Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Social and Educational Sciences
Department of Geography

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Urban Living Labs as an Approach for Co-Creating Sustainable Cities

A multiple case study of contemporary Urban Living Lab designs and their operationalization of co-creation methods in sustainable city contexts

Master's thesis in Globalisation and Sustainable Development
Supervisor: Hilde Refstie
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Abstract

As a response to the growing sustainability issues there are new types of collaborations emerging in the form of Urban Living Labs (ULL). ULLs are increasing in popularity as an approach for tackling sustainability challenges in urban cities. However, the role of ULLs in urban governance is not yet completely clear. This thesis takes form as a multiple case study by analyzing how the ULL approach is articulated, and co-creation operationalized, in contemporary projects and initiatives towards sustainable cities. The three ULL cases analyzed in this thesis are: United Future Lab (Ålesund, Norway), Bøker & Bylab (Trondheim, Norway), and Asprela + Sustentável (Porto, Portugal). Through applying qualitative research methods studying three separate cases, data was collected through nine semi-structured interviews providing the project to point to certain tendencies in the design of the ULL approach. Findings point to the three characteristics geographical embeddedness, experimentation and testing, and participation and user involvement as characteristics identified in the ULL design in the selected cases, in line with academic literature. Furthermore, findings suggest how co-creation is seen as a crucial element as part of the ULL approach in the selected cases, being characterized by partnerships between sectors (public-private-academia-citizens), and collaborations working towards a common goal of tackling sustainability issues. Tendencies suggest that main advantages of co-creation through the ULL approach in the cases was tightly linked to the big knowledge exchange occurring in cross-sectoral communication and citizen involvement, seen to increase the likelihood of producing better solutions for society and the environment. Furthermore, findings suggest a significant overlap in identified benefits and added value of the co-creation concept through the ULL approach, and the added value of the ULL approach in its entirety in the cases when working with sustainable city projects. Main findings in overlapping value are related to the ULL being a "physical neutral arena" for collaboration, facilitating innovation for all groups in society. However, findings do also point to a problematic nature with the cases co-creation process through the ULL approach, mainly identified as communication issues related to different value systems and predetermined habits of each stakeholder.

Preface

This master´s thesis was written to fulfill the graduation of the MSc in Globalisation and Sustainable Development at the Norwegian University of Science and Technology spring of 2022. Firstly, I would like to express my gratitude and special thanks to my Supervisor Hilde Refstie for her continuous support and guidance through this process, and for her immense knowledge and enthusiasm. Secondly, I would like to thank my research participants for their contribution to my research despite their busy schedules, and for providing me with your insights. Lastly, I want to thank to my amazing friends and family for their encouragement and support while writing this thesis.

Wida Angela Wingsnes
15th of May 2022

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List of Abbreviations

ULL	Urban Living Lab
NSD	The Norwegian Centre for Research Data
NTNU	The Norwegian University of Science and Technology
SDGs	Sustainable Development Goals
UN	United Nations
NMK	Norwegian Maritime Competence Center
EU	European Union
ENoLL	European Network of Living Labs
EEA Grants	European Economic Area Grants
JPI Urban Europe	Joint Programming Initiative Europe
U4SSC	United for Smart Sustainable Cities
UNECE	United Nations Economic Comission for Europe

1. Introduction

1.1 Rationale for the study

All cities are facing pressing challenges of how to provide economic prosperity and social inclusion, while still working towards and achieving environmental sustainability (Marvin, Bulkeley, Mai, McCormick & Palgan, 2018). City administration organs have in many ways been the leading forces of promoting initiatives that aim to create more sustainable futures, and small-scale experiments relating to the topic of urban sustainability have been flourishing in considerable numbers across the world (Marvin & Silver, 2016). However, as methods and research evolve, it has become clear that urban sustainability experimentation is not a singular phenomenon that can be understood by using only one conceptual entry point (Bulkeley, Marvin, Palgan, McCormick, Breitfuss-Loidl, Mai, Frantzeskaki, 2019). As a result, policymakers, funding bodies, charities and companies are increasing their focus on finding ways to translate direct experiments into broader change (Hodson, Evans & Schliwa, 2018). However, without collaboration between large numbers of both stakeholders and citizens, efforts towards solving sustainability issues are bound to be inadequate (Gallagher & Hartz-Karp, 2013). Co-creation as an approach towards problem-solving has therefore risen on the agenda (Lund, 2018). Co-creation in urban governance is thus argued to extend beyond stakeholder and citizen engagement, referring to a complete co-production of knowledge and sharing of solutions and implementation management (Mahmoud, Morello, Ludlow & Salvia, 2021).

Within the context of creating sustainable cities, and the need for multiple stakeholder collaborations, the concept of Urban Living Labs (ULLs) has emerged as a form of experimental governance bringing together stakeholders from different sectors to co-create, experiment, and produce solutions in real life settings (Mahmoud, 2021; Evans & Karvonen, 2014). While there is no uniform definition of ULLs, they can be described as urban sites providing an arena for learning within which the co-creation of innovation can be pursued between multiple stakeholders like public institutions, community actors, private sector, and research organizations, (Marvin et al., 2018).

This thesis takes form as a multiple case study researching three selected ULL cases to analyze their articulation of the ULL design and how they implement co-creation in their approach to develop solutions/practices/projects in their work towards a sustainable city. The ULL approach and its implementation of co-creation tools will be analyzed through the lens of academic literature and researchers' distinction of three main ULL characteristics: 1) *geographical embeddedness, 2) experimentation and testing,* and lastly 3) *participation and user involvement* (Voytenko et al., 2016; Bulkeley et al., 2018; Marvin et al., 2018). By analyzing the selected cases according to characteristics identified in ULL design from academic literature, it creates a baseline for a systematic analysis while still allowing space for further reflections and nuances to existing theory. Furthermore, emphasis on co-creation theory through the lens of the ULL approach in will provide an in-depth insight of ULLs benefits and/or challenges in the context of sustainable city co-creation.

1.2 Research Objective and Questions

As discussed above, ULLs are increasing in popularity as an approach for tackling sustainability challenges. However, at the same time, the role of ULLs in urban governance is not clear, whether it represents a completely new phenomenon replacing other forms of co-creation, participation, experimentation and learning in cities, or simply an extension of existing techniques and methods (Voytenko, 2016; Marvin et al., 2018). Followingly, Puerari et al. (2018) and Nesti (2018) discuss the wide consensus of co-creations importance in the ULL approach, however it remains understudied "how" and in "what ways" co-creation takes place in within the ULL-structure, and what impact it has. This thesis aims to address this gap by *analyzing how the ULL approach is articulated, and co-creation operationalized, in contemporary projects and initiatives towards sustainable cities*. The three ULL cases analyzed in this thesis are: United Future Lab (Ålesund, Norway), Bøker & Bylab (Trondheim, Norway), and Asprela + Sustentável (Porto, Portugal).

The research questions explored are:

1. How is the ULL approach articulated and applied in the selected projects, and what characterize their design and goals?
2. How is co-creation applied in the ULLs, and what are identified as the main advantages and challenges of co-creation through ULLs in work towards sustainable cities?
3. What is the Urban Living Lab approach seen to add to sustainable city-projects in the selected cases?

Through applying qualitative research methods, semi-structured interviews were conducted with nine interviewees from the three ULL cases (three from each case). All individuals interviewed represents central roles in their project. The interviews represent the majority of the data presented in the analysis, however additional documents and project reports provided to me by the interviewees themselves or found on their official webpages is added to the analysis to provide the general descriptions of the cases. Studying two cases in Norway and one in Portugal with initiators from both the public sector and an international funding program, will allow for analyzing a broader specter of ULLs and facilitate cross-case comparisons on a larger scale. The first research question aims to investigate how the ULL approach is designed and articulated in the selected cases, and what characterizes their visions and goals. The three ULL cases are selected based on their common use of the label "living lab/city lab/lab", they are applying ULL methodology in an existing urban context, and they all have an explicit objective to tackle problems related to environmental, social, or economic sustainability. The second research question addresses how the concept of co-creation is applied through the ULL framework in the selected cases, also focusing on what is identified as main advantages and challenges. The third research question aims to investigate what is seen by the interviewees as the added value of the ULL approach in in their projects working towards a sustainable cites.

Main findings suggest the concepts of geographical embeddedness, experimentation and testing, and participation and user involvement characterize the ULL design in the three cases studied in line with academic literature. Furthermore, interviewees point to co-creation being a is a crucial component in the ULL approach, characterized by cross-sectoral collaborations working towards a common goal of tackling sustainability issues. Main advantages of co-creation through the ULL approach in the selected cases were access broad specter of knowledge within the ULL stakeholders increasing the likelihood of producing better results, it is a neutral arena for collaboration facilitating innovation and solutions developed are likely to fill the needs of multiple societal groups. Main findings in precepted added value through ULLs include access to broader knowledge when developing projects/solutions, likelihood of solutions pleasing a larger range of societal groups and the environment, arena for citizen involvement, neutral physical arena for co-creation, less hierarchy, result evaluation in real time, easier to transfer solutions to other geographical areas, and potential funding.

1.3 Thesis Outline

In this first section of the thesis, I have demonstrated the rising attention given to sustainability projects in urban environments, and how ULLs are increasing in popularity as an approach for tackling sustainability challenges. Followingly, the next chapter (chapter 2) provides a theoretical framework creating a knowledge base for the empirical work of the thesis. The sections consist of: firstly, an historical context and definition to the concept of co-creation, secondly the chapter will elaborate on recent developments in co-creation literature adopting the framework to analyze ULLs in a sustainable city contexts, the last section explains how ULLs operate and provides an overview of three characteristics generally identified in the ULL approach in academic literature: *geographical embeddedness, experimentation and testing, and participation and citizen involvement*. Chapter 3 provides clarifications on the methodological framework adapted when conducting the research for this thesis by using qualitative research methods through semi-structured interviews and additional data collection from reports and selected webpages. Next, the chapter describes the data collection and data analyzing process, as well as rationalization of ethical considerations that were made, concluding with the trustworthiness of the study.

Chapter 4 presents how the data was analyzed separated into three sections. Firstly, a brief presentation of each ULL case is provided. Secondly follows a section on the cases design and application of the ULL approach structured according to the three characteristics *geographical embeddedness, experimentation and testing, and participation and citizen involvement* with particular emphasis on the last characteristic. Lastly data is analyzed to identify what is seen as the added value of the ULL approach in the selected cases. Chapter five provides a discussion on findings from the analysis addressed in response to the research questions: *how is the ULL approach articulated and applied in the selected projects, and what characterize their design and goals?; how is co-creation applied in the ULLs, and what are identified as the main advantages and challenges of co-creation through ULLs in work towards sustainable cities?; what is the Urban Living Lab approach seen to add to sustainable city-projects in the selected cases?*

Chapter 6 provides a brief summary and concluding remarks on the findings while reflections on the need for further research on the topic is addressed.

