



**Utrecht
University**

Master Thesis U.S.E.

Urban living labs as a way to realise urban nature-based solutions

Student name: Sofia Servera Reynolds

Student ID: 8094489

Student email: s.serverareynolds@students.uu.nl

Word count: 10.670

Supervisor: Dr. Helen Toxopeus

Second supervisor: Dr. Katrin Merfeld

Utrecht University.

Faculty of Law, Economics and Governance.

Master Business and Social Impact.

30th of June, 2023

The copyright of this thesis rests with the author. The author is responsible for its contents and opinions expressed in the thesis. U.S.E. is only responsible for the academic coaching and supervision and cannot be held liable for the content'.

Abstract

As a result of climate change leading to heat stress in cities, there is a growing demand for urban sustainable development. To address the social, economic, and environmental issues, interventions such as urban nature-based solutions (UNBS) are being implemented. An Urban living lab (ULL) is envisioned as a collaborative space that encourages innovation and brings stakeholders together to achieve a common goal. This study concentrates on how ULLs can promote UNBS and stakeholder co-creation. The paper takes a qualitative approach and focuses on an ongoing ULL in Utrecht's City Centre. The study reveals three key roles of ULLs that can promote UNBS and encourage stakeholder co-creation. These roles are trust building, scaling up predefined innovations and fostering inclusive social outcomes. By taking on these roles, UNBS can overcome its barriers, both socio-economic and biophysical. The study, therefore, highlights the benefits of ULLs, in promoting sustainable urban development by providing a collaborative space for stakeholders to perform better towards achieving UNBS. ULLs' characteristics such as stakeholder co-creation, user management, and innovation can potentially enable UNBS to tackle its barriers in a real-life context. Policymakers, urban planners, and other stakeholders involved in developing solutions for UNBS must consider this approach as it offers valuable insights. Concluding, this study adds value to both theory and practice by improving the understanding of how ULLs can facilitate the planning, execution, and management of UNBS.

Keywords: urban living labs, urban nature-based solutions, stakeholder co-creation, urban sustainable development.

JEL – codes : Q01,Q56, O35.

Acknowledgements

I would like to thank both of my supervisors for their guidance and support throughout this research. I would also like to express my appreciation to those who took part in the case study of the ULL in Utrecht's City Centre, their insights contributed immensely to the findings of this research. A special thanks to my family for their constant support and for allowing me to grow in such a warm environment. Finally, to the rest of the people who have accompanied me on this path, those present and from a distance.

Table of contents

1. Introduction	4
2. Literature review.....	7
2.1. Urban nature-based solutions (UNBS).....	7
2.1.1. UNBS barriers and challenges.....	8
2.2. Stakeholder co-creation.....	9
2.3. Urban living labs (ULLs)	10
2.4. Facilitating stakeholder co-creation in ULL for UNBS	13
2.5. Conceptual model.....	15
3. Methodology and data collection	17
3.1. Research design.....	17
3.2. Data collection.....	18
3.3. Data analysis.....	20
4. Results	23
4.1. Key Success Factors and Characteristics for Achieving ULLs.....	23
4.2. Stakeholders' roles in the co-creation process of ULLs	29
5. Discussion.....	31
5.1. Discussion.....	31
5.1.1. Trust building for stakeholders IN UNBS	31
5.1.2. Upscaling predefined innovation for UNBS.....	32
5.1.3. Fostering inclusive social outcomes, addressing users' needs and promoting learning processes for UNBS	33
5.2. Theoretical implication.....	34
5.3. Managerial implication.....	35
5.4. Limitations and future research	36
6. Conclusion	38
References	39
Appendix	42
Appendix A: Interview guide	42
Appendix B: Coding scheme	44
Appendix C: Fieldtrip to the city centre – Evaluating locations	46

1. Introduction

The fast urbanization trend has created serious challenges for the cities' future agenda. For urban areas to have a sustainable future, a number of socioeconomic problems as well as challenges must be resolved. The future of cities must be given urgent consideration and action due to climate change and the large population growth anticipated in the next decades (Feola, 2015). One major issue that needs to be addressed in the future is the increasing population growth, which has significantly affected cities in recent years. By 2050, the United Nations (2018) predicts that over 70% of the world's population - up from the present percentage of approximately 50% - will live in cities or urban areas. As a result, climate change is a significant issue that needs to be addressed. Due to rising temperatures and heat waves, cities and urban areas are particularly sensitive to climate change (Geneletti & Zardo, 2016). Increased greenhouse gas emissions, deforestation, and the depletion of natural resources are among the many biological and environmental footprints associated with climate change that have their root in urban areas (Beatley, 2012). The effects on urban areas have far-reaching consequences on the well-being of the urban populations.

Urban sustainable development is needed to address these issues (Xie et al., 2022). To effectively address the challenges and allow for this transition, it is crucial for stakeholders to collaborate and ensure urban sustainable development. Collaboration leads to the development of liveable, vibrant, and inclusive cities that benefit everyone. To ensure that cities continue liveable for current and future generations, collaboration between urban planners, policymakers, community members, and key players in the public and private sectors is essential (Semanjski & Gautama, 2019). Greening cities and urban areas is a solution for urban sustainable development. Green cities aim to achieve a harmonious balance with nature, moving beyond viewing nature only as an aesthetic addition to the urban landscape (Breuste, 2023). The primary objective is to make the community as liveable as possible by reducing energy consumption and social and environmental impact (Lindfield & Florian, 2012). Green cities offer significant benefits and improvements to community life, while also incorporating new technology (Beatley, 2012). This is facilitated with the help of urban planning and a multi-stakeholder approach. It is important to keep in mind that the transition could face obstacles in terms of management, legislation, and financing. The involvement of multiple stakeholders is necessary to effectively organize the process (Brears, 2018).

Towards the pathway for greener cities and urban sustainable development, nature-based solutions are crucial (Glumac & Islam, 2020). Nature-based solutions (NBS) aim to protect, sustainably manage and restore natural and modified ecosystems while at the same time benefiting people and nature (International Union for Conservation of Nature, 2016). Urban nature-based solutions (UNBS) specifically focus on transforming urban areas by planning and implementing solutions that simultaneously benefit humans and the environment (Ershad Sarabi et al., 2019). UNBS are thus viewed as an approach for a greener transition of cities and urban areas. However, the concept of UNBS is still emerging and faces several barriers to effectively planning, implementing and managing them (Sarabi et al., 2020). According to current literature, the barriers to successful UNBS are typically classified into two main categories: socio-institutional and biophysical barriers (Ershad Sarabi et al., 2019). Socio-institutional barriers encompass a wide range of challenges related to social, economic and institutional factors. Within this category, socio-economic barriers specifically arise when aiming to secure public and/or private finance for upscaling UNBS (Toxopeus & Polzin, 2021). Biophysical barriers arise from the physical and ecological aspects of implementing UNBS. This paper aims to enhance academic research on the positive effects of UNBS by introducing the potential of urban living labs as a tool for their realisation.

Living labs are physical or virtual spaces that bring together all the relevant parties to achieve innovation and co-creation in a real-life context (Westerlund & Leminen, 2011). Urban living labs (ULL) are a specialized form of living labs that offer an opportunity to promote sustainable development in urban areas, which can lead to a healthier future for city living. ULLs enable partnerships with the community, investors, engineers, urban planners, and municipalities—multiple stakeholders—to collaborate towards a common goal. This pertains to the following research question (RQ):

RQ: What role can ULL play in bringing together stakeholder co-creation to realise UNBS?

This study contributes to the existing knowledge on implementing UNBS by analysing the literature on ULLs. The research showcases the potential of ULLs in promoting UNBS and highlights their advantages, success factors, and value for innovation and co-creation. The research holds significant societal relevance as it adds value to the current policy implications and their role in the transition to greener cities, such as the Sustainable

Development Goals and the European Green Deal¹. Specifically in this context, This research connects the 11th SDG – Sustainable Cities and Communities with the 17th SDG – Partnerships for the Goals (UN, Sustainable Development Goals, 2023).

To address the research question, a qualitative approach is been adopted, utilizing a case study of an ongoing ULL in Utrecht's City Centre. Participant observation and interviewing key stakeholders from the ULL provide valuable findings that add to the findings. The initial aim of the studied ULL was to establish a common space owned by Utrecht University that promoted innovation while also ensuring inclusivity and addressing concerns such as heat stress and biodiversity. To achieve this collaboration, the ULL involved multiple stakeholders such as the municipality, community members, researchers and students. The research's findings are based on a two-and-a-half-month data collection that included eight interviews and an in-depth participant observation. The data analysis revealed three main roles leading from the success factors of ULL and its stakeholder co-creation approach: trust building for stakeholders, upscaling predefined innovation and fostering inclusive social outcomes, addressing users' needs and promoting learning processes for UNBS. By focusing on these roles, it can empower the development of UNBS in urban areas. In addition, the paper examines the characteristics of the current ULL and suggests possible methods for utilizing ULL as a means to unlock UNBS in the future.

Thesis structure

In order to address the research question: *What role can ULL play in bringing together stakeholder co-creation to realise UNBS ?* the paper is structured as followed. Section two explores the literature review of key terms and theories essential for this research, such as UNBS, ULLs, Stakeholder co-creation, and a contribution section. In the third section, the qualitative methodology is explained, including the case study and the chosen approach. The fourth section presents the results and key findings. In the fifth section, the significance of these results is discussed along with the identification of three key roles that answer the research question. This section also discusses the implications, future research, and limitations of the study. Finally, the paper ends with a conclusion.

¹ The European Green Deal is the current European Commission Flagship Initiative. It involves various initiatives, strategies and legislative acts with the intention to enable a just, sustainable and inclusive transformation of the European society and economy. It was presented by Commission president Ursula von der Leyen on 11th December 2019 (Fetting, 2020).

2. Literature review

2.1. Urban nature-based solutions (UNBS)

Nature-based solutions (NBS) are defined as actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature (International Union for Conservation of Nature, 2016). NBS have the dual purpose of securing long-term economic security and competitiveness while tackling the global environmental crisis (Maes & Jacobs, 2017). In order to support sustainable and resilient urban planning, NBS are increasingly being used in urban areas (Biswal et al., 2022). Urban nature-based solutions (UNBS) refer to the design and implementation of NBS in urban areas, which are referred to in this thesis.

