy 3: replication of lab structures. In this strategy, the structural model of how the ULL is setup and operate becomes the subject of diffusion. ULL identify the essential elements of their respective organizational and business model in order to translate the lessons learned in one lab context into other locations. Learning about how to operate ULL and developing practices of how to adapt the structural lab model to new application contexts are essential elements of this replication strategy.

Exemplary practices: Stpln and BlueCity Labs are intentionally engaging in this replication strategy. In order to nurture replication opportunities, Stpln Lab in Malmö is conducting different activities to initiate learning about its organizational model. The lab organized a

conference and a series of workshops with people interested in translating the concept into other areas in Malmö, into other Swedish cities and beyond. These workshop series included exchange visits to other bicycle kitchen initiatives for example in Riga, Latvia, in order to learn how the other initiative is organized. These observational visits and ‘how to do it’ workshops have already lead to spin-offs from Stpln lab to other Swedish cities.

Similarly, at BlueCity Lab in Rotterdam, the lab management identified the structural model of operation and outcome generation. This model and the lessons learned from running BlueCity Lab in the first years of experimenting were prepared for dissemination among interested actors from Rotterdam and from other cities. Promising ways how to replicate the BlueCity lab model have now become the topic within training sessions about the Blue Economy within an international network (see also the following strategy Nr. 4).

‘We are also setting up a conceptual model: what is BlueCity? So that if someone else wants to start a BlueCity in another city, what is the concept, what is the model and what are our learnings, because there are a lot of interests from other cities.’ (BlueCity Lab, Lab founder)

4.1.2.2. Observed strategy 4: education and training. This strategy puts capacity building and learning about the key features of ULL at centre stage. ULL aim at systematically designing training programmes in order to translate and disseminate their work. Moreover, ULL involve groups of students and researchers from partnering knowledge institutions into the lab activities in order to include ‘experimenting’ and ‘learning by experimenting’ as a valid urban planning approach for early-stage researchers and future urban planners. Learning by experimenting through ULL then becomes part of the cities’ institutionalized learning arenas.

Exemplary practices: CHV lab involves groups of students in the lab activities and has anchored lab-based learning as a regular part of the curriculum at the University of Applied Sciences in Rotterdam. Lab managers emphasize that all students enrolled in building-related programmes are exposed to teaching in and learning at the lab. In each semester, students have the opportunity to actively get involved in lab work as part of the engineering education.

‘It is very interesting from an educational point of view, that they (the students) have worked on sustainable buildings in the Lab and advocate this later on.’ (Concept House Village Lab, Researcher/Lab Co-director)

Likewise, MIP lab builds on a strategy of capacity building and training to translate and disseminate their work beyond the boundaries of the lab. Trainings are offered to interested individuals and groups to initiate local spin-offs. MIP representatives speak about replication in the form of setting up local co-labs. These are collaborative spin-offs that replicate one of the lab innovations under supervision of Malmö University, one of the current key partners of the lab. In so doing, the spin-off activities are able to build on the experiences and knowledge available from the knowledge partner, while Malmö University gets an opportunity to further evaluate and learn from lab diffusion. The lessons learned then can also be integrated into teaching programmes of the University. Similarly, BlueCity Lab offers trainings in running Blue Economy experiments for national and international participants. In addition, one of the entrepreneurs at BlueCity Lab also offers courses on ‘how to’ organize their circular economy business model in other socio-spatial contexts.

4.1.3. Scaling

4.1.3.1. Observed strategy 5: stimulating entrepreneurial growth. The strategy aims at scaling up business models of start-ups by promoting entrepreneurial growth in the lab and beyond. This strategy is about attracting promising start-ups in the ULL, nurturing their development until establishing a proof of concept and a solid business model, and further supporting them in making pathways towards further market diffusion. This often involves strategic collaboration with business incubators in the field of sustainable entrepreneurship. ULL often pursue this strategy together with external partners in the city and beyond.

Exemplary practices: BlueCity Lab emphasizes its entrepreneurial approach to experimenting with new circular economy models in Rotterdam. The lab works with flexible implementation processes to accelerate scaling of their start-ups. Due to the limited space within the lab premises, flexible growth is planned to be realized for example in container units and other decentralized locations, while the head office is supposed to remain at the lab. This entails the collaboration with new partners such as land and real estate owners and logistic companies to provide shipping containers.