2. Co-creating Sustainable Cities Through Urban Living Labs

2.1 Co-Creation - Definition and Context

The concept of stakeholder participation within the field of urban governance has gone through a significant development in recent years (Lund, 2018). In academic scholarship, civic participation in governance and planning can be traced back to 1963 when Strauss argued that participation was a way to reduce inequalities in society. One of the most famous conceptualizations of participations is however the "ladder of citizen participation" proposed by Arnstein (1969) describing eight levels, ranging from "no participation" to "full citizen power". Participatory planning has also been prominent in development studies, literature and practice connected to bottom-up thinking on development in the 1980s and 1990s (Chambers, 1983). Up to and throughout the 1990s, the concept of participation in urban governance developed and was formalized in politics and in policy documents in many parts of the world (Lund, 2018). The context of the formalizations was much revolved around the citizens right to participate in the development of their local environments as part of building citizenship and local democratic engagement.

In addition to initiatives focused on participation as a means of empowerment to support inclusiveness, a more neoliberal strand of urban governance has also influenced the conceptualization of participation (Lund, 2018). Throughout the same period of the 1990s, new strands of public-private partnerships and networks developed as collaborative units to tackle different societal issues including social inclusion among other things. The reasoning for these new partnerships and networks of different sectors was that they were more inclusive than initiatives only based in the public sector because they created new arenas for participation and collaboration. The idea was also that these partnerships would release more funds and create more efficient strategies due to their cross-sector nature. The more recent forms of participation that are now mostly referred to as co-creation or co-production are thus not only judged on level of citizen- and sector inclusivity, but also on their level of innovativeness and their ability to deliver social services (Lund, 2018)

There is not one clear definition of co-creation in urban development, and how it is defined is commonly a result of the academic standpoint it is being produced from (Lund, 2018). The concept is often discussed in the frames of social innovation literature, in the private sector

innovation literature and in in the "communicative turn" in planning theory. A widely generic and literal definition of co-creation is "making something together", however when studying the concept more in detail it is more difficult to find a common conceptual consensus of the term (Puerari et al., 2018). When looking at the private sector co-creation is often revolved around methods that involve users in the development of the services and products (Prahalad & Ramaswamy, 2004). In the public sector, co-creation is also used as a method for addressing and solving complex societal problems within a set framework and strained budgets, this meaning solving problems in new ways by utilizing the resources that society possess (Voorberg, Bekkers, & Tummers, 2015).

Lund (2018) states how co-creation in urban development to some extent builds on knowledge from processes of innovation created in the private sector, which are applied to public service delivery. Studies on co-creation in the public sector shows tendencies of the main concern being to generate knowledge about citizens and their experiences with public services, to better identify the existing problems for the professionals to act on, rather than inventing a model that allows the citizens themselves to invent or produce new ideas and services of public value in which the public sector can support. Lund (2018) also stresses how co-creation in the public sector often is based on the individual citizens representation of groups or communities and their unique interaction and experiences with the specific public service being addressed.
Critiques argue how co-production within sustainability science often fails to adequately account for power within the science-society relationship, triggering questions regarding whose knowledge is being co-produced, for what outcomes, and who the knowledge is aiming to benefit. Concerns have also been highlighted about how the co-production term is being presented as a "*panacea*", pointing at value conflicts and the low public accountability that occurs when processes blur boundaries between sectors (Wyborn et al., 2019, p. 323).
Researchers have unpacked different aspects of participation, and in more recent years those aspects have been developed to analyze co-creation in a sustainable city context (Gohari, Ahlers, Nielsen & Junker, 2020).

Arnsteins ladder of citizen participation (1969) has been used by researchers to study modern concepts like smart cities where it has utility to examine how the citizens are positioned in practice (Gohari et al., 2020). However, despite its utility, Arnsteins model has also been critiqued for not fully account for important elements in citizen participation like the type, role, political discourse/framing and function (Cardullo and Kitchin 2019). With reference to

discussions on co-creation and multiple stakeholder experimentation platforms such as ULLs, there is thus a need for further broadening and reflection upon classic models on citizen participation. Mahmoud et al. (2021) discusses how co-creation in urban governance extends beyond stakeholder and citizen engagement and refer to the complete co-production of knowledge and sharing of solutions, implementation and management (Mahmoud et al., 2021). It responds to the need for establishing clear communication channels between cities´ local administration, stakeholders and citizens and overcoming silo boundaries necessary to transcend in sustainable city work.

As shown above, the concept of co-creation does not have one clear definition but consists of a mixture of ideas and perceptions that stem from a wide range of research traditions, including public service management, marketing, urban planning, design, and innovation (Lund, 2018). In this thesis, I refer to the general definition as provided of Lund (2018) that describes co-creation as "innovation and value creation taking place as a collaborative process involving different types of actors" (Lund 2018, p. 8). In this context it is also important to note how the terms co-creation and co-production seem to be related and is often discussed interchangeably in the literature (Voorberg et al., 2015). However, the concept of co-production "is seen as more service- and product-oriented as well as more concerned with cost reduction than value creation" (Lund, 2018, p. 6). Since the topic discussed in this thesis is not product oriented or focused on cost reduction, I will therefore refer to the concept of co-creation rather than co-production. Nesti (2018) argues how the growing body of the academic literature on co-production has led to a conceptual stretching of the term to cover other types of co-activities such as co-design and co-evaluation, to be applied to various services and include a wide range of participants. Therefore, in this thesis the term co-creation will also be used to cover the term co-design, due to their interchangeable significance in this particular study.

2.1.2 Co-Creating Sustainable Cities

Today, over half of the world´s population lives in cities, and by 2050 two-thirds of all civilization will be living in urban areas (UN Habitat, 2020). This has massive implications for the prospects for sustainable development. Cohen (2018) describes a sustainable city as a city with a goal to build human settlements that have the smallest impact possible on the environment. There is no clear consensus on what directly comprises a sustainable city in the literature. However, the key topics referred to by scholars include environmental, social, political, economic, demographic, cultural and institutional goals (Satterthwaite, 1997).

Sustainable Cities and Communities is also an own goal 11 in the Sustainable Development Goal (SDG) framework with a focus on making cities and human settlements inclusive, safe, resilient, and sustainable (United Nations, 2022).

As introduced above, the use of the concept "sustainable city" in strategic urban planning is often simply described as involving the stakes and rights of current and future generations, emphasizing humankinds' duty to reduce environmental degradation and global climate change while at the same time addressing issues related to socio-economic inequalities and *Leaving No One Behind* (Hatuka et al., 2018; United Nations, 2022). *Leave no one behind* is the central, promise of the 2030 agenda for the United Nations (UN) SDGs. The promise is a commitment of all member states of the UN to eradicate all poverty and end discrimination and exclusion (United Nations, 2022). The concept of the sustainable city is therefore concerned not only with environmental sustainability, but with all three dimensions of sustainability, including the social and economic dimensions (Hatuka et al., 2018). Spatially the concept of the sustainable city is typically concerned with the reconstruction and transformation of major societal infrastructures like energy efficiency, transportation systems, green areas, housing and so on.

The prospect of achieving sustainability depends on the collective effort of the societal actors of the city, the national government with all its institutions and private corporations (Hatuka et al., 2018). The implementation of work focused on the sustainable city is thus dependent on interventions at multiple societal levels, including municipalities and neighborhoods. Sustainability issues involve highly complex interactions between the three dimensions of sustainability which is very often viewed and tackled in very different ways according to different stakeholder groups (Gollagher & Hartz-Karp, 2013). There is not one single solution to solve sustainability issues, and in cities as elsewhere there is a need for multiple and variated sites of action to reach sustainability. Gollagher & Hartz-Karp (2013) discuss how problems that can be caused by "unsustainability" such as climate change have no single correct solution, and therefore they cannot be solved by the application of technical expertise alone. Without a collaboration between large numbers of stakeholders and citizens, solutions trying to solve sustainability issues are bound to be inadequate. The stakeholders that have a role in how the problem is defined and addressed, brings a variety of interests and personal priorities into the solution, as well as belief systems, values, knowledge, and perceptions.

> «Marshaling the knowledge, experience, information, resources, and readiness to share responsibility, authority, and power will require collaboration between governments, non-government organizations, the private sector, and civil society. Anything less than full participation by all who are connected in 'intricate web(s) of interactions in linked systems, both natural and social will reduce the prospects for success" (Gollagher & Hartz-Karp, 2013, p. 2346).

2.2 Urban Living labs as an Approach to Co-Creating the Sustainable City

As a response to the growing sustainability issues there are new types of collaborations emerging in the form of urban living labs (ULL), which can be described as sites to design, test and learn from social and technical innovation in real time through co-creation and experimentation between multiple sectors and societal actors (Marvin et al., 2018). Some scholars define ULLs as partnerships between sectors (usually public, private and citizens) where learning institutions play a big role, while others see living labs as a method for pilot and demonstration projects working like supportive tools for private actors when commercializing their services and products (Kommonen & Botero, 2013). Living labs can be viewed as an arena (limited geographical area or an institution), but also as an approach for intentional collaborative experimentation of researchers, citizens, companies, and local governments (Schliwa & McCormick, 2016).

Many projects studying and testing the living lab methodologies have emerged as a direct response to the sustainability challenges that cities are now facing (Voytenko et al., 2016). The concept of "Living Labs" was first introduced in the European Union (EU) in in 2006 when Finnish Presidency launched the European Network of Living Labs (ENoLL) and the European Commission started financing projects creating living labs[1] (Nesti, 2018). The recent growth in the exploration of the living lab directly linked to the availability of targeted funding from various stakeholders like JPI Urban Europe, EEA Grants and Horizon (EU funding programme), as well as funding from researchers, innovators, and municipalities (JPI Urban Europe, 2020; EEA Grants Portugal, 2019; European Commission, 2022; Voytenko et al., 2016).

[1] Placed under the Seventh Framework Programme for Research and Development within the smart city strategy (Nesti, 2018)

The debate on whether the living lab approaches can help govern sustainability and low carbon transitions in urban cities has been brought up in academic literature and professionals due to the rapid proliferation of the approach stressing the lack of research on to which extent these experimental interventions can effectively address the urban sustainability challenges (Bulkeley et al., 2018). Some point to that existing analysis of ULLs often remain very "broad-brush" and "mainstream", which can result in a limited understanding of drivers and results of ULLs (Bulkeley et al.,2018; Nesti, 2018). Another known critique that addresses not only the concept of cross-sectoral co-creation, but the ULL approach in particular, is the challenge with the limited duration of many projects as they are often seen to be shut down after the project period is complete, or when the funding stops (Mahmoud et al., 2021; Nesti, 2018). Some ULL projects, usually initiated or funded by international organizations like the EU, will usually last for about 3-5 years due to a set project duration period, and there is usually little systematic controlling of any practical outputs afterword (Mahmoud et al., 2021).