Stakeholders, ranging from political actors, populations of cities and private sector actors have increasingly become more aware of the importance of urban sustainable development (Karatas & El-Rayes, 2015). In recent years, following the shift in perspective towards sustainable development, UNBS has been increasingly perceived as a tool to address social and environmental degradation. They are advantageous for various urban stakeholders that touch upon different values, including ecological services, and social and economic benefits (Toxopeus & Polzin, 2021). UNBS can be used to address the impacts of global environmental challenges such as heat stress in cities and to be able to create new opportunities for a variety of stakeholders (Mahmoud & Morello, 2018). Furthermore, there is a growing interest in using UNBS to enhance urban resilience due to their potential to provide social and benefits. The interventions focus on and contribute to the overall goal of building resilient cities and urban areas (Tozer et al., 2023). Adopting UNBS is not only beneficial for preserving the fragile ecosystem, they also provide both human and ecological benefits (Ershad Sarabi et al., 2019). These benefits go beyond the core objective of preserving the fragile ecosystem, they include advantages in the well-being of the people residing in urban areas. The interventions aim to achieve the overall goal of building resilient cities and urban areas (Ershad Sarabi et al., 2019; Tozer et al., 2023). Therefore, cities have the potential to address complex issues and are key targets for UNBS implementation (Frantzeskaki, 2019). To implement UNBS effectively, it is essential to tailor its natural and design features to match the specific social, economic, and ecological environment.

Customizing and adapting UNBS to local contexts is essential for its success. This is because sustainable transitions are not always simple processes of upscaling predefined innovations (Tozer et al., 2022). Therefore, when it comes to upscaling UNBS, physical characteristics still need to be tailored (Dorst et al., 2019).

2.1.1. UNBS barriers and challenges

Drawing on previous literature, UNBS face multiple barriers that still need to be addressed. Dorst et al. (2022) identified the structural conditions that create obstacles to implementing UNBS. These structural conditions include limited collaborative governance, knowledge, data and awareness challenges, low private sector engagement, competition over urban space, insufficient policy development, implementation and enforcement, insufficient public resources, and challenging citizen engagement. Barriers faced by UNBS have slowed down the progress in realising its potential benefits for cities globally. These challenges are also reflected in other numerous studies on UNBS barriers and challenges (Dorst et al., 2022). Ershad Sarabi et al. (2019) also identified structural barriers to UNBS integration as socio-institutional barriers and biophysical ones. Socio-institutional barriers encompass a range of social and institutional factors that obstruct the planning, execution, and management of UNBS. These include institutional fragmentation, a lack of policy and regulatory capacity, and limited awareness and comprehension. Biophysical barriers, on the other hand, pertain to physical and ecological factors such as insufficient green spaces and climate-related limitations. Additionally, inadequate financial resources pose a significant obstacle to the implementation of NBS, including UNBS.

The results from a later study by Ershad Sarabi et al. (2019) on the uptake and implementation of NBS highlighted that the barriers attributed to silo mentality and the absence of design standards and guidelines for maintenance and monitoring of NBS were the most prominent barriers. Noteworthy barriers also identified were the lack of political will and long-term commitment, inadequate sense of urgency among policy and resilience (Ershad Sarabi et al., 2019). Many reasons lead to the lack of financing and resources for UNBS. According to Toxopeus & Polzin (2021), UNBS face two key barriers regarding finance. First, the lack of coordination and balance between private and public financiers can cause issues in financing UNBS due to several differences in incentives, resources and priorities of both sectors. Second, financing UNBS is hindered by the failure of

traditional valuation and accounting methods to fully integrate the benefits of UNBS. This inadequacy results in a failure to allocate resources based on the complete value of UNBS, thereby making it challenging to secure funding remains a challenge. According to this paper, limited collaborative governance is identified as a significant barrier (Dorst et al., 2022). Further, it is important to acknowledge that stakeholders operate across different sectors and boundaries, including organisational and jurisdictional ones. However, if this collaboration is not executed properly, it may result in negatively impacts urban development. This shows that there is a lack of joint action and collaboration between municipal and governmental entities and various stakeholders in the development of UNBS (Dorst et al., 2022).

2.2. Stakeholder co-creation

There are numerous reasons to study the relevance and potential outcomes of stakeholder co-creation in this context. According to Freeman's *stakeholder theory* (1984), stakeholder relationships, rather than merely focusing on maximising profits, are the fundamental drivers of value. For this, the best way to maximise value sustainably is to fulfil stakeholder interests (Freeman et al., 2010). The stakeholder theory emphasises the promotion of shared interests and relationships. The central task of promoting stakeholder relationships is ensuring the long-term success (Freeman & McVea, 2005) of organisations, firms and businesses. Knowledge is co-created through multiple stakeholders (Kazadi et al., 2016). The effectiveness of stakeholder co-creation findings in diverse contexts highlights the need for its applicability. Co-creation is a form of interaction that leads to enhanced innovation and stronger and more active stakeholder relationships (Ramaswamy & Guillard, 2010). Stakeholder co-creation has become a crucial aspect for businesses in recent years, balancing limited resources with the need to boost innovation has made it even more significant. This approach raises questions about the extent to which organisations participate in co-creation activities with stakeholders such as consumers or interest groups. Businesses and firms have limited resources and are moving toward innovation processes that involve multiple stakeholders (Kazadi et al., 2016).

Many studies emphasise that collaboration among various stakeholders is crucial in creating knowledge (Kazadi et al., 2016). The importance of stakeholder co-creation is evident in diverse settings, highlighting the effectiveness of this approach. As explained

by Ramaswamy & Guillard (2010), co-creation fosters interaction, leading to better innovation and stronger relationships with stakeholders. Organizations must involve stakeholders such as consumers or interest groups in co-creation activities to explore innovation processes that involve multiple stakeholders (Kazadi et al., 2016). In order to understand how to overcome the limitation of conventional stakeholder practices, it is necessary to research the advantages of stakeholder co-creation. Definitions of co-creation claim that it goes further than mere participation in joint work (Bendapudi & Leone, 2003). Many studies investigated the influence of engagement, where the use of interactive system environments in co-creation processes is highlighted by the active participation and interaction of the components involved (Loureiro et al., 2020). Stakeholders' engagement is crucial as it enables actors to interact with one another and influence the participation of other stakeholders. Innovation processes place a special interest in these capabilities (Kazadi et al., 2016).

To remain in a competitive environment in innovation processes, there is evidence on how organizations create value through a wide range of social relationships (Hult et al., 2011). During the innovation process, stakeholders require new capabilities to manage the challenges they may present to adapt to environmental changes (Kazadi et al., 2016). Specifically, in this context, research does not address enough the link between co-creation during the innovation process and its performance (Laursen & Salter, 2006). Stakeholders are becoming more interconnected and empowered (Kazadi et al., 2016), so the next step for active participation in stakeholder co-creation is to determine their capabilities.

2.3. Urban living labs (ULLs)

Living labs are defined as “*physical or virtual spaces where stakeholders form public-private-people partnerships of firms, public agencies, universities, institutes, and users all collaborate for the creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts*” (Leminen et al., 2012). Living labs are found to be concerned with the environmental, economic and social effects. They contribute to societal development in urban areas by engaging relevant stakeholders (Hossain et al., 2019). Urban living labs (ULLs) are living labs established to achieve goals specifically in urban areas. ULLs can be viewed as both a physical space and a research methodology. This study aims to identify the most effective definition and

approach of ULL that can facilitate to better achieving UNBS. In recent years there has been a growing interest found in living labs as a mechanism for innovation that has drawn significant attention to both the different types of this methodology and to the organisations that put it into practice (Almirall et al., 2012). ULLs are considered to play a pivotal role in green cities (Hossain et al., 2019); however, this is yet to be analysed in more depth (Leminen et al., 2017). Therefore, it is important to address this research gap in order to gain a better understanding of how ULLs can contribute to creating greener cities.

ULLs are characterized by two main ideas. First, in engaging users as co-creators on equal grounds alongside other participants. Second, conducting experiments in real-world settings (Almirall & Wareham, 2008). ULLs play a crucial role in bringing together a wide range of partners and participants for the benefit of future innovation networks although the innovation and value that these provide are not well-represented in the existing literature (Nyström et al., 2014). It is important to note that the concept of living labs can be viewed as a platform for innovation (Leminen et al., 2017) and therefore it can be a promising tool towards the development of UNBS. The research approach strives to promote innovation by experimenting and co-creating in real-life scenarios, with the *UULabs model* of Stuckrath & Rosales (2021) serving as a reference model (Figure 1). The user-centred model emphasises equal collaboration among all parties involved, including government, academia, citizens, and businesses.

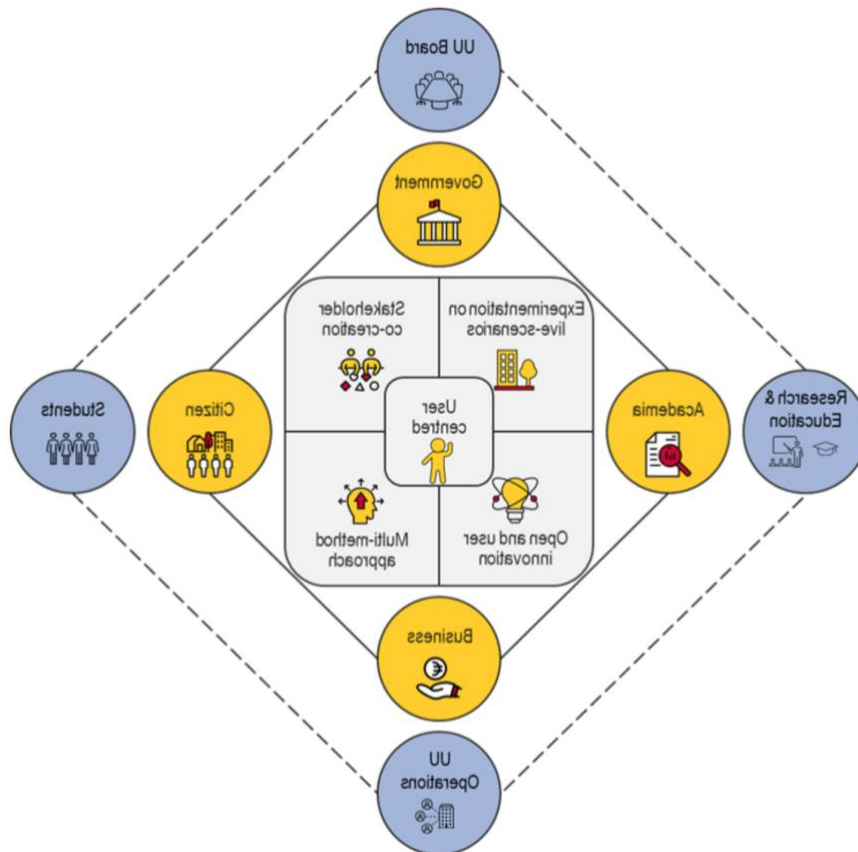


Figure 1: *UULabs Model* (Stuckrath & Rosales, 2021).