CHV lab follows an intentional and market-oriented strategy of scaling as well, yet with a different process of practical implementation. New socio-technical configurations that proofed their technical feasibility for sustainable building renovation in the course of the lab experiments are proposed to participate in the Building Technologies Accelerator (BTA). BTA is a service hub to reduce the time to market for sustainable building technologies. It is led by knowledge institutions and private enterprises under the roof of the EU Climate KIC program. BTA offers diverse actions and marketplace activities to boost business opportunities for new building solutions. CHV lab is an active member of the BTA network.

‘We are now joining Building Technology Accelerator (BTA). All universities that were participating in the Living Lab community are now participating in BTA. It is the second phase now: it is not experimenting with sustainable dwellings anymore, it is bringing it to the market.’ (Concept House Village Lab, Academic initiator/Lab manager)

4.1.3.2. Observed strategy 6: Narratives of impact. With this strategy, ULL seek to increase the spread of niche experiments by establishing narratives around the goals and growing impacts of lab activities. This strategy broadly attempts to create and disseminate new narratives about alternative (more sustainable) urban futures. Implementing this strategy requires to regularly create and discuss stories for external partners about alternative futures represented and produced by the lab as parts of the systemic impact ULL can bring about. Likewise, ULL report the importance of cultivating these narratives as a regular element of daily debates and discourses within the lab, being part of the mission and vision statements of the ULL.

Exemplary practices: Members of MIP lab emphasize the importance of strategic storytelling in the context of developing the goals and visions of the lab and its impacts. These narratives of possible, more sustainable visions of urban life were established as a regular element of daily debates and discourses at MIP and in communication with partners from outside, in particular with the City of Malmö.

Similarly, at BlueCity Lab, initiating and cultivating narratives about sustainability and circularity are an essential part of the wider transition strategy. The discursive element is

said to play a relevant role in scaling the sustainable and circular solutions beyond the boundaries of BlueCity. The practice of ongoing storytelling about the growing effects and the diffusion of the circular economy models often complements the practices described in the strategy of transformative place-making. Through leading by example, narratives of successfully scaling up circular business models were complemented with establishing the lab locality as a unique place of change in order to create visibility for the alternative socio-technical niches evolving from the lab. These reported practices are carried out intentionally and are meant for supporting diffusion processes in general, and scaling processes in particular. Their supportive potential for scaling evolves at least twofold. First, reaching out with narratives of impact triggers attention and interest by creating positive, visionary perspectives. This outreach to potential future adopters, policy maker and investors paves the ground for further acceleration of the experiments' uptake. Second, addressing previous steps of scaling processes already happening in combination with illustrating future pathways of further scaling up allows potential new adopters to build on these previous experiences and discloses the access to feasible solutions for further diffusion.

'It is a transition strategy, where people talk about sustainability and circularity. They talk about new tactics, and new institutional boundaries and how we do things.' (BlueCity Lab, Lab initiator, Board member/Initiator)

5. Discussion

5.1. Through which strategies and practices do ULL seek to affect wider transformative change?

With the study at hand, we have analysed the strategies and concrete practices through which the selected ULL engage in processes of *embedding*, *translating* and *scaling*. Based on our empirical analyses of four ULL in the Netherlands and Sweden, we identified six strategies, by which ULL seek to initiate impact beyond the immediate boundaries of their experiments.

First, ULL recognize the shaping of place meanings as an important element of their embedding in the socio-spatial context. The use of the built environment serves to establish a symbolic locality of change in the city. It is complemented with creating new place-related narratives around a site of experimentation. The observed practices, by which the strategy of *transformative place-making* manifests, reflect one of the defining characteristics of ULL: being situated in a real urban context in order to ground innovation experiments on a manageable scale, for example in a single building, a neighbourhood, or a city as a whole (Voytenko et al., 2016). They carry an inherent potential to become a vehicle for place-making and new place meanings. This finding invites to think further about the role of ULL in the contexts of person-place relations in cities (e.g. a sense of place) as well as in becoming an instrument for urban transition governance.