Through the ULL design, public, private, and community-based actors seek to deliver innovative and transformative development across the urban milieu through initiatives like green buildings and spaces, sustainable transportation, and energy systems, to social sustainability initiatives (Marvin et al., 2018). The ULL approach present a sort of evolution from the traditional living lab approach in which it stems from and it shares its basic characteristics, however the ULL term usually refers to a wide variety of local experimental projects with a participatory nature aimed at *urban* solutions (Nesti, 2018). Even though the term living labs have different areas of focus and their innovation activities represent diverse goals, ULLs fit the definition of the term created by Westerlund & Leminen (2011) describing a living lab as "a virtual reality or a physical region in which different stakeholders can form public-private-people partnerships of public agencies, firms, universities, and users collaborate to create, prototype, validate, and test new technologies, services, and systems in real-life contexts" (Westerlund & Leminen, 2011, p. 20). In this sense, it is arguable that the terms living labs and urban living labs can be used interchangeably, in this thesis however the term urban living lab (ULL) will be used since the cases studied are located in urban environments.

State actors in ULLs are mainly governmental, and Nesti (2018) through her study on three ULL cases found how a peculiar aspect of ULLs in comparison to mainstream co-production shows that ULLs pursue public innovation, in her research the municipalities try to find new

solutions to urban challenges. Further she adds how experimentation through ULLs can help local governments to break through two barriers to innovation: risk aversion and excessive bureaucracy. Nesti followingly stresses how co-creation[2] in ULLs suffers some limitations. Firstly, there is a common problem specifically in publicly initiated ULLs regarding the governance of co-creation, where civil servants as coordinators must adapt a radically new mindset that requires a flexible approach in opposition to their pre-determined habits. The specific role of public authorities broadly becomes that of the enabling state rather than a regulating state (Lund, 2018). The second challenge presented by Nesti (2018) is the more general problem of maintaining the motivation between stakeholders to collaborate. Mahmoud et al. (2021) establishes two important factors for success in co-creation through the ULL approach that responds directly to these challenges. Firstly, it requires a specific set of skills in areas such as facilitation and organization, meaning that there is a need for skills within structure and monitoring of outcomes in the ULL. Secondly, to create commitment and a sense of ownership of the involved stakeholders in the ULL there is a need for involving relevant stakeholders in the co-creation from the very beginning. There is a link between early stakeholder involvement and throughout the entire project, and ownership to the co-creation process and potential upscaling of solutions.

There is a wide consensus that achieving sustainability in urban areas is not a matter of gathering even more data, creating technical fixes, or establishing new institutions (Bulkeley et al., 2019). The changes that are required are in the ways in which systems of provision and services are organized, designed, and delivered. To reach these types of changes there is a need to encompass new technologies, new infrastructure, shifts in markets policy and culture. As a response to these challenges and the need for change, different types of urban governance are under development and is being tested in various European cities (Voytenko et al., 2016; Marvin & Silver, 2016). Urban living labs working towards sustainable cities emerging in Europe, have different goals and ways of working. They are initiated by various actors, and the partnerships they form vary in structure.

There is an increasing and vital need for these various governance actors to link their knowledge production and practices to both public visibilities of addressing key global socio-environmental concerns, as well as the strategic direction of future preparedness (Marvin &

[2] Nesti (2018) refers to co-production in her study

Silver, 2016). In this, ULLs play an increasingly central role in shaping particular urban transition pathways. This is particularly visible in cities with clear policy development concerned with low carbon agendas and sustainability. Voytenko et al. (2016) describes ULLs in relation to sustainable cities as "a form of experimental governance, whereby urban stakeholders develop and test new technologies, products, services and ways of living to produce innovative solutions to the challenges of climate change, resilience and urban sustainability" (Voytenko et al., 2016, p. 46).

Although ULLs all has unique characteristics, they are to be considered part of a wider politics of experimentation in not only large scale but also local sustainability governance (Kronsell & Mukthar-Landgren, 2018). This growing way of conceptualizing the living lab approach is not only focused on innovation in technologies like in its early stages, but the ULL seeks to solve issues of consumption, behavior, and lifestyles in cities facing sustainability challenges (Voytenko et al., 2016). When cities try to position and market themselves as innovation leaders in sustainability, ULLs can be perceived as high-profile statements with a clear goal, and they can help secure funding for sustainable urban development. In the other end, for governments and institutions offering funding, the ULL approach can be used as a motivator and encouragement for cities to adopt innovative solutions.

2.3 Characteristics of Urban Living Labs

Some researchers focus on the role of different actors in the co-creation processes to identify different types of ULLs, usually referring to the principal promoter or to the most active participant (Puerari, 2018). Another way to analyze ULLs is according to how they are designed, where three main characteristics in ULLs are identified by academics (Voytenko et al.,2016; Bulkeley et al., 2018; Marvin et al., 2018). The three characteristics identified are: geographical/*placed-based embeddedness* - ULLs are placed in a geographical area and seeks to undertake socio-technical experiments in a particular material setting. Secondly, *experimentation and testing* - ULL tests and experiments with new solutions, technologies, and policies in real-life conditions in visible ways with a focus on active forms of learning together with all involved stakeholders. Thirdly, *participation and user involvement* - co-design and participation with all stakeholders and citizens appears in all stages of the ULL approach. As previously stated, in this thesis the term co-creation will be used when referring to co-design. These three characteristics share the overarching objective of some form of evaluation and

learning where the ULL facilitates formalized learning among participants and helps to achieve their vision to act as urban labs or test beds. The concept of co-creation through the ULL approach has been discussed in previous sections of the thesis, the following two sections will clarify the terms *experimentation* and *geographical embeddedness* in the ULL approach, followed by a visualization of the three characteristics in figure 1.

2.3.1 Placed-based embeddedness

The experimentation in ULLs is often placed in a particular geographical area in the sense that they both represent ecosystems of open urban innovation, as well as being situated in real urban context where process takes place (Steenbergen & Frantzeskaki, 2018). The geographical area of focus can be region, a city, an agglomeration, or a neighbourhood/district or even a single building. Examining the impact of ULLs in an urban sustainability context, requires some understanding of its geographical embeddedness. Steenbergen and Frantzeskaki (2018) states how it remains unclear in what way place based embeddedness influences the impact of the ULL, but further examination of the effects of the geographical area on the experimentation is encouraged.

2.3.2 Experimentation and testing

Sengers, Späth and Raven (2018) distinguish between the notion of experimentation, and experiments and ULLs. Experiments are concrete individual initiatives, while an ULL can be conceptualised as a limited geographical area where multiple experiments take place or as the institutional accumulation of experiments. Experimentation can therefore be seen as the overarching term referring to the individual act of conducting experiments and preparing implementation of the ULL. This distinction is however quite strict, and most academics use the terms interchangeably. In this thesis the term experimentation will refer to the overarching term as part of the ULLs implementation of projects for "testing" new solutions and collaboration styles.

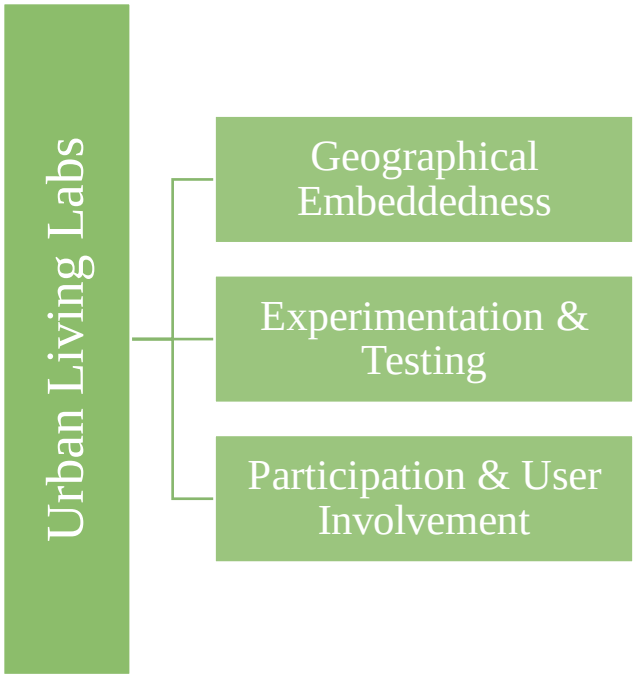

Figure 1: Visualization of ULL main characteristics

2.4 Chapter Summary

In this chapter academic literature on co-creation has been provided and contextualized in the developing governance of the sustainable city. Sustainability issues involve highly complex interactions between environmental, economic, and social factors (Gollagher & Hartz-Karp, 2013). It is established that there is not one single solution to solve sustainability issues, and there is a need for multiple and variated sites of action to reach sustainability. As a response to the growing sustainability issues there are new types of collaborations emerging in the form of urban living labs (ULL), which can be described as sites to design, test and learn from social and technical innovation in real time through co-creation and experimentation between multiple sectors and societal actors (Marvin et al., 2018). ULL as an approach to co-creation can take many different forms, and in this thesis the theoretical framework provides an academic basis for further analysis on the selected cases.

In the following chapter I will use the theoretical framework presented to analyze how the selected ULL cases are articulated according to the characteristics: *geographical embeddedness, experimentation and testing, and participation and citizen involvement*, like established in academic literature. Their sustainability goals and values will be presented. In this thesis, particular emphasis will be on how the concept of co-creation is applied through

the ULL approach in their work towards sustainable cities, and what the interviewees identify as the main advantages and challenges with co-creation through their case. In two of the selected cases, the public sector is a big component in the ULL, therefore additional attention will be given to the perspective of the municipality. Concludingly the chapter will provide the cases perception of the added value the ULL approach brings to their sustainable city projects.

3. Methodology

In the following chapter follows the methods and methodological framework that is used for this thesis. The sections below will rationalize the choice of using qualitative research methods to conduct a case study on three selected ULL cases. To ensure trustworthiness is established the research process and data analysis, the following sections will present: the research design and case selection, how the data was collected, sampling of informants, ethical considerations, and lastly a discussion on validity, reliability and limitations will be provided.