ULLs often encounter obstacles when trying to secure funding, which can be particularly challenging in the early stages of operation. Typically, ULLs rely on national or regional funding, mostly on a project-by-project basis. However, this approach may not provide sustainable funding options for the long term, according to studies. To keep operating for an extended period after the project, consistent funding is crucial. Adequate funding can help tackle long-term projects, and measuring the benefits can inform future research on maintaining funding (Hossain et al., 2019). Considering that ULL can be understood as a method and a conceptualisation (Leminen et al., 2017), this study investigates the innovation potential of ULL to determine the benefits and advantages that this tool can bring to UNBS.

2.4. Facilitating stakeholder co-creation in ULL for UNBS

As previously stated, due to the spread of various forms of collaborative innovation in urban areas, urban sustainable development and developing green cities have recently received a growing amount of attention from scholars and researchers. Simultaneously, diverse stakeholders of living labs have expressed a desire for value co-creation, experimentation, and collaboration (Sutinen et al., 2016). ULLs can leverage the innovation opportunities provided by urban environments and cities. If the long-term goals of these areas align with collaborative innovation, the resulting success can make the ULL a permanent fixture in the city's innovation system (Leminen et al., 2017). It has been demonstrated that cities must rely on effective urban logistics to maintain their quality of life and economic development (Semanjski & Gautama, 2019). Furthermore, recent literature points out key enablers to the uptake of NBS in urban settings. The partnership among stakeholders and organisations from both multiple and vertical levels is found to be the most frequently identified socio-institutional enabler (Ershad Sarabi et al., 2019). Therefore, creating organisations between stakeholders seems, by all accounts, to be the most often observed enabler for UNBS. Other enablers to be considered important are effective monitoring, knowledge sharing, financial instruments, plans, and legislations, education, training, combined with grey infrastructures, open innovation and experimentation, and appropriate planning and design (Ershad Sarabi et al., 2019). UNBS must actively promote ULL's innovation and stakeholder co-creation to reap its numerous benefits. Therefore, it is imperative that UNBS prioritizes and considers the perspectives of all stakeholders when making decisions. Though, we must consider that UNBS is a relatively new concept and that they have few academic papers that perform alongside ULL. This research study explores the co-development of knowledge explicitly to guide the creation of urban sustainable development (Bulkeley et al., 2016). Accessing reference models is crucial for stakeholders to effectively guide the development of ULLs and their activities. These models promote co-creation among various actors and should be utilized to manage and further ULLs to their full potential. The collaborative environment required for ULLs (Sarabi et al., 2020) must involve diverse participants to accurately reflect the complex socio-ecological nature of UNBS (Hossain et al., 2019).

Based on the *Living Lab Triangle* (Figure 2), ULLs have three key pillars: outcome, environment and approach.

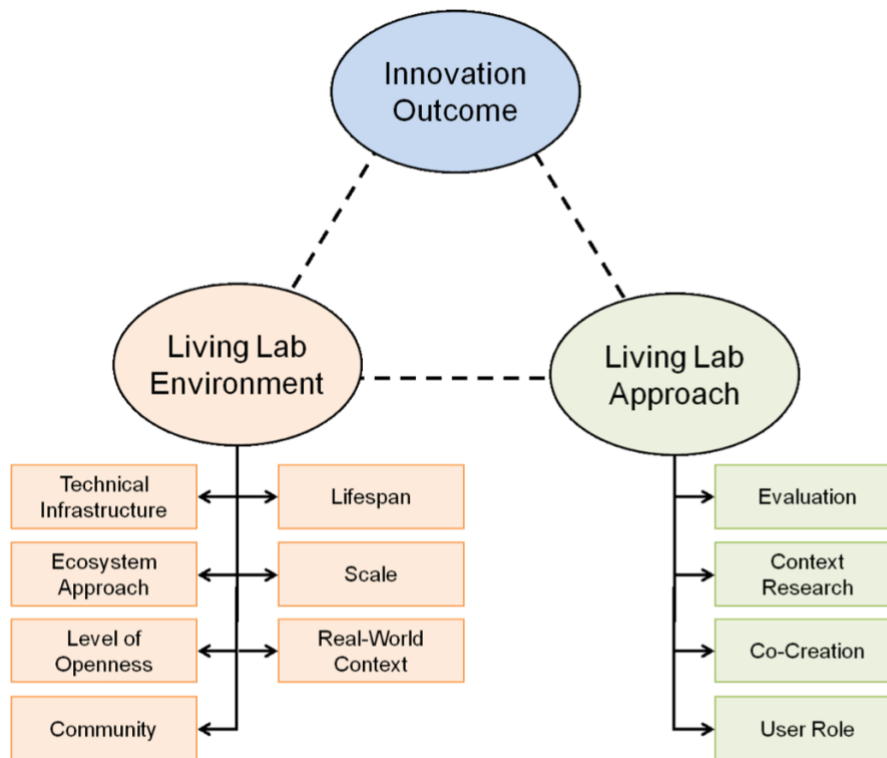


Figure 2: *The Living Lab Triangle*: The triangulation between environment, approach, and outcome in living labs (Veeckman et al., 2013).

ULLs are a unique type of network that combines user-centred research and innovation processes (Leminen et al., 2017). This method involves working collaboratively to improve customer satisfaction by addressing their goals. ULLs typically involve a diverse range of stakeholders, including suppliers, customers, users, competitors, research units of universities, and other institutions and organisations. By leveraging the expertise and insights of these stakeholders, ULLs are able to create highly innovative solutions that are grounded in real-world needs and experiences. Overall, ULLs represent a powerful tool for advancing academic research and driving innovation in a wide range of industries and fields (Leminen et al., 2012). In order to achieve collaboration and innovation in ULLs, the 4Ps (public, private, people and partnership) must bring their respective interests forward. By utilising a stakeholder co-creation approach, ULLs can effectively combine existing literature from both ULLs and UNBS to develop urban sustainable development and promote green cities. This collaborative approach encourages

innovation from a diverse range of sources, fostering a conducive environment for stakeholders to work together towards the advancement of ULL development (Veeckman et al., 2013). This study seeks to expand upon the current literature surrounding ULLs by exploring its potential as a physical space that promotes UNBS through a multiple-stakeholder approach. While ULLs have already been identified as a common space for innovation and networking communities, this research explains what is ULLs' ability to facilitate additional interventions from various stakeholders. By examining the nature and purpose of ULLs in this context, the research contributes to a deeper understanding of the potential benefits that ULLs can offer as a means of promoting UNBS (Semanjski & Gautama, 2019).

2.5. Conceptual model

The goal of this research is understood in the following conceptual model:

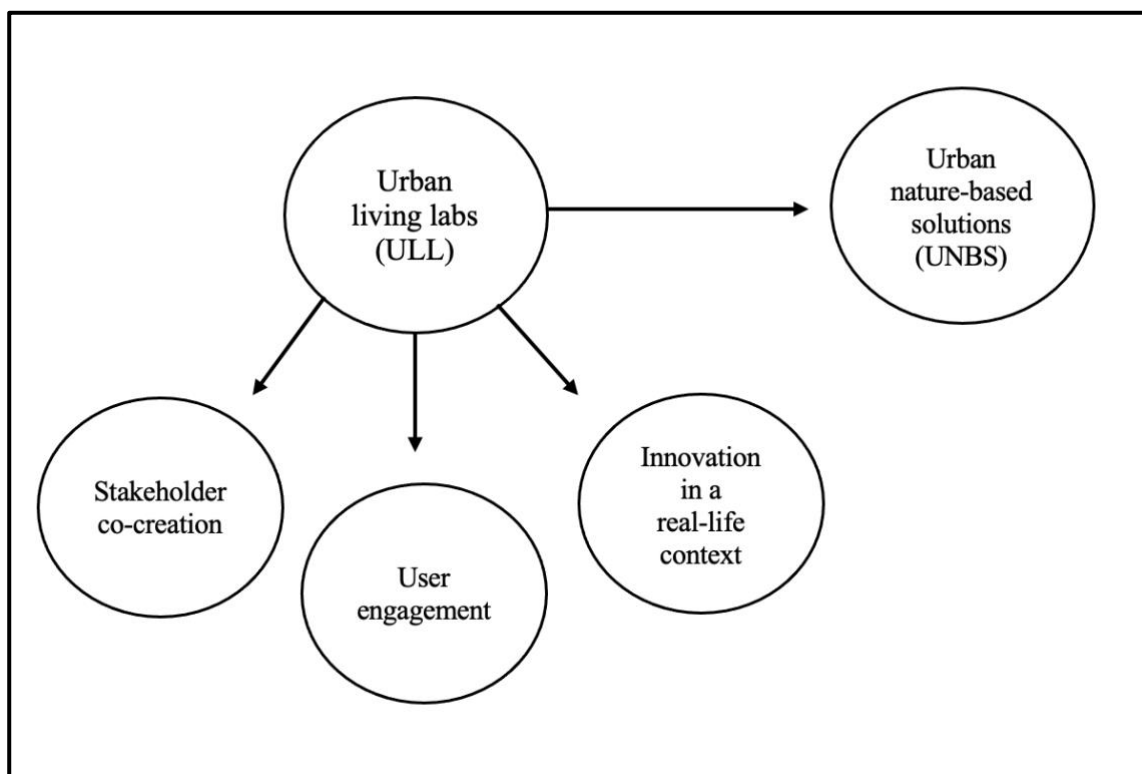


Figure 3: *Conceptual model*

The conceptual model depicts the relationship between ULL and the realisation of UNBS. ULLs cannot run without collaboration and co-creation between stakeholders, user engagement and innovation. The model portrays the importance of ULLs characteristics in realising UNBS. This research aims to encourage the adoption of ULLs as a tool to adopt UNBS. ULLs have the ability to unite different stakeholders, thus reducing information asymmetry. The utilization of the ULLs model is an instrument for stakeholders who aim to better achieve urban sustainable development through UNBS.