This duality of person-place relations is illustrated in the case of BlueCity lab in Rotterdam. The transformation of the iconic building with its outstanding location in the city now starts playing a role in the regeneration and local transformation of the surrounding neighbourhood. For example, the lab has become a meeting place for the community and participates in efforts to improve the local air quality by supporting a greening proposition from the respective neighbourhood. At the same time, the community is home to diverse

locally engaged and connected citizens who advocated for specific development restrictions of the buildings' future appearance and functionality. Aspects of place continuity, which refers to the preservation of place characteristics in order to maintain the associated meanings and values of a place, played a strong role when addressing the planning department of the city administration in this issue. How ULL affect place meanings over longer time periods (and vice versa) and how varying place meanings over time unfold in impacts on urban sustainability transitions are questions yet to be addressed in further research.

Second, the identified strategies of diffusion do not emerge independently from each other, but they are often jointly put into practice. Impacts emerge from interwoven practices serving strategies that complement each other. This becomes apparent when considering the strategy of transformative place-making, which, in practice, cannot be separated from *activating network partners*. For example, the two Swedish lab examples emphasized the strategic importance of practicing local collaborations in new network constellations around the ULL of Stpln lab and Malmö Innovation platform. When taking a niche development perspective, ULL can be conceptualized as experimental spaces that 'provide learning platforms for new social networks to emerge' (Raven, Heiskanen, Lovio, Hodson, & Brohmann, 2008, p. 465; see also Kemp et al., 1998). As such, ULL can be seen as instruments for urban planning that are open-ended spaces for experimenting with new ways of engagement and participation, as well as for trying, testing and/or hybridizing new sustainable solutions. Hence, they reach beyond dialectic spaces and are more 'action and solution spaces' for urban sustainability transitions. An emerging network of lab partners can negotiate, struggle, learn and further embed promising feasible sustainability solutions in the urban realm. Indeed, several scholars have described the importance of local partnerships for amplifying urban sustainability transitions (Evans & Karvonen, 2011, Frantzeskaki, Wittmayer, & Loorbach, 2014). The observed ULL in our study are often embedded in public-private people partnerships (Ng, Wong, & Wong, 2013). Such partnerships face the challenge of converging traditional bottom-up and top-down perspectives on approaching change in cities. According to Evans and Karvonen (2011), living laboratories offer potential to 'sidestep the tensions between bottom up and top down approaches to innovation in favor of lateral partnerships' (p. 136) exploring instances of urban governance innovation and experimentation (Bulkeley et al., 2016). As Evans and Karvonen (2011) have speculated, we also find indications that perhaps these collaborative partnerships (ideally) form a new mode of trans-sectoral generation of solution-oriented knowledge. ULL provide platforms to create this type of knowledge, in all its tacit, embodied and contextualized forms among the network partners.

Third, the translation of the labs' operating model was found as a strategy in order to *replicate the lab structures* elsewhere. It is often implemented together with *educational and training activities* offered by the ULL. Both strategies aim at capacity building for the set-up and operation of spin-off's from ULL in another socio-spatial context. While some ULL reported an easy, straightforward process of replicating the lab structures (e.g. Stpln Labs' repair Café), others pointed to the unique, place-specific elements of the lab (e.g. BlueCity Lab). This tension between translating generic concepts of an experiment (e.g. organizational models, financing structures, operating rules) into a new context and strongly context-dependent lab characteristics remain understudied. Our findings suggest the importance of identifying models out of experiments while keeping them

modular and flexible to contextualize and adapt to new networks, sectors, needs, and localities.

Fourth, our data shows that ULL do not consider the mechanisms of diffusion as separate nor distinct processes. Instead, we observed a concurrency of several processes and practices. Creating a strong and positive narrative about the ULL is essential to build-up a network that carries the ULL beyond its boundaries. The narrative has to entail about the strategies, the mission and vision of the ULL as well as how the activities carry out this mission and advance the practice or technology that the ULL was set to test and trial. In addition, the more anchored and embedded the ULL are in their local structures, such as having a strong place identity or tight links to the local universities and education programmes, the more likely it becomes that has effects beyond its initial boundaries. This is due to the fact that the practices of implementing the strategies evolve interrelated, i.e. performing well in one area increases the chances of performing well in another (e.g. having an iconic building helps to create a strong narrative that further attracts interest from other actors, which in turn broadens the network and increases the chances for external funding that can lead to internal growth and/or more organizational capacities to engage in additional outreach activities such as training). Such concurring processes evoke questions about how different strategies and practices of accelerating sustainability experiments interact, complement, or impede each other, which appear to be an avenue worth future research.