3.1 Qualitative Research Method & Design

This research is based on a case study approach within the field of qualitative methods. Qualitative methodology allows for contextual explanations for trends and generating new insights (Cope & Hay, 2021). The case study approach involves "*the study of a single instance or a small number of instances of a phenomenon with the goal to explore in-depth nuances of the phenomenon and the contextual influences on and explanations of that phenomenon*" (Baxter, 2021, p. 109). There is no standardized method for studying the topic of ULLs and their design, however, previous research demonstrates how a case study approach is well suited for investigating ULL design and operationalization in a sustainable city framing (Voytenko et al., 2016). This research process is conducted positioned within the social constructivist theory of knowledge, as the study expects the participants perceptions to be affected by their personal experience with my research topic, and that ULLs as a social phenomenon are not given, rather shaped through interpretations (Berger & Luckmann, 2011).

In this study I will be conducting a multiple case study of three cases that suit the ULL literature. The chosen cases are United Future Lab Norway (in Ålesund, Norway), Bøker & Bylab (in Trondheim, Norway) and Asprela Living Lab (in Porto, Portugal). A multiple case study aims to provide a broader basis for exploring theoretical concepts and explanations of a phenomenon (Baxter, 2021). Multiple case studies are generally not approached with the purpose of establishing statistical generalizability, but they can instead be seen as a way of deepening and expanding already existing theoretical concepts. In this thesis the research questions aim to explore questions about ULL design and their use of co-creation, therefore the multiple case study approach is better suited than a single case study approach, due to it allowing for cross-case comparisons, studying the cases in parallel, as well as studying nuances on a broader spectrum of ULL rather than a full in-depth investigation.

3.2 Selection of Topic and Cases

When doing research about a topic of interest, the comprehension and understanding of what cases are well suited for research in that specific field will develop (Stratford & Bradshaw, 2021). This process will generally evolve into an interpretive logic of who should participate as informants in the study, as well as what questions should be asked in particular concern of the study. In the beginning of the process planning my research topic, my initial interest was concerned with the topic of sustainable cities, smart cities and city planners adjusting their tools to prevent environmental degradation. As time passed and my interest evolved, I discovered how the ULL approach was discussed as a phenomenon in relation to these topics often focused on all three dimensions of sustainability. The decision to do my thesis research on the ULL approach was sparked through my internship at International Development Norway[3] as they in collaboration with the Asprela Living Lab project. I was in the same semester given the opportunity to join NTNU Smart Sustainable Cities[4] on a study trip to Ålesund through my supervisor, where we visited United Future Lab Norway as a part of the program. Bøker & Bylab was known to me from my internship in the Centre for Sustainable Development in Trondheim Municipality, and the ULL was therefore choice of both curiosity, relevance, and accessibility. After careful consideration of my research topic and articulation of the research questions,

I selected the ULL cases through the following requirements 1) they use the terminology "lab/living lab/city lab" in their project name, 2) they apply ULL methodology in their project, and 3) their goal is to tackle sustainability challenges in at least one dimension of sustainability. In addition, a crucial factor was accessibility of suitable respondents from each case through potential gatekeepers (like academic acquaintances or my supervisor). Regarding these requirements, all cases have the overarching characteristics of an ULL working with projects with the goal of creating a sustainable city/neighborhood, as well as leading stakeholders from each project agreed to do an interview. ULL as an approach to co-creation can take many different forms and in the selected cases of this thesis the public sector is an important component, hence when discussing co-creation between stakeholders[5] through ULLs, particular emphasis will be on perceptions from a municipal/public sector standpoint. Within these frames

[3]See: https://id-norway.com/
[4] NTNU Smart Sustainable Cities is a cross-disciplinary knowledge cluster offering co-creation support on topics like ULLs and smart cities. See: https://www.ntnu.edu/smartcities
[5] ULL stakeholders are often referred to as "partners/lab partners" by interviewees

focus will be given to the ULL design, with particular attention to co-creation through the ULL approach.

3.3 Data Collection

I started of the research process by searching the web for relevant reports and webpages with public and general information about the ULLs. Some of these reports and web pages gave general information about goals and projects which provided a good base for the general case descriptions. All documents used in analysis are collected from the regarding municipalities and reports from funding applications and are referenced accordingly in the text. Since the Asprela case is still in its planning stages, general information about the ULL is collected from a descriptive internal report provided to me by the respondents from the case. The choice of collecting information from multiple sources by adopting a process of triangulation allowed for checking information from various sources, in addition to providing a knowledge base before the main data was conducted through semi-structured interviews (Hay & Cope, 2021).

3.3.1 Semi-Structured Interviews and Sampling

When researching the topic of ULL in a sustainable city context, the choice of conducting semi-structured interviews was made in consideration of their predetermined order but nonetheless flexible structure and questions/order (Hay & Cope, 2021). Dunn (2021) emphasize the importance of writing an interview guide with a list of general issues you want to cover in an interview when doing semi-structured interviews. In advance of conducting my interviews I wrote a flexible interview guide with the general topics I wanted to touch upon in the interviews, as well as a list of questions to choose from (see appendix 1). Dunn further suggests that this allows the interview to act like an informal conversation but still providing the interviewer with "fallback" questions to ask if they don't arise naturally in the conversation. Depending on the participant, their knowledge, and the natural flow of the conversation, I chose questions from the list that were the most suited in the conversation in no particular order, this also left space for me to adjust questions or add new ones if interesting topics came up as the interview went on. The interviews generally started with me asking about topics like the starting phase of the ULL and questions about the ULL design, later moving into topics of co-creation elements and structures within the ULL, as well as added value and challenges that the approach involves according to the respondents.

In qualitative research it is usual to study only a subgroup of a phenomena associated with the case/cases (Stratford & Bradshaw, 2021). Since the cases selected in this thesis are more concerned with an in-depth analysis of these specific contexts, the knowledge and involvement of each informant is more important than the number of informants in the sample. Taken these considerations and due to time and space limitations, I decided to aim for 3 respondents from each case with central roles in the implementation and coordination of their respective ULL. Informants are usually chosen with purpose and chosen based on their ability to communicate aspects of their experiences and ideas that are relevant to the phenomena under investigation (Dunn, 2016). When contacting potential informants, my requirements involved the individuals' level of involvement in the ULL being adequate to answer questions regarding their respective ULL and the research topics addressed in my research, preferably from an organizer/planner/coordinator position in a leading ULL partner. I started sending out a few emails to potential participants suggested to me by contacts with general information about my area of research asking for either participation in an interview or contact information to other potential respondents. After the initial contact was made some interviews were planned immediately, while others manifested through snowball sampling, meaning access to informants through recommendations of already existing informants (Hay & Cope, 2021). There was in total performed seven interviews with nine respondents (three from each case), as two of the interviews was done with two participants from one case at the same time due to practical reasons.

Initially the plan was to have all respondents representing the public sector/municipalities in the lab partnerships, and that the role of respondents from each case was directly comparable as this would provide a base for better cross-case comparison of the ULLs. However, it was not possible to get in touch with a respondent from the municipality involved in the Asprela Living Lab, resulting in the respondents being from the 2 other main coordinating organizations of the ULL. I considered only writing the thesis based on the two Norwegian ULL cases as this would provide a more comparable and centered multiple case study also in regards of how far the ULLs are along in their establishing phase. I did however decide to keep the Asprela case considering 1) The respondents in the Asprela case are employed in the two other leading partner organizations outside of the municipality (one organization being the formal leader according to project formalities), 2) It provides a good opportunity to explore the ULL approach in another European country, and 3) The case can provide additional in depth information and nuances of the ULL approach that municipal stakeholders might lack.

	ULL	Sector/ Background
1	United Future Lab Norway	Ålesund Municipality, ULL staff
2	United Future Lab Norway	Ålesund Municipality, ULL staff
3	United Future Lab Norway	Ålesund Municipality, ULL staff
1	Bøker & Bylab	Trondheim Municipality, central coordinator
2	Bøker & Bylab	Trondheim Municipality, central coordinator
3	Bøker & Bylab	Trondheim Municipality, central initiator
1	Asprela Living Lab	Main partner organization 1, central staff
2	Asprela Living Lab	Main partner organization 1, central staff
3	Asprela Living Lab	Main partner organization 2, central staff

Table 1: Respondent Overview

The choice of not giving each participant an individual point of reference like a nickname or numbers is due to the individual reference to each interview not being of any significance for research findings and the participants from each case represents the same type of stakeholders/sector. Due to importance of maintaining the anonymity of participants when discussing certain subjects, the participants will in a few quotes be referenced to as Interview X/Informant X. Throughout the thesis, interviewees will be referred to as interviewees, informants, respondents and participants to prevent disturbing grammatical repetitions.

As discussed in Dunn (2016) digital interviewing is an appropriate method when informants are difficult to physically reach, as well as giving the opportunity of conducting a higher number of interviews due to convenience. Five interviews were performed digitally in Microsoft Teams due to the respondents being located in different cities/countries. Two interviews (the Bøker & Bylab case) were performed in person by meeting the informants locally in Trondheim. All interviews were recorded with prior consent, in addition to that I took a few notes formulating any new questions or noting down my own thoughts during the interview for personal reflection. In all online interviews the web cameras were turned on which enabled a more "realistic" interview setting, eye contact and observation of facial expressions. The online interviews came with limitations in observing the respondents body language, this did however not restrict the interview quality in any significant way due to the nature of the topic being discussed. In a few of the interviews, participants sent me reports/PowerPoints/links with additional information on their ULL through email either during or right after the interview.

3.4 Data Analysis

After conducting the interviews, they were manually transcribed in separate documents. The data was analyzed to seek meaning from each interview, and to construct themes and patterns through computer-aided qualitative data analysis software, as this is suggested to be an effective tool in relation to semi-structured interviews (Dunn, 2021). After transcribing, all files were imported to NVivo to start the coding process. NVivo was a helpful tool when coding interview data as it facilitated the organization of each code while also allowing changes in structure to be made and codes to be adjusted throughout the entire process.

I started making descriptive codes, dividing the interview data into category labels with the main themes I am investigating in this study answering "who, what, where when" type questions about the ULL design, goals, co-creation approach and other surface related information (Cope, 2021). Alongside the initial descriptive codes, a few analytic codes were also added from the start to reflect research question 2 and 3, going in depth on topics like co-creation patterns in the ULL design and reflections on what value/challenges this approach implies. Cope (2016) states how descriptive codes often bring about analytic codes by revealing patterns along in the process. When analyzing and categorizing data into the preselected codes, new patterns were discovered that inspired additional analytic codes acting as subcategories to the ones previously existing adding nuances to the data allowing new parallels to be drawn. After a process of organizing the data, going back and forth adding codes, all data was categorized and separated as sub-codes under main labels representing each research question with the labels "ULL Design", "Co-Creation in ULL" and "Added Value of ULL Approach" like demonstrated through the visualization in Figure 2.