3. Methodology and data collection

3.1. Research design

The research design reflects the collection and analysis of the data of this present research (Bryman, 2016). The ultimate goal of the research aims to provide qualitative information on how ULLs can be perceived as a facilitator for UNBS. In order to achieve the research objectives, participant observation and interviews were undertaken in a ULL to draw conclusions on both the potential of this tool and the obstacles that ULLs can also encounter. Further, the objective was to discover and establish whether bringing various stakeholders together by their co-creation in ULLs could facilitate the realisation of UNBS. In order to achieve relevant results, a qualitative research design to collect empirical data is the most fitting. The case study approach is a detailed and intensive analysis of a single case (Bryman, 2016). A case study with double data collection was undertaken in this research, the data collection was primarily qualitative (Yin, 2002).

Consequently, the research concentrated solely on a single case study that gathered the most useful data. A single case study is selected because it generates an intensive examination (Bryman, 2016) of the particular case selected in the data collection. The research design is a valid method because it proves that ULLs can facilitate stakeholder co-creation and contribute to the success of UNBS. The case study is an unfinished real-time working ULL based in the city centre of Utrecht, The Netherlands. The establishment of a physical space where multiple stakeholders can convene to acquire knowledge, experiment, and collaborate toward effective solutions that simultaneously foster the engagement and interaction of the city's community is the overarching objective of the ULL, which also aims for urban sustainable development and a greener city centre. The primary objective is to discover a number of strategies for reorienting the owned spaces of Utrecht University in the direction of sustainability. The project's contribution to finding solutions for the natural and social environment is a key component, and the participation of various stakeholders is essential for the effectiveness of the city's green spaces.

Yin (2002) assures that the design of data for this type of research needs to meet a middle point because it relies on multiple sources of evidence. Therefore, the inclusion of participant observation of the case study combined with interviewing key stakeholders is key to ensure a more comprehensive study. The study allows an in-depth analysis of the

concerns of stakeholders in ULLs for relevant contributions and remarks on how they can contribute towards UNBS. The selected case analysis provides the maximum instrumentality possible to answer the initial research question: *What role can ULL play in bringing together stakeholders to realise UNBS?* Additionally, it enabled the development of the results and discussion section taking into account the potential strength and limitations of future research (Yin, 2002).

3.2. Data collection

The design of the data collection for qualitative research is a fundamental task in order to gather details and insights into the role of ULLs in facilitating UNBS. The research obtained useful empirical results through data collection using two methods: semi-structured interviews and participant observation. These methods allowed for a more open-ended approach to the research process (Bryman, 2016). First, conducting interviews with the key stakeholders of the “*Green in City Centre, UU ULL*”. The interviews were a key data collection because they collected valuable insights into the stakeholders’ roles, participation, and responsibilities within the living lab. Based on the research methodology, fifteen individuals were approached to participate in interviews, ultimately conducting eight. The selection process was carefully designed to identify stakeholders who would provide valuable insights for our study. Table 1 shows the different stakeholders with their respective roles in the ULL and other additional details. It is important to note that Interviewee 7, although not directly involved in the ULL as a stakeholder, is a senior researcher with extensive experience in living labs. This inclusion added a valuable perspective to the study. The interviews were planned through a prior email request and conducted online by the platform Teams with an average duration of thirty minutes each. With the participation consent and ensuring confidentiality, the interviews were recorded for accurate data analysis and discussion.

The interviewees were asked questions to explore their objectives and concerns related to the ongoing ULL in Utrecht. The semi-structured interviews started with an introductory question on their role in the ULL. This was followed by a set of questions that emerged from the interview guide, which can be found in Appendix A. The guide was designed to ensure that all relevant topics were discussed in relation to the research question. The main objective of this data collection was to find mechanisms and different approaches

to ULLs, as well as the challenges that these have encountered in the past ULLs, and the current issues faced in the ongoing *Green in City Centre UU ULL*.

Interviewees	Role	Date of interview
Interviewee 1 (I1)	Stakeholder and facilitator of <i>UULabs Green in City Centre</i>	24.04.2023
Interviewee 2 (I2)	External stakeholder of <i>UULabs Green in City Centre</i>	26.04.2023
Interviewee 3 (I3)	Stakeholders and initiator of <i>UULabs Green in City Centre</i>	04.05.2023
Interviewee 4 (I4)	External stakeholders of <i>UULabs Green in City Centre</i> and PhD student on evaluating livings labs to achieve sustainability	09.05.2023
Interviewee 5 (I5)	Stakeholders of <i>UULabs Green in City Centre</i> and sustainability supporter/advisor in the Province of Utrecht	10.05.2023
Interviewee 6 (I6)	Stakeholders of <i>UULabs Green in City Centre</i>	10.05.2023
Interviewee 7 (I7)	Social Scientist/Interdisciplinary senior researcher	07.06.2023
Interviewee 8 (I8)	Stakeholder and facilitator of <i>UULabs Green in City Centre</i>	13.06.2023

Table 1: Interviewees and Roles

Activities	Participants	Date
Weekly office-based observation – Green Office, UU, Utrecht	Facilitators from the UU ULL – Green in City Centre	01.05.2023-15.06.2023
Field trip – Utrecht City centre	Stakeholders from the UU ULL – Green in City Centre	01.05.2023
Meeting – Green Office, UU, Utrecht		15.06.2023

Table 2: Participant observation

Participant observation was the second source of data collection but was as important as the first (Table 2). This method is highly effective in providing valuable information on observed behaviour during a specific time period in the case study (Bryman, 2016). This process involved closely focusing in-depth on the procedures and identifying success factors and potential challenges during the various meetings of stakeholders. The first field trip involved in this data collection aimed to collectively make a decision on the chosen location for the ULL (Appendix C). The process was crucial for the future design of the ULL. During the data collection process, a meeting was also held with stakeholders in the last week. To add value, informal data collection was conducted by taking meetings and field notes during participant observation. This research method helped the research to effectively document observations, reflections, and analytical insights (Bryman, 2016). By combining these data collection methods, a deep understanding was gained of the stakeholders and the future of the analysed ULL. Their engagement and participation in the ULL also supported and contributed to the stakeholder co-creation literature review. Overall, engaging and participating in the ULL also supported and contributed to the stakeholder co-creation literature review.

3.3. Data analysis

Qualitative data analysis generates a large amount of material to analyse (Bryman, 2016). The analysis of collected data for this case study was examined carefully for the correct understanding of the final results and discussion section of this research. A suitable approach for this type of qualitative research is thematic analysis because it emphasises

repetition or pattern searching within the data (Bryman, 2016). More specifically, to guide the data analysis the research explores the method by Gioia et al. (2012). This methodology for qualitative data analysis aims to combine systematic rigour with creative thinking. The analysis was divided into “1st-order” and “2nd-order” allowing to organize the results section into a more structured form (Gioia et al., 2012). During the coding process, first-order codes were assigned to the language and perspectives used by interviewees, while second-order codes were applied to the researchers' interpretation and analysis (Table 3). The inclusion of both analyses helped establish a connection between the collected data and the derivation of general principles or concepts from specific observations (Gioia et al., 2012). This method enabled the discovery of valuable insights and the development of a contribution based on the research findings.

The main unit of analysis for this research was through interviews and field and meeting notes on the participant observation of the key stakeholders of the *Green in City Centre UU ULL* in Utrecht. The interviews and field notes were transcribed word-for-word and were then carefully analysed through the coding process, which is a crucial step in the data analysis process (Bryman & Burgess, 2002). For the coding process, the software NVIVO was used as the main tool to process the qualitative data analysis. Coding is a process where the data collection is subdivided and assigned into categories (Wong, 2008). The transcribed texts, notes, and documents were sorted into their respective categories and added to the NVIVO software along with their information (Appendix B). The purpose of performing this data analysis in this manner was to pinpoint common themes and patterns that were relevant to the research question of this study. The interviews mainly consisted of open-ended questions, and as a result, stakeholders expressed similar ideas using different words. These ideas were then categorised into common groups. Other sources of data were analysed such as documents and field notes from members of ULL before this research. This enhanced comprehension of the holistic approach to ULLs functionality and nature, and provided additional insights from participant observations and interviews.