Fifth, the two strategies identified to advance scaling efforts often occur simultaneously and interwoven. *Stimulating entrepreneurial growth* does entail creating visions of future spread in combination with providing a solid business model for the aspired growth. An expansion of activities does normally not emerge without envisioning and promoting *narratives of the (planned) acceleration* pathway. In BlueCity Lab, for example, we observed the scaling of one circular economy business model, which is currently spreading into other parts of the City of Rotterdam and beyond. This growth of a niche experiment entails the spatial scaling (i.e. the geographical extent of applying the circular approach is enlarged), actor scaling (i.e. the network of collaborating partners and customers is becoming bigger), while content scaling (e.g. by applying the circular models also to related but different materials) and resource scaling (e.g. by expanding the funding sources beyond the current single investor) are still in the planning phase. At the same time, the lab management reports a lack of agency and resources to further support these scaling efforts. Otherwise, the experiment runs the risk of diminishing in early stages of diffusion, as Heiskanen and colleagues (2017) reported. Considering longer time frames for scaling up is particularly necessary when scaling is conceptualized beyond a narrow idea of growing the experiments' content. Scaling processes imply an organization (or actor) moving from high-risk trials and experimentation towards lower risk, yet, often more capital intensive operational working and further scalar planning. This would also involve shedding previous and acquiring new expertise and skills to enable the further diffusion process. We propose future research to address how different priorities and emphases highlight things for attention while pushing other things into the background in experimenting with and scaling (up) sustainability solutions. Moreover, we expect valuable insights from decoding the particular selection environments for experiments within and beyond ULL.

When identifying these strategies of scaling up experiments, we also discovered that scaling up experiments is not always perceived by lab founders as something that should be achieved. At Stpln lab in Malmö, the sheer scaling up of the lab's activities was not perceived as a desirable goal. Instead, lab representatives questioned the feasibility and value of scaling for the lab activities at hand. In fact, the notion of scaling is not unproblematic as a way of assessing the impact of experiments. It runs the risk of imposing a conception of linear growth on the development of an experiment (i.e. the bigger it gets the better). Moreover, there is a potential conflict with the experimental setting. Due to a wide range of uncertainties involved in experimentation, experimental projects fail more often than they succeed, in terms of delivering workable new solutions. Nonetheless, such failures provide important scope for learning about the experiments. When the impact of an experiment would only be measured in terms of its ability to scale, this would put an overriding (and naïve) emphasis on its success stories.

5.2. ULL and learning for sustainability transitions

A defining feature of ULL is that the experiment does not take place in a 'sterile' laboratory environment, but rather in an unruly and messy real-life societal context (Evans & Karvonen, 2011), enabling more multifaceted and capacious learning processes. The observed educational and training activities practiced in the ULL institutionalize learning from and beyond the boundaries of these ULL. For example, Malmö Innovation Platform established processes of training coordinators to set up and run 'co-labs', which replicate one of the lab innovations elsewhere under university supervision. This practice can be denoted as a broad type of learning. Van den Bosch (2010) discerned three ideal-typical learning processes in relation to real-life niche experimentation: broad learning about a certain problem on different interacting dimensions including technological, environmental, and institutional (Frantzeskaki et al. 2014); reflexive learning about 'underlying assumptions such as social values, and the willingness to change course if the innovation does not match these assumptions' (Raven, Van den Bosch, & Weterings, 2010, p. 65); and social learning as 'a process in which multiple actors interact and develop different perspectives on reality' (van den Bosch & Rotmans, 2008, p. 22). Insights and lessons from broad learning processes in ULL translate more easily than reflexive, or, social learning processes given the deep embeddedness of the latter into its specific context (Gertler, 2003).