Five of seven interviews were conducted in Norwegian due to the informants being Norwegians speakers like myself, in the other two the informants and myself spoke English. I made a conscious choice to carry out the interviews with the Norwegian speakers in their native language to prevent language restrictions from affecting the formulations or wording in the interviews. When translating the quotes used in the thesis from Norwegian to English, careful thought has been put in wording and formulations to make sure no message or point loses or changes meaning.

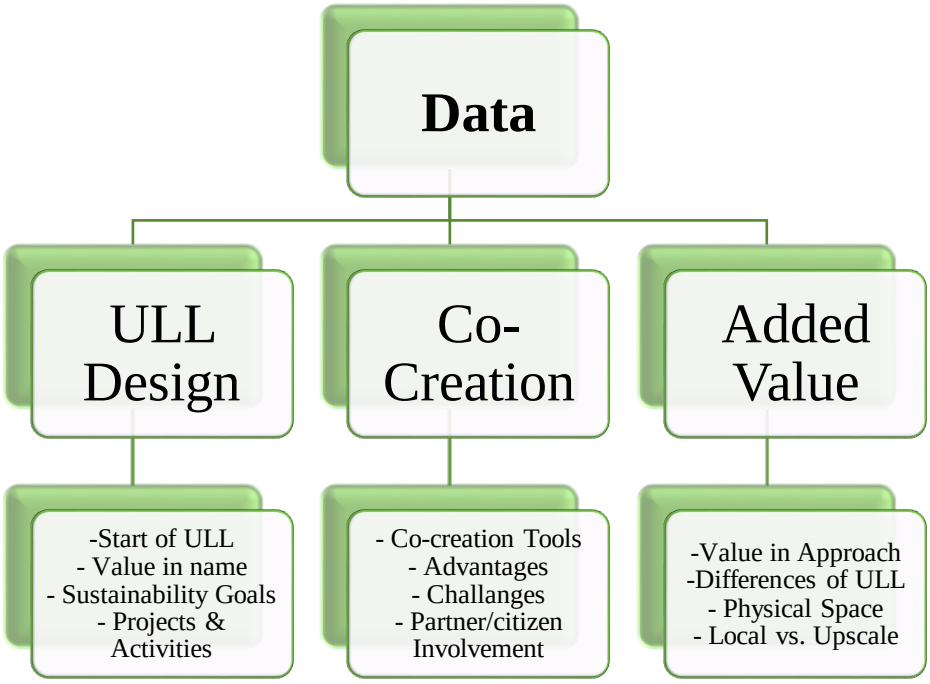

Figure 2: Visualization of code categorizes and structure

3.5 Ethical Considerations in Research

Choosing to do qualitative research methods will always raise certain ethical concerns that one should be aware of. For most geographical research, participants must give their consent to being part of the research (Catungal & Dowling, 2021). In the very beginning of starting my thesis I entered an application for my thesis research to NSD that got approved in January of 2022. Before conducting my interviews, I acquired the participants permission in written consent to use the data collected from them in my research. The signature was given at the end of an informant letter (see appendix 2) that was sent to the respondent before the interview was conducted. The informant letter contained information about the participants rights of withdrawal during the process, storage of the data and voice recordings and contact information to me and my supervisor/the institute. In every interview I also made sure to recap the respondents right orally and asking for permission to voice record before commencing.

When transcribing the interviews in separate word files, I was careful to not write down any names or titles in the file along with the transcription. Instead, color codes and numbers were used to replace participants name to preserve anonymity throughout the process. To keep track

of the respective participant to each color I kept an overview of this in a separate document stored in a different folder.

When doing research in the field of qualitative methods it is important for the researcher to be aware of reflexivity through every step of the research process (Catungal & Dowling, 2021). Being reflexive means analyzing your own situation as if it were something you were studying and being aware of one's positionalities and their impact on the research. Catungal & Dowling (2021) lists tools that might be useful in developing reflexive practice, one of them being a research diary to keep track of reflections and the process. During the entire research process, I have regularly written these types of notes of experiences during interviews, through processes that arose during the data collection, as well as documenting the analysis process to keep track of my own thoughts and staying aware of how my positionalities effect my research. A second tool to maintain reflexive practice is sharing reflections, dilemmas, and experiences with other researchers. Having regular meetings with my supervisor throughout the whole research process discussing everything from the planning stages to conducting and analyzing data has been very helpful. The meetings have contributed to reflections, clarifications and guidance that has helped my work maintain focused and reflexive.

3.6 Trustworthiness & Limitations of Study

The term trustworthiness speaks more directly to qualitative research in the field of geography, compared to the terms reliability and validity which are more commonly referred to in quantitative research (Hay & Cope, 2021; Mansvelt & Berg, 2021). Trustworthiness sees research in the geography field as a reflexive practice that recognizes that knowledge is constructed, open ended and fluid. The aim of this research is to investigate the design of each ULL case, their implementation and interviewees perceptions on cross-sectoral co-creation, and the added value of ULL. I as a researcher acknowledge that the perceptions in this research field is fluid, and therefore I am not presenting the data as a universal truth, but several perceptions of the ULL approach that can contribute to the nuances of existing research. Therefore, I also acknowledge limitations with the study. For instance, having interviewees from the same sector in all cases would probably contribute to a higher degree of direct parallels in data, and therefore allow for even more specific findings. However, the sample of respondents and cases still provides a good basis for exploring the core of the research questions, while adding the benefit of findings on a broader spectrum of ULLs. All respondents represent leading stakeholders in

each ULL which aligns with my intention of interviewing participants of the ULLs initial development. Another limitation of the study to keep in mind is how all cases are quite new and has suffered through a pandemic in their early stages. Another potential limitation of the study is that all selected cases are relatively new, and their experiences are mainly based on the ULL implementation and development in its early stages.

When discussing generalizability in case studies, Hay & Cope (2021) argues that a well-studied case can be used to produce robust and theoretical explanations that are generalizable in an analytical sense rather than a statistical sense. As this multiple case study represents a small sample of ULLs, a bigger sample would give a broader base for cross-case comparisons, while a single case study would allow for further in-depth research. Additional respondents on each case representing a broader specter of stakeholders would provide more perspectives. Nevertheless, I argue that the depth the research questions require would not allow for a bigger ULL sample due to time and space limitations of the study. It is nonetheless important to note that the interviewees in this study speak only from their own perspective and their experience with the ULL approach, therefore the results cannot be seen as an universal truth but must be seen as different perspectives of reality reflecting each case.

4. Analysis

The following chapter presents the findings in the data collection after analyzing the interviews as well as public and internal reports, and web pages about each case. Firstly, the ULL cases will be presented separately through a case introduction to conceptualize their main framework and goals. Secondly, to build upon the theoretical framework presented in chapter 2 the cases will be discussed under the themes of: *geographical/place-based embeddedness*, *experimentation, and testing*, and *participation and citizen involvement* (Voytenko et al., 2016; Bulkeley et al., 2018; Marvin et al., 2018). In analysis process main emphasis has been on researching ULL design in the selected cases, how co-creation is applied in the cases through the ULL approach, and whether the approach was seen to give added value to work focused on creating more sustainable cities. Due to particular interest in the topic of co-creation, the topic will be heavily weighted in the analysis under the category of *participation and citizen involvement*. As discussed in chapter two, the concept of co-creation can have various meanings and could therefore be addressed under all characteristics in the analysis. However, the data directly addressing the co-creation topic will be placed under the last characteristic due to its tight relationship and overlapping with the title concepts.

4.1 Case Introductions

4.1.1 United Future Lab – Ålesund (Norway)

United Future Lab Norway[6] (mostly referred to as Future Lab) is a network of partners from the public sector, private business and academic institutions (United Future Lab Norway, 2021). The Future Lab is a part of the "United for Smart Sustainable Cities Implementation Programme" (U4SSC) founded by the United Nations Economic Commission for Europe (UNECE) and the International Telecommunication Union (ITU). Ålesund Municipality was "*challenged by OIER that leads the UNs U4SSC programme, to establish a lab as an arena for co-creation across sectors and industries to reach the UNs sustainability goals"* (Future Lab, Central Staff, April 25th 2022).

[6]Report about Future Lab and U4SSC
https://www.unitedfuturelab.no/download?objectPath=/upload_images/837E6F8A720

The main responsible stakeholder and the runner of the lab is Ålesund Municipality, and the ULL has their office space at the Norwegian Maritime Competence Centre (NMK) (Ålesund Kommune, 2021). The starting point of the work in the Future Lab is based on U4SSC's analysis of how sustainable and smart cities are according to a set of Key Performance Indicators[7] (KPIs). From the KPIs the lab works to contribute to reaching the UN´s Sustainable Development Goals (SDGs) within 2030 locally in Ålesund, which is also seen as a contribution to the global fulfilment of the SDGs (Ålesund Kommune, 2021). The Future Lab staff are responsible for the daily operation, and to facilitate conditions for a successful collaborative project. The lab is the link to the UN and U4SSC and other actors that are linked to the same focus areas as the Future Lab. The team has a list of responsibilities in the operation of the lab involving everything from stimulating establishment of relevant projects, connecting partners, and organizing events