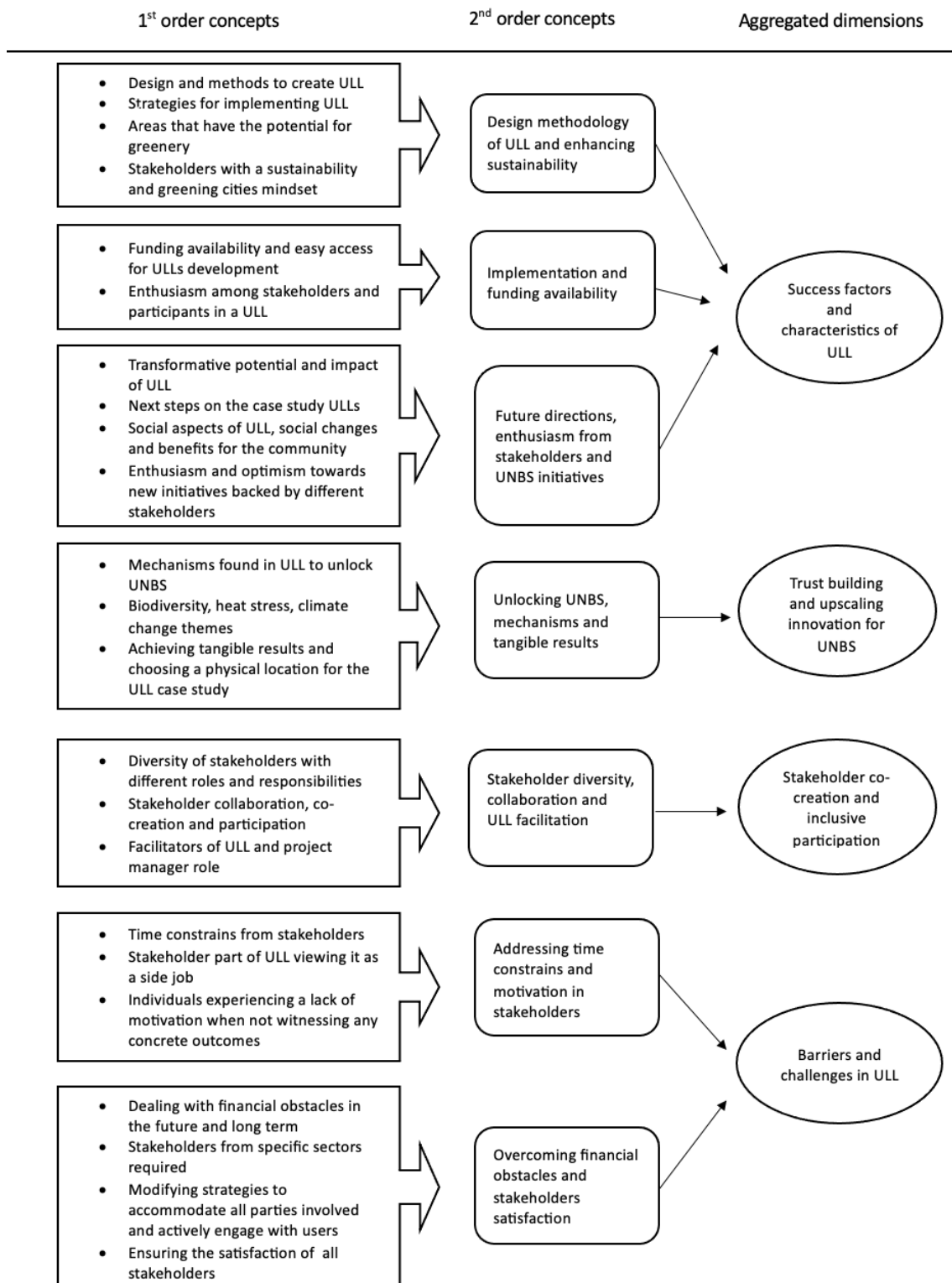


Table 3: Gioia table (Gioia et al., 2012)

4. Results

This chapter elaborates on the findings of two months and a half of data collection. It includes findings from interviews, participant observation, and field notes, as well as meeting notes from the case study. The data analysis questioned the success factors of ULL, co-creation aspects for stakeholders, and barriers to ULL. The findings led to the identification of three themes, which are discussed in the discussion section of the paper.

This section allows us to answer the following research question: *What role can ULL play in bringing together stakeholder co-creation to realise UNBS?*. The results discovered key roles that ULLs could play in stakeholder co-creation, particularly when realizing and aiming to upscale UNBS. Stakeholder participation, co-creation, and roles and responsibilities within living labs are also discussed.

4.1. Key Success Factors and Characteristics for Achieving ULLs

The data analysis revealed several success factors and characteristics of ULLs. One significant document that contributed to the establishment of the ULL in the city centre of Utrecht was from the *UULabs – Living Labs for Sustainable Development*. The goal of this ULL was to identify a university-owned location in the city centre of Utrecht to establish a ULL. While the university had planned various living labs in the *Science Park* region of Utrecht, none had been established in the city centre. In addition, other sources of data analysis contributed to this section, providing insights into ULLs' success factors. These included the correct design and implementation, stakeholder co-creation and collaboration, transformative potential and funding availability. These characteristics represent the various perspectives of interviewees and the participant observation on the inclusion of the case study.

Design and Implementation

The design of the *ULL in the city centre of Utrecht* was initiated with two main drivers—both sharing concerns about the future of the city centre. The facilitator explained:

It started with someone saying that the city centre used to be a lot greener and certain aspects were disappearing (I8).

The ULL was created to tackle research topics and come up with design solutions to address them. There was a desire to improve and enhance areas to mitigate heat stress, biodiversity, cultural heritage and future learning spaces. The alignment of ULLs with these sustainability goals reflected a broader commitment to addressing and promoting urban sustainable development. One prominent factor that emerged from the interviews was stakeholders' involvement in ensuring the success of the ULLs' initiatives. Stakeholders promptly responded to the identified needs, and the project leaders were able to quickly involve various stakeholders with their connections in the university network.

We initially reached out to a few people we thought would be useful. It was an interesting process because it was highly embraced by the people we reached out to (I8). (...) then people suggested to people from their own network and I was able to get in touch or connect to them (I1).

Two participants also emphasized that the city centre's development of living labs is crucial as regulations shift towards sustainability, encouraging more to develop in the future.

Transformative potential and mechanisms to unlock UNBS

The findings highlight further success factors, particularly related to UNBS. The ongoing ULL addressed the pressing issue of heat stress in the city, focusing on climate adaptation and resilience:

It is an important issue to reduce heat stress - when there is a demand from society for the topics, then this living lab will help. And yes, there is an urgent demand at the moment for reducing heat stress in cities (I5).

There are nature-based solutions for heat stress and sort of feeling that you are in a green area, the climate feels nice and looks nice, you feel tranquil (I8).

Furthermore, stakeholders at the ULL had displayed a remarkable dedication to sustainability, despite it not being their primary job:

People that are working with living labs and collaborative projects are really enthusiastic about sustainability and they do that in their free time (I4).

Sustainability is a long run, we are not here to quick fix, it is a real transformation (I4).

One interviewee brought to attention that the ongoing demolitions and reconstructions throughout various locations of the city presented opportunities for the ULL to exhibit its transformative potential for scaling up and contributing to UNBS. This indicated that various stakeholders had varying interests in the benefits of UNBS, but they could collaborate to achieve them. The ULL served as a platform to unite these stakeholders:

It can be more attractive than it is right now in the coming years, there will be a lot of developments because some of the buildings will be renovated or even demolished (I2).

There are people that want to use NBS to decrease the temperature of buildings and there is other that just want a building that looks a bit more beautiful and for the place to be more accessible and nicer (I4).

During the interviews, key mechanisms for developing ULLs mentioned were trust building, knowledge sharing, and bringing stakeholders together. Regarding how ULLs measure success, an important aspect was also highlighted that plays a key role. The potential for transformative knowledge sharing was emphasized as a means for developing societal impact, even though it may not be immediately measurable. Interviewee 5 explained that ULLs could facilitate long-term changes and lead the way for future UNBS realisation. By tracking the knowledge from one stakeholder to another, knowledge sharing can be identified and learning processes can unlock this potential:

If you have the potential that this nature-based solution is copied 100 times but it is not yet realized, then the living lab has this potential. But to realize and measure this potential, you have to, for instance, organize learning processes. You do that from one stakeholder to the other stakeholder measuring the knowledge transfer. That's the way to do it, then you have some indications of learning (I5).

In terms of how this could be useful and transformative for UNBS, there was a particular emphasis on being location-specific:

I actually think that nature-based solutions play a big role with the location and you really need to build that depending on the context that you have. And living labs are all about the context (...). The living lab approach for nature-based solutions really aligns very well (I4).

In the questions concerning ULLs and the future of UNBS, it was suggested that providing space for such actions could be beneficial if the University were to focus on topics such as climate change, energy transition, air quality, and biodiversity. Although stakeholders generally acknowledged the potential of ULLs to support UNBS, Interviewee 6, pointed out the upscaling transformative potential:

There is an opportunity in ULL to facilitate UNBS, absolutely. I think it would be one of the main ways of really proofing nature-based solutions on a smaller scale and then use it for upscaling (I6).

Selection of physical location for ULLs

As part of the ULLs' design process, on May 1st, 2023, a location was selected for the development of the ongoing ULL. This was a collaborative process that involved visiting different locations (Appendix C), gathering input from stakeholders and allowing time for discussion. In the field notes, it was highlighted that the participants were very enthusiastic and motivated. They spent much time selecting the best place without showing any signs of concern about the time spent.

Initially, the facilitators (I1 & I8) gained access to the potential locations so they could explore them before the field trip. During the field trip, stakeholders visited the three possible locations owned by Utrecht University. To determine the best location, brainstorming sessions were conducted in small groups of three to four people. After careful consideration, the selected location was the Library Courtyard (location 1), which showed the greatest potential for impact and connectivity to the city. During the participant observation, it was discussed that people visit the courtyard as a tourist attraction of the city. It was also discussed that the selected location could serve as a testing ground for lowering the temperature in the city centre of Utrecht, in addressing

the issue of heat stress. Contrary to the first location, the Drift Gardens (location 2), already had significant greenery. Stakeholders discussed and decided to use this location as a pilot site for future comparisons with the Library Courtyard. Weeks later, a comparison was conducted to evaluate heat stress, demonstrating and confirming that the gardens had a lower temperature compared to the Courtyard.

Though, the importance of choosing a physical space is not always necessary, as stated by Interviewee 7, who suggested that social changes can also benefit the community involved in the ULL: *“If the solution is not physically changing the space then it might be socially changing the space”* (I7). This resulted in viewing ULLs as a more democratic approach to implementing UNBS because they provide a platform for understanding what people want and what is important to them, instead of assuming their needs. They allow for direct engagement with the users:

Urban living labs are a more democratic way to implement urban nature-based solutions. While trees are often perceived as essential for providing shade, it is important to think of the diverse preferences of people. Some people may prefer walking under trees to sitting under them because it is really hot. If you involve the users you can also learn from them and then replicate it in different spaces (I7).

Funding availability

During the interviews, different insights were expressed regarding the availability of funding/financing of ULLs. It was noted that government institutions play a vital role in starting and supporting ULL programs. However, it was unclear which funding sources were specifically designated for ULLs. Some assumed that research from the Universities and public funding might be involved in the future:

Regarding financing, I am aware that there is a significant amount of funding available from the government, either through the ministry or the province, and they are actively looking for projects to invest in (I3).

We may seek funding from external sources like a collective or the municipality of Utrecht. If not available, we could start a student-led research project to showcase the value and attract future funding from the University (I1).

One specific participant highlighted the expense of financing research, but the approach was contrasted when another stakeholder viewed this as advantageous for attracting funding. On the other hand, in the early stages of the ULL one stakeholder mentioned that you could get access to funding, this phase allowed to prove the concept and first ideas of the project. The stakeholder referenced other past projects that were successful. During the early stages of ULLs, Interviewee 6 mentioned that funding is accessible to prove the concept and initial ideas of the project. The stakeholder also provided references to past successful projects:

I suggest linking or establishing contracts for funding with an initial incubator project phase. If the incubator is successful, additional funding can be activated. This approach is similar to the one used in the pathways to sustainability, where an initial phase is used to test and prove the concept and initial ideas (I6).