Our observations at Concept House Village Lab illustrate that learning in lab experiments also becomes institutionalized in programmes of higher education. By integrating lab-based courses into the curricula of universities, students are exposed to an educational setting of co-creation and complex, real-world challenges. The lab setting allows students and researchers to experience new types of learning situated in and related to the respective socio-spatial context of the lab. This resonates with the analyses of learning presented by Heiskanen et al (2017), who distinguish the techno-scientific, cognitive type of learning and, in contrast, the situated type of learning. While the first refers to learning opportunities such as testing an innovations' functionality and market demand as well as improving solutions in its application context, the latter understands learning as 'emergent, involving opportunities to participate in the practices of the community' (p. 3). Moreover, the type of situated learning highlights the importance of 'tacit, embodied and local knowledge and skills developed in interaction' as it can 'pertain

to a reshaping of personal and professional orientations and valuations’ (p. 4). It is particularly this latter quality, to initiate and facilitate the type of situated learning, which allows us to conceptualize ULL as vehicles for collaboratively enacting transformative knowledge. ULL would then be one concrete format of such enabling partnerships within the universities third mission (Nelles & Vorley, 2010), intending to serve as seeding grounds for advancing urban sustainability transitions. Learning holds a key role in diverse processes of impact creation out of ULL. Hence, we propose future studies to elicit more explicitly how learning evolves from processes of experimenting and co-creation in ULL, as recently initiated by Puerari and colleagues (2018). Such studies should address both, more formalized ways of learning for example in the form of institutionalized training programmes, yet, including as well informal, learning-by-doing processes as an essential element of ULL activities.

5.3. ULL as embedded nuclei for urban transition governance?

Previous empirical research on transitions could show that ‘niches provide a good context for experiments with sustainable practices, but at the same time adaptation to this specific and deviant context makes it difficult to scale up experiments to the dominant context (regime)’ (van den Bosch & Rotmans, 2008, p. 34; see also Smith, 2007). An entry point towards overcoming this paradox requires offsetting the contextual binding of experiments in ULL. As argued earlier, identifying structural models (e.g. a new circular business model) out of experiments that remain modular and flexible enough in order to contextualize and adapt to new localities appears to be a promising pathway. During our empirical work, one lab representative suggested to (re-)conceptualize ULL as an adaptive research infrastructure. This would make ULL eligible for infrastructure funding schemes and could position the labs unequivocally as an urban artefact of scientific progress. Yet, this definition largely disregards the essential aspects of co-creating (transformative) knowledge among diverse urban actors, the embeddedness in a real urban context, and the recent proliferation of ULL as a potential governance instrument in the policy sphere. Nevertheless, it also needs to be acknowledged that some of the lab characteristics are indeed not new at all. A debate about the unique value and novel functions that ULL provide is still in its infancy (Bulkeley et al., 2016). In this context, Torrens and colleagues (2018) have pointed to the ‘risk of overemphasizing the creation of designated spaces for experimentation, either as laboratories or as strategic niches’ (p. 17). Instead, the authors proposed three lenses (i.e. seedbeds, harbour, battlegrounds) to study the diverse dynamics at play during the development of favourable socio-spatial contexts for urban experimentation. Embracing the ‘contextual dynamics’ in future studies on the co-evolution of ULL and their socio-spatial contexts appear to be a promising avenue for research.

While ULL are proliferating, their impacts and implications not just for but also on urban governance remain largely unexamined. Through their explicit emphasis on governance by experimentation ULL may generate nuclei or niches of new knowledge and techniques for governing urban transitions. Turnheim, Kivimaa and Berkhout (2018) identify three outcomes of such experimentation: (1) practical or abstract knowledge and learning, (2) systemic and transformative change and (3) political ordering and mobilization. Yet, similar to Shove and Walker (2007), cautioning against myopia in transition

management, we may be left wondering: ‘But what about the details?’ What are the new institutions of experimentally governed ULL, and what are the mechanisms through which ULL are to be embedded and institutionalized beyond their original (short-term) project and time boundaries? Here the current literature on ULL seems somewhat biased towards a less coordinated bottom-up view of experimentation at the expense of examining how ULLs relate to more formal structures and coordinative institutions of urban place-making. So far, surprisingly few studies have paid attention how ULL are designed, implemented and evaluated at the intersections with ‘traditional’ governance instruments and activities such as urban planning and design. This is surprising given the proposed status of ULL as an inter-boundary space that negotiates, contests and reconfigures the institutional logics and politics of urban place-making.