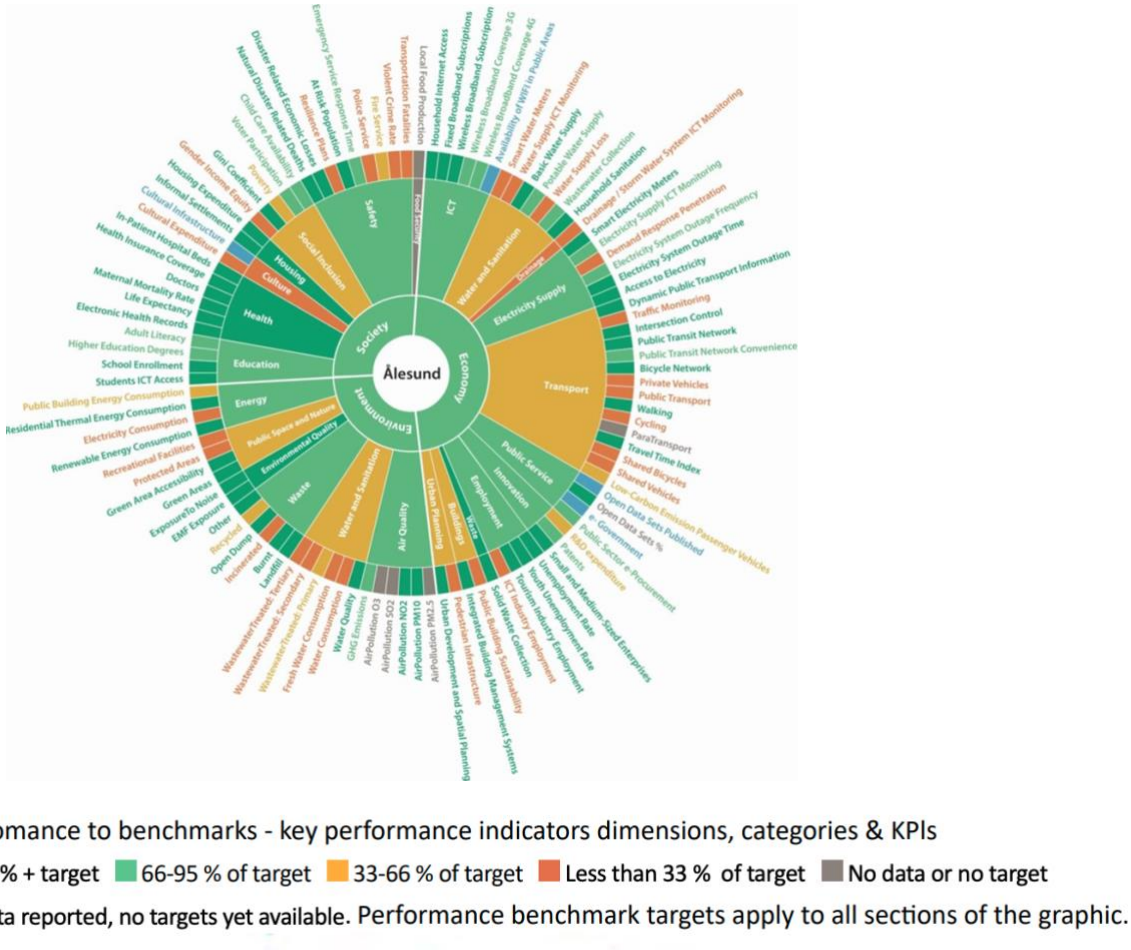

Figure 3: KPI Analysis of Ålesund Kommune (United Future Lab Norway, 2021, p. 10)

[7] U4SSC KPI Verification Report of Ålesund. For more information follow this link:
https://alesund.kommune.no/_f/p1/ia281c94c-e25b-4674-9363-3402952967c8/u4ssc-verification-report-alesund-utkast.pdf

The figure shows 92 indicators covering all sustainability areas of society revealing the gap between Ålesunds sustainability status and the UN´s sustainability goals.

The overarching framework and value foundation of the lab is set by the U4SSC network, but the practical work, creation of local partnerships and project implementation/creation is handled by the staff employed by the municipality of Ålesund. The main goal of Future Lab is to facilitate collaboration between their partners and realize specific projects. Through the collaboration between partners from different sectors, the aim is to share knowledge, competence, and experiences to find common solutions to challenges. The objective is that through projects the lab will stimulate to actions that contribute to the development of sustainable cities, communities, and businesses.

Future Lab defines themselves as an institution, and therefore there is no planned end date, however the UNs role in the project has been up for discussion and this can affect the definition of the lab in the future. "Future" in the name stands for *making changes and transform what is in the future*. Future Lab does not strictly define themselves as either a living lab or an ULL, the reason being that academic definitions of the terms *never has been discussed in the lab,* also making them unsure of what academic definitions include (Future Lab Interview 1, Central Staff, January 19th 2022). The values in the "lab" title in Future Lab means being an arena for co-creation between the public sector, the private sector and academia and work together on projects related to sustainability

4.1.2 Bøker & Bylab Elgeseter - Trondheim (Norway)

Bøker & Bylab[8] Elgeseter was established in 2019 as a two-year pilot project run by Trondheim Municipality in collaboration with the student welfare organization in Trondheim[9] and NTNU (Haugslett, Rønningsen, Riedesel & Grabinsky, 2021). However, due to the pandemic the testing period has been extended, there is also a possibility that the ULL will be made a permanent institution. The lab is located in the Elgeseter area in Trondheim, which is close to the NTNU and neighborhoods housing citizens. The premises is an inviting space of 450 m2 based in the buildings 1st floor. The overarching goal of Bøker & Bylab is to be an arena

[8] Norwegian for «Books & City Lab»
[9] Studentsamskipnaden i Trondheim

contributing to faster and better sustainable city development. This main goal works through the three dimensions of sustainability working with projects related to the environmental, economic, and social aspects. Bøker & Bylab plan to engage in these goals by 1) being an arena for hosting activities for the citizens, 2) being an arena for co-creation and collaboration between multiple stakeholders, and 3) being a democratic arena for citizen involvement related to the big changes happening in the Elgeseter area.

Bøker & Bylab collaborates with two main groups of partnerships, one group being partners that helps to run the ULL office space and the co-creation aspects (like the CityxChange project, the Centre for Sustainable Development, NTNU and SINTEF and private businesses), the second group is the stakeholders that take over the lab in the afternoons and weekends like voluntary organizations. Both groups that are involved in the lab, especially the second group became partners in the lab as a result of a *"snowball effect"* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). Lab partnerships are formed in Bøker & Bylab across the public sector, private sector, academia/educational institutions, and citizens.

Figure 4: Bøker & Bylab seen from the outside - Trondheim citizen Observatory (Haugslett et al., 2021)

Bøker & Bylab has not defined themselves either as a living lab or an ULL but describes that the "lab" label to them means being a place for *co-creation, testing,* and *experimenting in a city setting* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). The "book" label, is inspired by a public library, but where the books are free for citizens to bring home and keep. The thought behind the book-label in the name is thought to be an element

making the ULL more available to the citizens by lowering the threshold for entering and using the space while also adding a component of circular economy by giving old books a new home.

4.1.3 Asprela + Sustentável – Porto (Portugal)

The project Asprela + Sustentável[10] (Portuguese meaning "A more sustainable Asprela") has the energy sector as its central vector, planning creates the first renewable energy community in the Asprela neighborhood in Portuguese city of Porto. In addition to the central purpose regarding renewable energy, the project will cover topics like sustainable mobility, green buildings, and circular economy. All projects within Asprela Living Lab will also aim to involve the entire community and its citizens in forms of citizen participation. The project is still in its planning stages, where coordination and organization of sub projects are still work in progress (planned project duration is from 2021-2023). Asprela + Sustentável is funded by the EEA Grants Environmental Program, where the EEA Grant funding contributes with about 1 million Euro. The project also aspires to be able to store parts of the energy that is produced, promoting sustainable energy and energy consumption. Asprela Living Lab is a collaboration between Porto municipality, knowledge centers, companies, industries, and citizens. The area of Asprela is demonstrated in Figure 5.

Figure 5: Visualization of the Asprela area (Internal report describing pilot projects)

The project stakeholders are from all sectors, however the leading coordinators are Porto Municipality, the local energy agency and the formal leader which is a cooperative organization

[10] The lab concept within the project can be translated to Asprela Living Lab as referred to in this thesis

of renewable energies. Despite the latter being a formal “leader” a respondent states that there is not really any differences in responsibilities between the three main stakeholders making the coordination team.

Measures to increase the use of electric mobility, reduce waste production by maximizing repairments, recycling and other measures towards a circular model of food ecosystems will be implemented. The project implementation is hoped to trigger better environmental behaviors in the community by raising awareness and introducing sustainability concerns within a training process that is expected to have generational effects. Given the area being a central for students from both the Polytechnic Institute of Porto, as well as from other higher education institutions in the area, the project aims to provide regional, and even national, influence and inspiration.

The project defines itself as a Living Lab, pointing at their strategy with important elements of multiple stakeholders co-creating to provide innovative technological solutions in the limited area of Asprela. The ULL is thought to be a platform for entrepreneurship that allows using the city to create sustainable solutions that solve real-life problems, that translates in an increase in the quality of life for habitants and the environment. A goal in the projects is also for solutions and products created to be replicable for other cities.

To summarize this section, Figure 6 below provides a brief overview of the three labs. It demonstrates categorizations according to the three identified main characteristics.

4.2 Urban Living Lab Characteristics

The following section will discuss the three ULL cases under the categories: *geographical/place-based embeddedness*, *experimentation, and testing*, and *participation and citizen involvement.* Figure 6 below provides a brief overview of the three labs. It demonstrates categorizations according to the three identified main characteristics.

	Geographical Embeddedness	Experimentation & Testing	Participation & Citizen Involvement
Future Lab	- Ålesund Municipality - ULL is initiated by the municipality but is part of a UN Network	- Focus on SDGs - Technological solutions - - Internal experimentation	Mainly co-creation between the public sector, private sector, and academia
Bøker & Bylab	-Elgeseter (Trondheim) - Initiated by the municipality	Focus on local development, three dimensions of sustainability & social activities/events	Co-creation between public sector, private sector, academia & citizens
Asprela Living Lab	- Asprela neighborhood (Porto) - Initiated & funded by EEA Grants Environmental program	- Renewable energy transition & Circular Economy	Co-creation between public sector, private sector, academia & citizens

Figure 6: Lab Characteristics Summary

4.2.1 Geographical Embeddedness

As discussed in chapter 2, experimentation in ULLs is often placed in a particular geographical area in the sense that they both represent ecosystems of open urban innovation, as well as being situated in real urban context where process takes place (Steenbergen & Frantzeskaki, 2018). In order to establish a better understanding of the geographical embeddedness in the selected cases the following section will provide an overview of the spatial limitations of the three ULLs. In the three selected ULL cases, the characteristic of project focus being limited to a selected geographical area is confirmed. Future Lab is limited to Ålesund Municipality, Bøker & Bylab has their focus in the Elgeseter area, and Asprela Living Lab is embedded in the Asprela neighborhood.

Future Lab is located at the Norwegian Maritime Competence Centre (NMK) which is a part of the Norwegian University of Science and Technology (NTNU) Ålesund Campus (Ålesund

Kommune, 2021). The campus is close to the business industry and the region's hub for education, research, and business development. In 2020, many municipalities were merged as part of a Norwegian municipal reform, five municipalities were joined to form Ålesund Municipality, and this created space for a new and clear political initiative: Ålesund wanted to become a leading municipality within technology and innovation (Ålesund Kommune, 2021). With this message, the department/research community connected to the academic environment at NMK, and a collaboration was developed to create an innovation culture throughout the new municipality. Ålesund became the first Norwegian municipality to be a part of the U4SSC network together with Sula and Giske (neighbour municipalities in the Ålesund Region).

Bøker & Bylab is located in the Elgeseter area in Trondheim, which is close to the NTNU campus in addition to people living in the area (Haugslett et al., 2021). The premises are described as a space suited for meetings, co-creation space, library and an open space for discussions ideation and collaboration. The Bøker & Bylab premises aim to be an easily accessed for knowledge sharing and co-creation between different entities to create new solutions for the city (and the Elgeseter area specifically). The building is named Miljøbygget[11], and it has several tenants and entrance points with a shared food court area. The premises aim to create a low threshold to enter and engage in activities.