During the interview, one participant admitted to being unsure about achieving perfect results but recognized the importance of undertaking the project nonetheless. The involvement of other stakeholders, such as businesses, could also offer financial support and invest time towards the project. The participants noted that receiving services and analysis without direct payment is a form of financing. To fully grasp all possible financing options, it is also essential to review the limitations and future research section of this paper, that highlights barriers and challenges that were identified during the interviews.

Future directions

During the last ULL meeting, it was observed that stakeholders agreed that the societal impact of the project must be a critical measure of success. Further, two main objectives were prioritized. The first objective was to identify the primary user of the ULL, and the second objective was to select the initial experiment that would be conducted for the ULL. The next follow-up meeting is scheduled to take place within the next three months when the academic year starts. It is important to note that stakeholders expressed satisfaction with the meeting's outcome, as the objectives and key users of the ULL were effectively narrowed down according to the meeting notes during the data collection process.

4.2. Stakeholders' roles in the co-creation process of ULLs

In this part of the results, the importance of stakeholder co-creation and coordination is emphasized, as well as the diverse backgrounds, expertise and motivations that these hold. The findings suggest a crucial role that can aid in supporting UNBS, which is elaborated on in the discussion section. The discussed and analysed ULLs were a combination of collaborative efforts between various stakeholders with different roles. The individuals involved in this project had various roles, including advisors, campus developers, university researchers, legislative organization representatives, and university staff members. During the interviews, stakeholders were asked about their roles and backgrounds, and they each shared their unique perspectives and approaches to the ULL project. They emphasized the importance of including diverse roles and perspectives from the City Centre, not just limited to the university:

There are about a dozen interested individuals involved, including university students, teachers, support staff, members of the City Council, and other people from the community. The goal is to make this initiative not just for the university, but for the residents of the City Centre as well (I3).

During the meeting and field trip, a facilitator or process manager was present to manage time and coordinate various tasks within the group, such as location selection, time management and brainstorming. It was noticed that the facilitator's role greatly affected the accuracy of the results. This highlights the important role that ULLs can have once UNBS is implemented. This key stakeholder also provided meeting summaries, captured key takeaways, and maintained a record of the entire process. It was observed that the facilitator effectively engaged stakeholders by discussing their interests and motivations. This created a circle of dialogue and encouraged active listening among the participants. As a result, stakeholder collaborations were facilitated and their interests were aligned. Further, in the ULL setting, data collection revealed key interactions. Their interactions reflected a shared belief in the future benefits of the ULL and expressed enthusiasm and optimism throughout the design and implementation process. The communication was observed easy and stakeholders were personally invested in the project's success. It was evident that they were interested in the ULL, either because of its personal significance

or because of their involvement in related work or projects. The following quotes support this:

There is an appetite for living labs, people are very interested (I1).

You could notice when people were interested, either because they found it a very meaningful living lab or because it is connected to what they are doing in their everyday work already (I2).

My work involves greening and university-related matters, which makes me interested in working in an environment that is sustainable, pleasant, and promotes well-being. Additionally, I consider the various stakeholders of the university and how to involve them (...). So, I would say my interest in this topic is also personal (I6).

The quotes indicate that stakeholders were enthusiastic and had personal connections to the analysed ULL. This demonstrates a high level of interest and engagement in the project, highlighting their involvement and reinforcing the significance of their participation.

5. Discussion

5.1. Discussion

The study's findings show that ULLs can serve three important roles in achieving UNBS by bringing together stakeholder co-creation. These include trust building, upscaling predefined innovation, and promoting inclusive participation. This discussion section of the research paper analyses and interprets the results linking to the theory presented in the literature review. It highlights the significance of the findings, key implications, and offers practical applications for future research. The case study has contributed to both current and past research on ULLs and UNBS.

5.1.1. Trust building for stakeholders IN UNBS

Trust and openness among stakeholders were interpreted as a key role to facilitate UNBS. It was observed during the interviews and participant observation of the case study that stakeholders emphasized the importance of achieving multiple urban goals and wanted to ensure that all participants benefited from the ULL's initiatives. Interviewees were eager to discuss during the meetings and field trips, implying a high interest in sharing knowledge. The current literature emphasizes the need for improved collaboration in UNBS (Dorst et al., 2022) and this can be facilitated by this ULLs role. Data collected in the *ULL in the City Centre of Utrecht* revealed that stakeholders had different motivations and goals regarding the ULL's outcome. Some wanted to enhance the aesthetic appeal of the city centre by making one of the locations more beautiful while the goal of reducing heat stress drove others. This diversity meant building trust in ULLs requires more than establishing a common purpose. Collaboration among stakeholders is crucial, as emphasized by Kazadi et al. (2016) and ULLs can play a significant role in promoting improved collaboration at UNBS despite the diversity of motivations and goals among stakeholders. It is important to acknowledge that the successful implementation of the ULL in Utrecht was made possible because of the role of the project leaders and facilitators. Their contribution was essential in promoting dialogue during meetings and the field trip. Their role was crucial as they considered the diverse perspectives of stakeholders and developed a solution that met the objectives of everyone involved. This

data collection fostered stakeholder co-creation, which was examined in the literature review chapter.

Concluding this finding, trust and collaboration was fostered during the process and the future direction of the ULL. Additionally, the stakeholders who were initially motivated by the desire for a more beautiful city centre could also then appreciate the importance of addressing heat stress. This ensured that multiple perspectives were considered and resulted in a more holistic implementation of UNBS. The lack of joint action and collaboration between various stakeholders, as mentioned by Dorst et al. (2020), hinders the progress of UNBS implementation. Therefore, trust-building within ULLs can help overcome this barrier by fostering relationships and establishing a shared purpose from stakeholders from different backgrounds. ULLs bridge the gap in collaboration efforts, resulting in a more effective and coordinated implementation of UNBS. This adds depth to the existing literature by providing a tool to fit and engage multiple-stakeholders perspectives in UNBS.

5.1.2. Upscaling predefined innovation for UNBS

The ULL's objective aimed to address four main goals (heat stress, biodiversity, cultural heritage and future learning spaces). The data analysis showed that choosing a physical location was an important step for the ULL's ongoing process. ULLs have the role of supporting the fact that UNBS help protect the environment and have positive impacts on both humans and nature (Tozer et al., 2023). Ershad Sarabi et al. (2019) identified institutional barriers that can hinder the planning, execution and management of UNBS. The results of this research suggest that utilizing ULLs for the planning process provides a structured approach that would not be possible if either the municipality or university had attempted it alone.

For UNBS to remain in a competitive advantage, stakeholders require for new capabilities to address challenges and adapt to environmental changes during the innovation process (Kazadi et al., 2016). Previous research on stakeholder co-creation does not address the link between stakeholder co-creation during the innovation process and its performance (Laursen & Salter, 2006). Achieving urban sustainable transitions through innovation processes, particularly in UNBS, previous research says that it is not a straightforward task of scaling up pre-existing innovations (Tozer et al., 2022). Because physical characteristics still need to be tailed (Dorst et al., 2019), ULLs provide the role of

upscaling and replicating. Interviewee 6 said that ULLs could be used as a method for testing UNBS on a smaller level before implementing them on a larger scale.

5.1.3. Fostering inclusive social outcomes, addressing users' needs and promoting learning processes for UNBS

The success factors and characteristics of the ULL have led to the emergence of a new role that impacts the social aspect. UNBS provide benefits to various urban stakeholders such as ecological services, and social and economic advantages (Toxopeus & Polzin, 2021). The desired outcomes are closely linked to improving the social dimensions of well-being and quality of life in urban areas. One key finding related to the drive of social and environmental goals of stakeholders was found during Interview 7, it highlighted the positive impact of ULL on social outcomes when implementing UNBS. This shows how ULLs can meet the needs of its users while also benefiting society. Even though in the case study selecting a space was part of the process, it was highlighted that the selection of a physical space is not always necessary, as social changes can also have a positive impact on the community involved. As expressed by Interviewee 7, *“If the solution is not physically changing the space, then it might be socially changing the space.”* This emphasizes the democratic nature of ULLs when implementing UNBS. While trees are often provided for shade as an essential solution, it is crucial to consider the diverse perspectives of individuals, because maybe these prefer walking under the trees to reduce heat stress.

The importance of ULL users was further emphasized during the participant observation of the ULL in Utrecht's city centre. This observation highlighted the need for a well-defined process to ensure the project's success. This role highlights potential solutions to the barriers when integrating UNBS, specifically structural conditions and socio-institutional obstacles (Ershad Sarabi et al., 2019). Additionally, according to Dorst et al. (2022), citizen engagement was a significant structural barrier when implementing UNBS. The findings show that prioritizing users in UNBS implementation through ULLs has a positive impact on the social aspect. It highlights the importance of user involvement.

Further, by measuring success, ULLs can play a crucial role in promoting UNBS. The findings show that to achieve social impact, sharing knowledge transfer is essential. However, measuring the success of ULLs based on knowledge sharing does not come

with an immediate result. Interviewee 5 stated that there is potential for particular UNBS to be replicated multiple times and that ULLs can facilitate this replication. Understanding that knowledge is co-created through multiple stakeholders (Kazadi et al., 2016) and that knowledge sharing is recognized as one of the key enablers of UNBS (Ershad Sarabi et al., 2019), the role of learning processes within ULLs aligns with the broader literature on promoting and implementing UNBS. Concluding, ULLs can enable the replication of UNBS by organizing learning processes and measuring knowledge transfer between stakeholders. This role provides a tool for UNBS to also measure their impact in the future while contributing to and enhancing its long-term changes.

5.2. Theoretical implication

Few studies have explored the use of ULLs to achieve UNBS and the crucial role that ULLs can play in bringing stakeholders together. Through a thorough analysis of the urban living lab process and the roles involved, UNBS can overcome current barriers and foster more engaged stakeholders. Validity is added to the research by utilizing different methods to develop UNBS and overcome key barriers. The need for improved collaboration of UNBS as asserted by Dorst et al. (2022) is addressed through the implementation of the ULL structure. While the research focused on a single case study, exploring and developing theories around this approach may develop more theories in addressing this challenge. By identifying barriers to UNBS and applying for the identified roles, meaningful insights can be gained, and applied theories can be investigated. The identified roles being trust building for stakeholders, upscaling predefined innovation and fostering inclusive social outcomes, addressing users' needs and promoting learning processes for UNBS are can empower the development of UNBS in urban areas.