Recent developments in urban planning and design, both theoretically and empirically, have increasingly emphasized the importance of ‘user involvement’ and active engagement with a range of different stakeholders. Faced with the unprecedented challenges in this new urban age of planetary urbanization, planning theorists, such as Gleeson (2012), propose that planning has been successful at finding ‘new aspirations and rationales’. Similarly, Carroli (2018) has suggested a variety of ways by which urban planning interacts with transitions as spatial processes unfolding over time while Raynor, Doyon, and Beer (2018) note how planning processes are required to be more responsive, adaptable and participatory despite substantially different methodologies, theoretical groundings, priorities, goals and attitudes towards consensus and experimentation. Others, adopting a more fast-lived perspective where cities have become liquid and mutable spaces where planning has become increasingly privatized (McCann, 2001), observe how design logics and approaches have become increasingly manifest as a formal place-making activity by consultants, planners and architects. These parallel discussions appear to have gone largely ‘under the radar’ in the ‘ULL literature’ but deserve and require, we argue, greater visibility and acknowledgement to better understand the role of ULL in governing urban sustainability transitions ‘beyond experiments’.

Conclusions

Our empirical findings proof ULL to be active sites of experimenting, contributing new knowledge and valid tested solutions to diverse aspects of sustainability challenges in cities. As such, they appear predestinated for testing, trialling, demonstrating and initiating the spread of knowledge, practices and socio-technical solutions beyond their immediate remit. The observed strategies and implemented practices do already contribute to the diffusion of more sustainable structures, cultures, and ways of doing things differently in cities. Despite these efforts to diffuse, ULL do not necessarily aim at transformative change as such and often do not provide the resources for diffusion beyond their boundaries. New actors may be needed in order to coordinate and (further) support the adoption of individual experiments within broader transition schemes in the city. Despite their recent proliferation in the European policy sphere and their undoubted success as a vehicle to generate public funding, we ask for a careful reflection of the urban actors’ expectations towards ULL. ULL are not the new panacea in the urban governance arena. Despite the promise of ULL to leverage participation and inclusive decision-making through cross-sectoral partnering and collaboration, there

is at the same time a need to remain cautious about the risks implied in such experimental governance arrangements for ‘organized irresponsibility’ (Beck, 1998), instances where society becomes a laboratory, but there is no one responsible nor held accountable for its outcomes. Cognizant of the increasing extent and range of actors involved in governing sustainability challenges in cities, we caution against post-political interpretations of ULL as if happening in an institutional vacuum where ‘anything goes’. In a similar vein, Kronsell and Mukhtar-Landgren (2018) call attention for the need to elaborate on democratic aspects for inclusion, legitimacy, power and transparency and how these institutional values relate to the roles of municipalities in ULL. In sum, taking ULL beyond experimentation requires greater care and attention for its interrelations with more orthodox and formal structures and institutions in urban policy and governance such as strategic planning and urban design.

Dealing with the inherent controversy between place specificity and replicable elements of urban experiments requires reflexivity to abstract these elements and adaptive implementation processes in new places, organizations and policies. Hence, we stress the importance of identifying spreadable models out of sustainability experiments, while keeping them modular and flexible in order to (re-)contextualize and adapt to specific needs. The transformative potential of ULL will be realized when applying their lessons across sectors, actors, and geographical boundaries. Future research should be undertaken on their long-term effects on sustainability transitions, their potential for place-making and urban regeneration in cities, their abilities and limitations as an instrument for urban transition governance, as well as their implications for informal and institutionalized learning about sustainable city futures.

Note

1. The notion of geographical contextualization has also been referred to as ‘geographical embeddedness’ in other studies (e.g. Voytenko et al., 2016).

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Appendices

Table A1. Data sources: interview date, interviewee position, professional affiliation and city context.

Interview	Date	Interviewee (role/position)	Professional affiliation	City
1	22.02.2017	Living Lab Manager/Founder	BlueCity Lab 010	Rotterdam
2	02.03.2017	Investor/Lab Founder	ifund.nl/BlueCity Lab 010	Rotterdam
3	09.03.2017	Board member/Initiator	BlueCity Lab 010	Rotterdam
4	09.03.2017	Academic initiator/Lab manager	Concept House Village Lab	Rotterdam
5	29.03.2017	Researcher/Lab Co-director	Concept House Village Lab	Rotterdam
6	19.05.2017	Head of municipal area development	Municipality of Rotterdam	Rotterdam
7	21.11.2015	Project responsible, City of Malmö	Malmö Innovation Platform	Malmö
8	21.11.2015	Lab initiator, Senior Researcher	Malmö Innovation Platform	Malmö
9	21.11.2015	Project manager Housing company	Malmö Innovation Platform	Malmö
10	29.02.2016	Lab Designer & Senior Researcher	Stapeln Open Maker Space	Malmö
11	26.02.2016	Director, founder of Bicycle Kitchen	Stapeln Open Maker Space	Malmö
12	11.03.2016	Project leader and founder	Stapeln Open Maker Space	Malmö