The location of Bøker & Bylab is placed in the specific area of Elgeseter because it is an *area in large transformation due to both development on the NTNU campus and other construction projects* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). The informants from the case discusses how the location of the lab is very important to them since citizens are curious to both learn about and influence the development of the area. One respondent from the same interview expressed how the geographical area of the lab is very important especially in this case where changes are happening in various fields, adding there is a necessity to be present with the citizens on location to make sure everyone is heard in this transformation in all aspects of sustainability.

The area of Asprela in the city of Porto, is the area with the biggest concentration of knowledge in the country of Portugal, and therefore its potential to host projects aiming for sustainability is great (Republica Portuguesa, 2020). The ULL is placed in the geographical area of the Asprela neighborhood due to the knowledge access stemming from the various universities in

[11] Environmental building

the area as well as the neighborhood otherwise representing a large variety in societal groups including social housing (Asprela Living Lab Interview 1, Central Staff, February 16th 2022). Respondents representing the case discuss how the location in Porto allow for testing out the solutions in an area with very different groups of people which allows for better adapted solutions that also have potential to be upscaled to other cities or countries.

Several informants spoke of the physical arena for collaboration as an important part of their ULL approach. Having physical premises dedicated to lab co-creation between the active ULL stakeholders, and project development, represents a neutral arena that can trigger new innovative ways of thinking. When analyzing spatial embeddedness in the ULL cases in regards of the geographical area where the experimentation /testing will take place, the effect of the office space/premises where the ULL activities take place should also be taken into consideration. Several informants from two of the cases point out the importance of the physical neutral arena where co-creation and organization/ULL activities occurs, one emphasizing how this physical space allows all stakeholders to step outside of their usual habits encouraging new ways of thinking and setting the scene for innovation. In the Asprela Living Lab however which is still in a planning stage, the plan is seemingly creating a virtual hub to replace this physical office space.

To summarize this characteristic of geographical embeddedness, the specific area of project implementation is well thought out in regard to what the surroundings can contribute with in the fields of knowledge as well as proximity to all important societal actors, in correlation with current ULL literature as presented by Voytenko et al. (2016). The three cases all represent the geographical areas from a municipality-neighborhood scale, well embedded in leading knowledge clusters on a national level. Concludingly the geographical embeddedness of each lab provides an important base for further deliberation on the ULL approach.

4.2.2 Experimentation and Testing

This section will present the ULL characteristic *experimentation and testing* (Voytenko et al., 2016). The section summarizes and gives examples on how all three cases experiments and tests new solutions through projects and collaborations created within their ULL framework.

In the ULL literature discussed in the theoretical framework, the use of technology in the experimentation phase to foster innovative and smart solutions is often mentioned as a characteristic of the ULL approach (Westerlund & Leminen, 2011; Marvin et al., 2018; Bulkeley et al., 2019).

In Future Lab there are different series of meetings, webinars, and workshops where the partners meet to collaborate on projects. The scheduled partner meetups often revolve around discussing projects and updating each other on our work. The lab staff also communicates sporadically with additional parts of the private sector, and acts as consultants when relevant on projects also outside of the lab partnerships. When children visit the office on certain occasions, the lab offers "active floor" which is a big screen placed on the floor that allows for them to step on and play with as a part of an interactive playground (Future Lab Interview 2, Central Staff, February 16th 2022).

According to their focus area report[12] for 2021, the smart sustainability projects at the Future Lab should follow certain characteristics, for instance the projects should contribute to the smart and sustainable development of cities, societies, and businesses within three SDGs, several of the lab´s partners should participate in the projects, the projects should be a source to common learning and the projects should use simulation/visualization tools where possible.

The starting point for all projects and experimentation in the Future Lab are the measurements the UN made on the Ålesund region linked to KPI´s. The measurements reveal the gap between the sustainability goals and Ålesund's current sustainability and level of smartness. The future lab uses this measuring tool when them and their partners identify and prioritize new projects, and while measuring project work.

[12]Report written by Future Lab as a summary of vision, values and focus areas for 2021: https://www.unitedfuturelab.no/download?objectPath=/upload_images/837E6F8A72034350BFDA93CC0FCAEC85.pdf

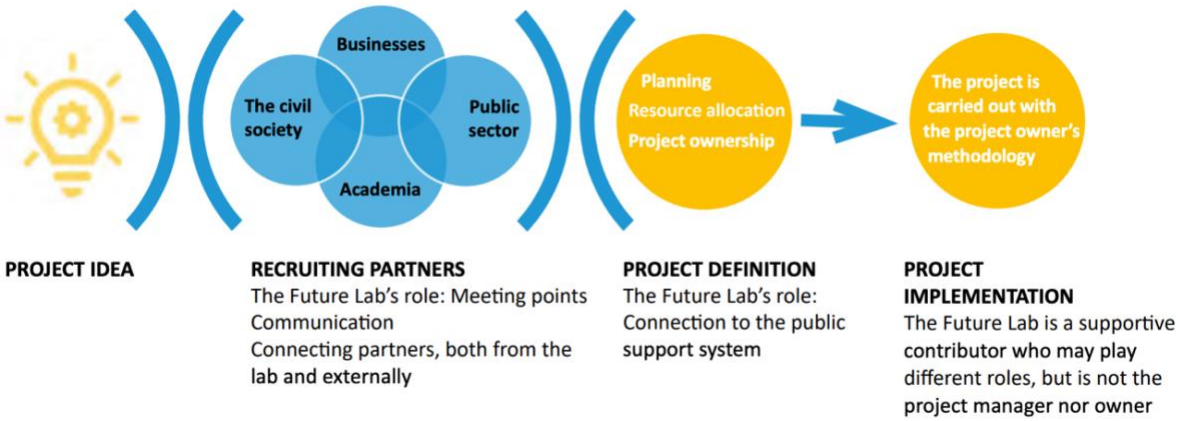

Figure 7: Project development process in Future Lab (Ålesund Kommune 2021 p. 9)

The figure7 retrieved from the "Objectives and Focus Areas" report for 2021 and demonstrates how the Future Lab implements projects, showing how the employees working there full time usually act as enablers and supervisors rather than project initiators.

Future Lab has large focus on experimentation using different technologies as tools to facilitate, explore and visualize components important to the development of the city. Digital twins are used by Future Lab as a tool to better understand large amounts of data, to visualise the KPIs measured by the UN, and it can be used to compare different parts of the city/other cities in regards of sustainability measures (United Future Lab Norway, 2022). *"We use the digital twin in multiple projects, we are working on making digital twins of cities, and gaining knowledge on how we can use this tool that is still under development"* (Future Lab Interview 2, Central Staff, February 16th 2022). The digital twins are produced by the lab partner and company Augment City[13]. The digital twin technology is used in the Future Lab project DatCo, which is an "innovation project that will test data-driven co-creation - methods and tools for sustainable innovation and societal development" (United Future Lab Norway, 2019). The goal of the project is to make it easier to understand how we affect the environment, and to use the digital twin technology to visualize opportunities for different actors in sustainability work. The project will specifically concentrate on the topics energy management and circular city, and the partners involved is the municipalities Ålesund and Bærum, as well as NTNU and Offshore Simulation Center.

[13] Augment City is the daughter company of the Offshore Simulation Center, see: https://augmentcity.no/

The experimentation and testing activities in Asprela Living Lab are in line with the two other cases also concerned with various aspects of sustainability, while the main area of focus differs from the two other cases being the energy sector. The main objective with the solutions created is to create the most sustainable km² in Porto. In the field of energy, the project is implementing and testing out new systems of solar panels that will deliver energy to the citizens of Asprela. The system that will be tested is technology installed to monitor progress throughout the three-year period of the project through the Asprela Virtual Hub. This virtual system will make it possible to monitor the reduction of CO2 emissions in the among other things the transport and construction sector, as well as tracking air and water quality. The Asprela Virtual Hub will also allow the ULL, and the leading stakeholders involved to share this information with the citizens of Asprela in real time through virtual technology solutions. The implementation of a virtual system to demonstrate sustainability status and progress in projects in real time is in line with the ULL description of Marvin et al. (2019), stating how ULLs are sites to design and test social and technical innovation in real time through co-creation and experimentation. In the field of electricity there are also plans for projects *regarding electric mobility and electric charging stations for electric vehicles* (Asprela Living Lab Interview 1, Central Staff, February 16th 2022). In addition to testing solutions within the field of energy combined with developing tools through a virtual hub, there are projects planned for promoting sustainable production and consumption of food (Good Food Hubs), a project to create workshops for repairing electronic equipment and donating equipment to families in vulnerable economic situations (The Reeboot).

The figure 8 below visualizes the focus of events in Bøker & Bylab in 2021 color coordinated after the three main areas: *co-creation arena* in yellow, *activity arena* in red and *democratic arena* in green. Bøker & Bylab is an arena for many different events, and all official partner stakeholders in the lab can use the premises for projects and activities as long as it fills the requirement of targeting one of the SDGs in link with future lab values. Examples of these types of events are as shown in the figure are common projects, voluntary work, student collaborations, workshops, meetings, information meetings, debates, courses, local neighborhoods meetings, culture program, elections, and exhibitions.

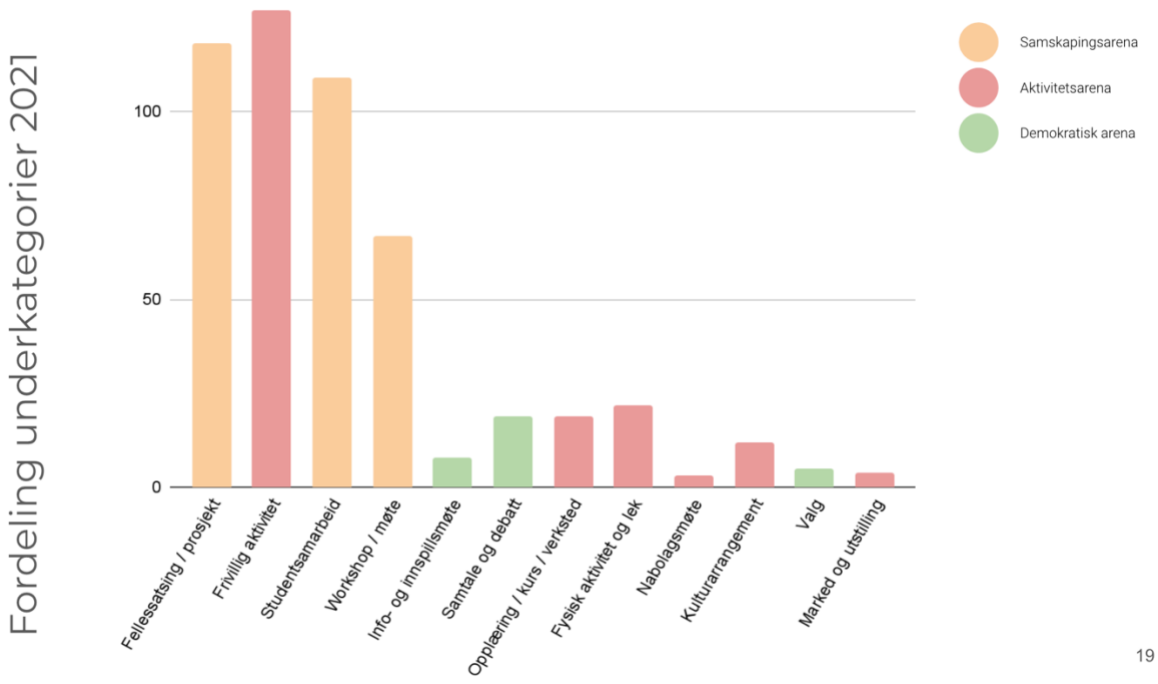

Figure 8: Bøker & Bylab activity overview 2021 (Internal PowerPoint - slide 19, Trondheim Kommune)

As shown in figure 8, the physical premises of Bøker & Bylab was mostly used for co-creation activities (yellow).