As such, the study supports the theory of stakeholder co-creation and emphasizes that implementing this approach increases stakeholder efficiency. The study suggests that ULLs have a significant impact on the development of UNBS, particularly in terms of its social impact. ULLs are a promising tool for facilitating stakeholder co-creation for UNBS, encouraging innovation from diverse sources and fostering a conducive environment for stakeholders to work together towards ULL development, as seen in the Living Labs Triangle (Figure 2) (Veeckman et al., 2013). This study provides a new approach that clearly identifies roles that were not previously linked in existing theories.

5.3. Managerial implication

This study has important implications for policymakers and decision-makers who want to support the transition towards green cities and urban sustainable development through Urban Nature-Based Solutions (UNBS) and Urban Living Labs (ULL). The research suggests that providing funding for ULL and UNBS is a crucial step towards achieving these goals. The study also highlights the importance of stakeholder co-creation and diversity in the development of ULL, emphasizing the need for inclusivity and decision-making processes that involve diverse stakeholders. The transformative potential of ULL in achieving its goals ensures and encourages its development, underscoring the importance of fostering strong relationships among stakeholders who share the same goals. The research also identifies challenges and barriers that ULL face. UNBS can prioritize trust building through ULLs, adopting effective stakeholder co-creation to enhance predefined innovation and promote innovation processes. Decision-makers can involve users and diverse stakeholders in the implementation of UNBS through ULLs. By fostering inclusive social outcomes, addressing users' needs and promoting learning processes, decision-makers can involve users and diverse stakeholders in the implementation of UNBS through ULLs. Prioritizing the diverse perspectives and considering its social impact may imply their implementation. Additionally, learning processes can be organized to measure knowledge transfer and evaluate the success of UNBS. As interviewee 7 said, *“this is the phase for living labs and nature-based solutions to interact”*, so the transition must be supported and promoted through this practical guidance.

According to Ershad Sarabi et al. (2019), challenges that may hinder the process of UNBS include can be institutional fragmentation, a lack of policy and regulatory capacity, and limited awareness and comprehension (institutional factors) and climate-related limitations (biophysical factors). It is known that UNBS can be developed without the involvement of ULLs, but it also highlights the importance of successfully overcoming challenges during implementation. It is valuable for policymakers to recognize the contribution that ULLs can make towards achieving the Sustainable Development Goals (UN, Sustainable Development Goals, 2023). Stakeholders showed dedication towards ULL and its potential to contribute to these goals, specifically SDGs 11 and 17. However, they expressed a lack of measures or indications to do so. This implies that managers and those involved in ULL and UNBS should keep this in mind. The research can be viewed

as a guide for policymakers and decision-makers looking to support sustainable and urban development through ULL and UNBS.

5.4. Limitations and future research

This research's limitations are mainly related to its practical approach and methodology. The research focused on a particular Urban Living Lab (ULL) in the centre of Utrecht. However, since the ULL was still in progress, the findings only pertained to its current state and not the final results, which limited the findings to the short term. The study focused on a specific urban space within the city with goals related to cultural heritage, biodiversity, future learning spaces, and heat stress. As such, the findings may not be directly relevant to other ULLs with different goals. Therefore it may not be applicable to all ULLs. Additionally, the study relied on self-reported data from stakeholders, which may be subject to biases and limitations in terms of reliability and objectivity. Another limitation was the time horizon of this research was contacting stakeholders, and interviewing in the given time was challenging. Furthermore, the availability and willingness to be interviewed by the stakeholders were affected, clearly represented in the efficiency of the number of interviews aimed for and the ones conducted. Regarding the study's trustworthiness, it was not possible to send the results to the ULLs case study participants due to time limitations. This means that the interpretation of the findings may not be 100% valid. However, despite its limitations, future research can overcome and explore the validity of the study.

During the interviews, stakeholders frequently discussed the barriers and challenges of ULLs development, even though it was not the main research question's focus. They made it clear that tangible results in ULLs require a significant amount of time and cannot be achieved within the next year or by the end of this research. Although most stakeholders were optimistic about this specific case study, some noted a lack of enthusiasm and motivation in past living lab experiences. Further, limited free time and viewing ULLs as a secondary priority meant the consequence of a lack of stakeholder participation. The availability of funding for projects promoting ULLs was also emphasized during the interviews with key stakeholders. Most stakeholders identified financing as a major challenge in this particular ULL. They recognized that securing funding for costly projects requires meticulous planning, and this is a significant barrier: *"I think that financing might be one of the biggest challenges with this lab (II)"*.

Therefore, stakeholders must seek funding opportunities from government bodies, apply for grants, and collaborate with other living lab groups. Stakeholders have acknowledged that ULLs are long-term projects, and significant outcomes may take time to materialize. Additionally, assuring long-term operation is a barrier that can be linked to the issue of securing funding for ULL in the long run (Hossain, Leminen, & Westerlund, 2019), as discussed in the Literature Review section. Depending solely on project-based funding from national or regional sources is not a viable and beneficial solution for the long-term sustainability of ULLs.

To ensure the success of ULLs, it is important to address the barriers and challenges they face. Collaborative UNBS involving different stakeholders should be studied to analyse their challenges and see positive outcomes when ULL roles are applied. While this study identified potential key roles for ULLs in realizing UNBS, further research is needed to understand their long-term impact and outcomes.

6. Conclusion

In response to the research question, "*What role can ULL play in bringing together stakeholder co-creation to realize UNBS?*" there are three main roles that can empower the development of UNBS in urban areas and cities. Firstly, ULLs can encourage trust-building with stakeholders of UNBS, which is essential to foster collaboration. Secondly, ULLs can upscale predefined innovations for UNBS, allowing for testing and replication on a smaller scale before implementing UNBS on a larger scale. Thirdly, ULLs can prioritize and foster inclusive social outcomes by addressing users' needs while promoting learning processes for UNBS. By involving users and diverse stakeholders, ULLs provide effectiveness and a positive social impact on UNBS.

The study provides a novel perspective and fills a gap in prior research by identifying previously unconnected roles. It highlights the connection between stakeholder co-creation and its performance through the success of ULLs. The findings suggest that UNBS can benefit from implementing this approach in the future. The paper analysed how ULLs can facilitate UNBS to overcome their main barriers. The case study revealed that there is a strong demand for more ULLs, which therefore presents an opportunity to use these tools to address the identified barriers. Further research and encouragement can be pursued in this area. Theoretical and managerial implications can guide and inform policymakers and decision-makers on transitioning to sustainable urban development through ULLs and UNBS.

References

- Almirall, E., & Wareham, J. (2008). Living labs and open innovation: Roles and applicability. *eJOV: The Electronic Journal for Virtual Organization & Networks*, 10.
- Almirall, E., Lee, M., & Wareham, J. (2012). Mapping living labs in the landscape of innovation methodologies. *Technology innovation management review*, 2(9).
- Beatley, T. (2012). Green urbanism: Learning from European cities. *Island press*.
- Bendapudi, N., & Leone, R. (2003). Psychological implications of customer participation in co-production. *Journal of Marketing*, 67 (1), 14-28.
- Biswal, B., Bolan, N., Zhu, Y., & Balasubramanian, R. (2022). Nature-based Systems (NbS) for mitigation of stormwater and air pollution in urban areas: A review. *Resources, Conservation and Recycling*, 186, 106578.
- Brears, R. (2018). *Blue and green cities: the role of blue-green infrastructure in managing urban water resources*. Springer.
- Breuste, J. (2023). The green city: general concept. In *Making Green Cities: concepts, challenges and practice*. Springer International Publishing, págs. 3-18.
- Bryman, A. (2016). *Social research methods*. Oxford university press.
- Bryman, A., & Burgess, R. (2002). *Analysing Qualitative Data*. Taylor & Francis e-Library.
- Bulkeley, H., Coenen, L., Frantzeskaki, N., Hartmann, C., Kronsell, A., Mai, L., . . . Voytenko Palgan, Y. (2016). Urban living labs: governing urban sustainability transitions. *Current opinion in environmental sustainability*, 22, 13-17.
- Dorst, H., Van der Jagt, A., Raven, R., & Runhaar, H. (2019). Urban greening through nature-based solutions—Key characteristics of an emerging concept. *Sustainable Cities and Society*, 49, 101620.
- Dorst, H., van der Jagt, A., Toxopeus, H., Tozer, L., Raven, R., & Runhaar, H. (2022). What's behind the barriers? Uncovering structural conditions working against urban nature-based solutions. *Landscape and Urban Planning*, 220, 104335.
- Ershad Sarabi, S., Han, Q., L. Romme, A. G., & de Vries, B. a. (2019). Key Enablers of and Barriers to the Uptake and Implementation of Nature-Based Solutions in Urban Settings: A Review. *Resources*, 8(3), 121.
- Ershad Sarabi, S., Han, Q., Romme, A., de Vries, B., & Wendling, L. (2019). Key enablers of and barriers to the uptake and implementation of nature-based solutions in urban settings: A review. *Resources*, 8(3), 121.
- Feola, G. (2015). Societal transformation in response to global environmental change: a review of emerging concepts. *Ambio* 44(5), 376-390.
- Fetting, C. (December de 2020). *The European Green Deal*. Obtenido de ESDN Report.
- Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. *Environmental science & policy*, 93, 101-111.
- Freeman, R. (1984). *Strategic Management: A Stakeholder Approach*.
- Freeman, R., & McVea, J. (2005). A stakeholder approach to strategic management. *The Blackwell handbook of strategic management*, 183-201.
- Freeman, R., Harrison, J., Wicks, A., Parmar, B., & De Colle, S. (2010). *Stakeholder Theory: The State of the Art*.