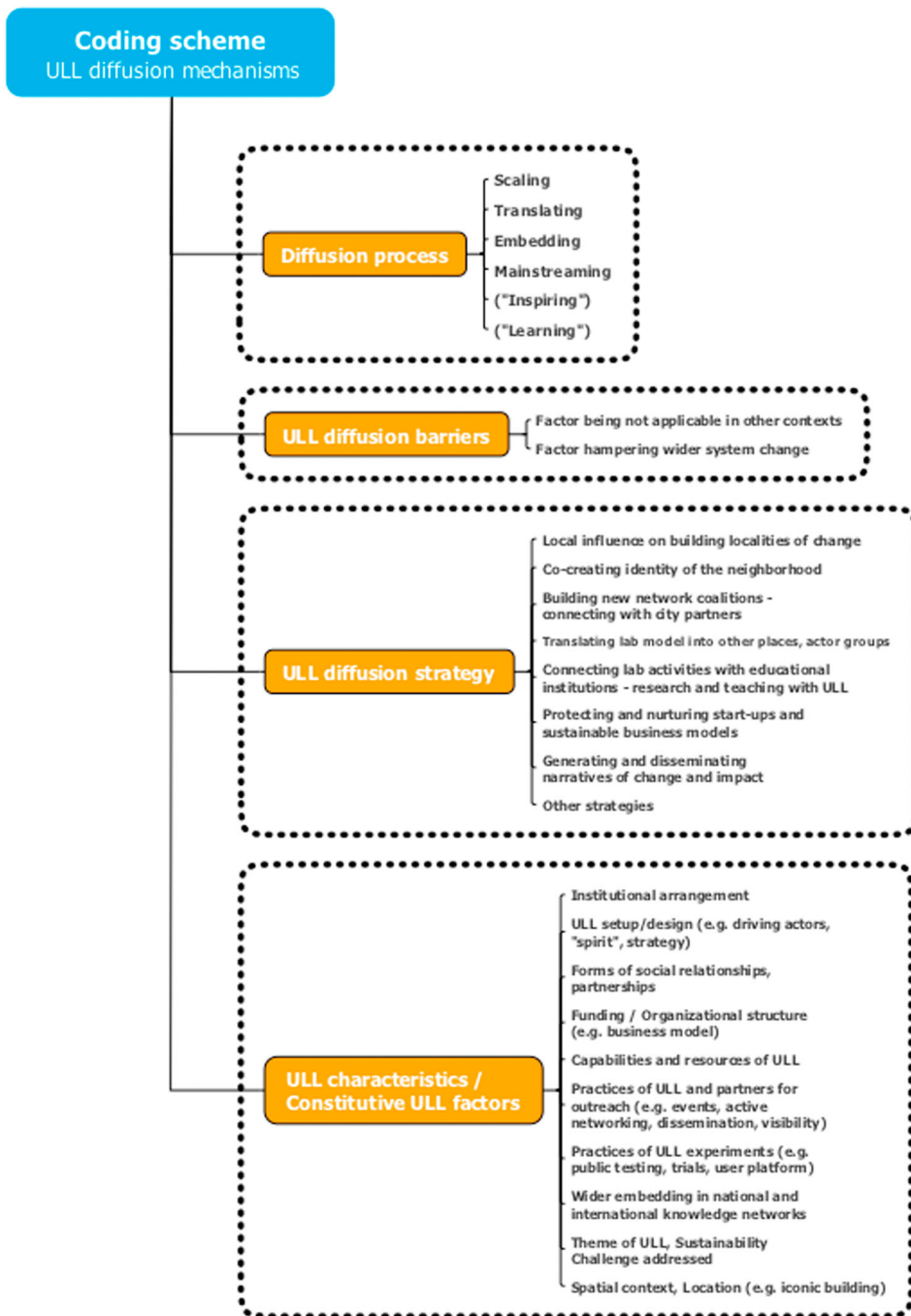


Figure A1. The initial, hierarchical coding scheme used for data analysis of the interview transcriptions.