- Geneletti, D., & Zardo, L. (2016). Ecosystem-based adaptation in cities: An analysis of European urban climate adaptation plans. *Land Use policy*, Volume 50, Pages 38-47.
- Gioia, D., Corley, K., & Hamilton, A. (2012). Seeking qualitative rigor in inductive research: notes on the Gioia Methodology. *Sage Journals*.
- Glumac, B., & Islam, N. (2020). Housing preferences for adaptive re-use of office and industrial buildings: Demand side. *Sustainable cities and society*, 62, 102379.
- Hossain, M., Leminen, S., & Westerlund, M. (2019). A systematic review of living lab literature. *Journal of Cleaner Production* 213, 976-988.
- Hult, T., Mena, J., Ferrell, O., & Ferrell, L. (2011). Stakeholder marketing: A definition and conceptual framework. *AMS Review*, 1(1), 44-65.
- International Union for Conservation of Nature. (2016). Obtenido de Nature-based Solutions: <https://www.iucn.org/our-work/nature-based-solutions>
- Karatas, A., & El-Rayes, K. (2015). Evaluating the performance of sustainable development in urban neighborhoods based on the feedback of multiple stakeholders. *Sustainable Cities and Society*, 14, 374-382.
- Kazadi, K., Lievens, A., & Mahr, D. (2016). Stakeholder co-creation during the innovation process: Identifying capabilities for knowledge creation among multiple stakeholders. *Journal of Business Research*, Volume 69, Issue 2, 525-540.
- Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, 27 (2), 131-150.
- Leminen, S., Rajahonka, M., & Westerlund, M. (2017). Towards Third-Generation Living Lab Networks in Cities. *Technology Innovation Management Review*.
- Leminen, S., Westerlund, M., & Nyström, A.-G. (2012). Living Labs as Open-Innovation Networks. *Technology Innovation Management Review*.
- Lindfield, M., & Florian, S. (2012). *Green cities*. Asian Development Bank.
- Loureiro, S., Romero, J., & Bilro, R. (2020). Stakeholder engagement in co-creation processes for innovation: A systematic literature review and case study. *Journal of Business Research*, 119, 388-409.
- Maes, J., & Jacobs, S. (2017). Nature-Based Solutions for Europe's Sustainable Development. *Conservation letters*, 10(1), 121-124.
- Mahmoud, I., & Morello, E. (2018). Co-Creation Pathway as a catalyst for implementing Nature-based Solution in Urban Regeneration Strategies Learning from CLEVER Cities framework and Milano as test-bed. *Urbanistica Informazioni*, 278(3), 204-210.
- Nyström, A.-G., Leminen, S., Westerlund, M., & Kortelainen, M. (2014). Actor roles and role patterns influencing innovation in living labs. *Industrial Marketing Management*, 43(3), 438-495.
- Ramaswamy, V., & Guillard, F. (2010). Building the co-creative enterprise. *Harvard business review*, 88(10), 100-109.
- Sarabi, S., Han, Q., Romme, A. G., de Vries, B., Valkenburg, R., & den Ouden, E. (2020). Uptake and implementation of Nature-Based Solutions: An analysis of barriers using Interpretive Structural Modeling. *Journal of Environmental Management*, Volume 270.
- Semanjski, I., & Gautama, S. (2019). A collaborative stakeholder decision-making approach for sustainable urban logistics. *Sustainability*, 11(1), 234.
- Stuckrath, C., & Rosales, J. (2021). *UULabs model*.

- Sutinen , P., Erkkilä, K., Wollstén, P., Hagman, K., Hirvikoski, T., & Äyväri , A. (2016). KYKY Living Lab Handbook for Co-Creation by Schools and Companies. *Espoo, Finland: City of Espoo*.
- Toxopeus, H., & Polzin, F. (2021). Reviewing financing barriers and strategies for urban nature-based solutions. *Journal of Environmental Management* 289 .
- Tozer , L., Bulkeley, H., Kiss, B., Luque-Ayala, A., Palgan, Y., McCormick, K., & Wamsler, C. (2023). Nature for Resilience? The Politics of Governing Urban Nature. *Annals of the American Association of Geographers*, 113(3), 599-615., 599-615.
- Tozer, L., Bulkeley, H., van der Jagt , A., Toxopeus, H., Xie, L., & Runhaar, H. (2022). Catalyzing sustainability pathways: Navigating urban nature based solutions in Europe. *Global Environmental Change*, 74, 102521.
- UN, *Sustainable Development Goals*. (2023). Obtenido de <https://www.un.org/sustainabledevelopment/cities/>
- United Nations . (2018). Obtenido de <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>
- Van de Valk, K. (2020). Evaluating Tiny Houses as a sustainable answer to relieve the housing crisis in the Netherlands. *Research Gate*.
- Veeckman, C., Schuurman, D., Leminen, S., & Westerlund, M. (2013). Linking Living Lab Characteristics and Their Outcomes: Towards a Conceptual Framework. *Technology Innovation Management Review*.
- Westerlund, M., & Leminen, S. (2011). Managing the Challenges of Becoming an Open Innovation Company: Experiences from Living Labs. *Technology Innovation Management Review*, 1(1), 9-25.
- Wong, L. (2008). Data Analysis in Qualitative Research: A Brief Guide to Using Nvivo. *Malaysian family physician: the official journal of the Academy of Family Physicians of Malaysia* 3(1), 14-20.
- Xie , L., Bulkeley , H., & Tozer, L. (2022). Mainstreaming sustainable innovation: Unlocking the potential of nature-based solutions for climate change and biodiversity. *Environmental Science & Policy*, 132, , 119-130.
- Yin, R. (2002). *Case study research: Design and methods*. Thousand Oaks, CA: SAGE.

Appendix

Appendix A: Interview guide

Opening: Thank you very much for accepting the interview with me. Before I start I would like to introduce myself quickly so you can also understand the aim of my study. I am a master's student of Business and Social Impact at Utrecht University and I am currently writing my thesis in ULL as a way to realise UNBS. I am to find different roles and mechanisms that ULL can address and facilitate the development of UNBS. Since you are ____, I am interested on your insights on this topic.

Semi-structured interview guide

1. What is your role and responsibility in the ULL and your involvement as a stakeholder in the ULL activities?
2. How do you ensure that co-creation is inclusive and representative of the diverse perspectives and needs of all stakeholders through Living Labs? How important are stakeholders in living labs development?
3. What are some of the challenges and barriers that you have encountered in driving stakeholder co-creation in the ULL in Utrecht and how have you addressed them until this point?
4. How does the ULL in Utrecht align with the UU sustainability goals? Specifically, SDG's 11 and 17?
5. How do you see ULL contributing to the development of UNBS in the city? Do you believe ULL can support UNBS and how?
6. What are your expectations for the field trip for the Green in City Centre ULL?
7. How do you think having the Gemeente on board with the ULL could be valuable for the development of the ULL?
8. Do you have other experiences with Urban Living labs, if so, what were your key barriers and challenges?
9. What do you know about financing and funding of ULL?

Closing questions

10. Is there anything you would like to add that has not been discussed?
11. do you have any questions or clarifications?

Specific questions (additional to the previous questions)

Stakeholder from the province:

- How does the province measure the success of living labs ?
- How can and does the municipality/Gemeente/Province approach sustainability and NBS?

Stakeholder - Facilitator of UULabs

- How is the stakeholder participation and full engagement of participants?
- How is the municipality approaching this initiative? Are they willing to participate?
- What are the key needs and goals of the ULL in the City Centre?

Senior researcher – social housing and UNBS

- In your recent paper on social housing you used the living labs methodology, why did you choose this methodology for the study?
- What was effective in using the living lab approach in your past research?

Closing: Thank you again for your time and for sharing your insights. I am sure that your answers will give a lot of value to my research. If you have any further questions or feedback, do not hesitate to get into contact with me.

Appendix B: Coding scheme

Overarching theme	Sub-themes	Example of coded text
ULLs	Success factors	<i>The living lab is that everybody learns a lot, because it's research method is basically on learning.</i>
	Definition and characteristics	<i>I have a very simple definition of living labs and that is that the first criterium is that it's in real life and the second criterium is that there is a lot of user involvement.</i>
	Methods	<i>You try different methods to involve the citizens and then of course, when you have them involved, you have to make a design and you have to present the design...You go step by step through the process. You then decide after each step what will be the next step.</i>
	Stakeholders: challenges and barriers, participation and co-creation, stakeholder roles and responsibilities.	<i>Who are the stakeholders here? Let's talk about maybe citizens. Citizens for instance who are living in the neighborhood of these courtyards. Well, I think it, it would be interesting to see how to involve them in the ULL.</i>
	Challenges and barriers	<i>I would say the challenge is to get out of this academic bubble and therefore to put even more effort in contacting and involving other stakeholders.</i>
Ongoing UU-ULL case study	Design, success and implementation	<i>We started without funding, like in a very entrepreneurial way. We build the proposal to the university and working double time.</i>
	Future directions and implications	<i>We must decide on who will be the users of the ULL</i>

	Challenges and barriers	<i>There's so many different aspects to this lab that we kind of want to think about and address that it doesn't necessarily answer a really tangible problem that the university itself has.</i>
Facilitation of ULL for UNBS	Innovation and testing	<i>The type of innovation that you're doing in a living lab is really contextual.</i>
	Scaling and replication	<i>There is an opportunity in ULL to facilitate UNBS, absolutely. I think it would be one of the main ways of really proofing nature-based solutions on a smaller scale and then use it for upscaling.</i>
	ULL as a tool	<i>“Urban living labs are more a democratic way to implement urban nature-based solutions. While trees are often perceived as essential for providing shade, it is important to think of the diverse preferences of people. Some people may prefer walking under trees to sitting under them because it is really hot. If you involve the users you can also learn from them and then replicate it in different spaces”.</i>
Other ULL case studies		<i>In this case it was about gardens in social housing. You have these building blocks in apartment buildings and in the middle there is some garden. To make that garden more useful, you have to interact with the people living there and you also need to talk to the municipality, to the housing corporation to the landscaper who is also usually doing the work there...</i>
Initiatives on other urban sustainable development		<i>I'm working on giving support to innovations in the region of Utrecht for sustainability.</i>

Appendix C: Fieldtrip to the city centre – Evaluating locations (UULabs, Utrecht University, Living Labs for Sustainable Development)

Context:

After the last two brainstorm sessions it was time to visit the possible locations and visualise how our ideas and plans would work in reality.

We visited three locations on the day:

- 1) The Library Courtyard
- 2) Drift Gardens (Drift 25-15)
- 3) Drift (10,8,6)/ Boothstraat



At each location the groups evaluated the possible functions, research themes, areas for improvement and possibilities for collaborative transdisciplinary experimentation (See appendix I). At each location design ideas were also drawn (see appendix II). After visiting all three locations we had an initial vote of which location we thought most suitable. A clear preference was for location 1, but what followed was a lively debate over pro's and con's between location 1 and location 2. Location 3 received no votes of interest.

What follows outlines the key discussion points noted during the debate, and how location 1 and 2 would provide various interesting avenues, with very different pro's and con's for a green in the city centre lab.