Bøker & Bylab has various partnerships that utilize the ULL premises for their projects, the +CityxChange project is a good example. A partnership where Bøker & Bylab has facilitated and collaborated is as a "*citizen observatory*" in the +CityxChange project (Haugslett et al., 2021). +CityxChange is funded by the EU Horizon 2020 research and innovation program in the category "Smart Cities and Communities" (Gohari et al., 2020). The vision for the +CityxChange project is to create a liveable future. The project focus is sustainable energy transition, with the intention of creating positive energy blocks Positive Energy Districts, and positive energy cities (Grabinsky, Riedesel & Haugslett, 2021). The project aims to reach their goal through integrated planning, common energy markets, citizen participation, regulatory sandboxes, and business models (Gohari et al., 2020) The project collaborates with Trondheim Municipality, and they have four physical "Citizen Observatories/innovation playgrounds" in the center of Trondheim that function as spaces that are meant to support and accelerate the goal of the city becoming energy positive. (Haugslett et al., 2021).

The project goals of CityxChange correlates with the values of Bøker & Bylab and emphasize how citizen engagement is crucial to the success rate of local politics, projects, and topics. The

observatories are therefore places in areas where the changes are being implemented. Letting citizens engage with city planning in their neighborhoods allows for knowledge sharing and testing of solutions together with the citizens from the very beginning of the process (Haugslett et al.,2021). A recent solution tested at Bøker & Bylab as a part of +CityxChange is the installation of digital screens around in the lab office to spread information and to collect input from citizens related to one of their partner projects CityxChange.

To summarize on the characteristic of experimentation and testing, this section sheds light on how all three cases experiments and tests new solutions through projects and collaborations created within the ULL framework in line with the design characteristic academic literature applies to the ULL approach (Voytenko et al., 2016). The three ULLs has general goals for the experimentation in terms of sustainability measures.

4.2.3 Participation, Co-Creation & Citizen Involvement in the Three Labs

As discussed in chapter 2, sustainability issues come with complex interactions between environmental, economic, and social factors that are often viewed very differently by different groups of stakeholders (Gollagher & Hartz-Karp, 2013). There is no straightforward solution to solving sustainability issues, and therefore the issue requires multiple sites of action through collaboration between all stakeholders and citizens.

ULLs are according to literature supposed to offer a space for reflexive, adaptive and multi-actor learning environments, where different ways of internal organizing and novel infrastructures can be experimented with in a real-life environment (Puerari et al., 2018). Although there is a wide consensus of the co-creation concepts importance in the ULL approach, it remains understudied how and in what ways co-creation takes place in within the ULL-structure, and what impact it has.

The next section will present how informants from the chosen ULL cases view and incorporate the concept of co-creation in their approach, and who takes part in the co-creation process. Emphasis will be put on the informant's perspective on the main advantages and the main challenges of co-creation trough their ULL when developing sustainable city projects.

4.2.1 Co-Creation Elements and Collaboration Learning Process

When investigating how the co-creation concept is applied through the ULL approach in the selected cases, the main areas of focus will be what co-creation methods is used, who is involved to what degree, where does it take place and why is co-creation a beneficial and/or challenging in the ULLs when working to create a more sustainable city.

The co-creation process in the three ULL cases are all based on variations of multiple stakeholder- and citizen collaboration. The co-creation in both singular projects within the ULL, and the co-creation between partners through other activities in the ULL premises/office occurs through meetings including all parties, workshops and arranged cross-sectoral activities, and different forms of citizen involvement. All co-creation processes in the selected ULL cases are aimed towards environmental, social and/or economic sustainability in some way, their selected geographical area. Common for informants from all three ULL cases is that the implementation of co-creation activities between stakeholders is viewed as one of the main determining elements of the ULL approach that in most cases will lead to better results/solutions although the process itself can be challenging and more time consuming.

As discussed in chapter 2, tendencies suggest that co-creation in the public sector is used mainly as a method for addressing and solving societal problems (Puerari et al., 2018). Bøker & Bylab which is a municipality initiative, stated that co-creation in their lab means inviting different stakeholders including citizens, to create something together. The co-creation approach in the lab can imply everything from "*where do we create a new road in the Elgeseter area*", to "*where do we build the parts of NTNU that is being moved to Elgeseter in the best way possible*" (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022). Co-creating the best solutions or services to Bøker & Bylab is mainly done through discussions with the parties involved. Activities arranged to foster co-creation in Bøker & Bylab are also quite many since the office space is very open for their partners and organizations to use in exchange for their presence in the premises at certain times, keeping it open and allowing for citizen involvement. Examples of these activities are such as cross-sectoral meetings, workshops with a circular focus where citizens can help each other fix broken clothes, toys, and furniture. The Bøker & Bylab premises is also used as an arena for events linked to *the CityxChange* project, and for events hosted by the *Centre for Sustainability* in Trondheim (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). Every Tuesday the ULL hosts a "language café" where refugees can

practice speaking Norwegian, and the premises has also been used as a local polling station. The two latter examples interviewees added to express the importance of the social sustainability and wellness dimension.

An incentive implemented by Future Lab to foster co-creation in their office space is their *"free seating"* concept, which means that all partners in the lab have the possibility to work at the office landscape alongside the employees in Future Lab when they wish (Future Lab Interview 2, Central Staff, February 16th 2022). The free seating concept is used for meetings, individual work or as a space to co-create internally as well as across the lab partnerships. The office also provides a podcast room where the lab partners can make podcast episodes, while also creating an arena where partners can interview and learn from each other. On every other Friday the lab performs what they call the "*Friday relay race*", where one partners starts to talk about themselves and their focus on sustainability, then sending the task over to another partner (Future Lab Interview 2, Central Staff, February 16th 2022). Within the lab activities and forums participants from Future Lab also mentions a "*Future Council*" consisting of 10 representants from different partners where 5 representants are switched every year to maintain continuity (Future Lab Interview 2, Central Staff, February 16th 2022). The council have no additional power compared to the rest but it is used to discuss important topics addressed in the lab.

The Asprela Living Lab is still in the planning and early implementation state, which means that they have yet to perform their planned co-creation activities. So far in the process all the different stakeholders have arranged regular meetings for coordinating the project. The process for each element of the project implementation is according to the participants time consuming because of bureaucratical systems. An example of such project is the *energy community project* mentioned in the previous section, and the installation of the energy storage system, this is completely new to the municipality of Porto and therefore it must be implemented in accordance with main state entities (Asprela Living Lab Interview 1, Central Staff, February 16th 2022). When Asprela Living Lab is completely up and running there will also be workshops among the stakeholders as well as the virtual hub that will allow citizens to interact with information from the leading stakeholders in real time.

As part of the ULL approach, co-creating with multiple stakeholders in an efficient way has been/is a learning process in all the ULL cases studied. The learning process to the informants means finding what methods for co-creation works for different projects, with what

stakeholders, according to what type of result is sought after. When asking informants to describe their learning process in the lab in terms of co-creation between the different stakeholders so far in the process, informants from all cases stated that they so far have learned a lot on how to organize the co-creation process, and what tools work for different types of projects. One of the informants from Bøker & Bylab discussed how the co-creation learning process in their ULL has made them more aware of what types of co-creation gives them the best results, and that there will never be one universal *co-creation tool* that will suit all stakeholders and projects, there is a need to develop a *toolbox* (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022).

When asking the informants from Future Lab what their role in partner involvement and the co-creation process is, the main topics mentioned was facilitators, coordinators, and enablers. *"We facilitate ideas, and we have quite a lot of knowledge of our partners goals and visions, and we use that to connect the partners with each other"* (Future Lab Interview 3, Central Staff, February 16th 2022). The role of coordinating a co-creation process in an ULL is connected to the learning process and developing the tools/models that work best for each project. One informant described how what she had learned so far in the ULL co-creation process, was related to *how* to coordinate a project when the different stakeholders are accustomed to different frameworks and terms.

4.2.2 Participation and Citizen Involvement

When developing sustainability solutions and projects that will be implemented in a society while affecting different societal groups and habitants, a goal should be to develop a solution that benefits as many as possible. The aspect of social sustainability is brought up by respondents from all three ULL-cases. When discussing how to maintain the wellbeing of citizens meanwhile also working towards creating a more environmentally sustainable city/neighborhood, co-creation is brought up as an important factor for success.

The role of citizens as part of the ULL approach in the three cases studied here do vary in some degree. The range between the three goes from actively involving citizens through local co-creation and citizen engagement, to co-creation focused mainly internally between the ULL stakeholders/partners to develop solutions for the city/and citizens. In this sense, the role of

citizen participation in the selected ULL cases is used both as an active tool to co-create *with* citizens, and as an indirect tool to co-create *for* the citizens. The ULL with the seemingly largest focus on active citizen involvement is Bøker & Bylab through having their office space as an open arena for anyone to use for co-creation and sustainable development purposes, as well as hosting events focusing on citizen engagement in local city planning, politics, and sustainability goals. *"Now we can invite the citizens in before we start making plans and create the plans together"* (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022).

As discussed in the theoretical framework, a critique of co-creation and citizen involvement in the public sector is the tendency of professionals using the knowledge generated about the citizens to co-create solutions for them, instead of allowing citizens themselves to invent and produce new ideas that the public sector can support (Lund, 2018). In the comparison on degree of citizen involvement in the selected cases, the ULLs overarching sets of values influenced by its initiators might be relevant to note. Bøker & Bylab is initiated by Trondheim Municipality, but the municipal funding does not allow for fulltime staff financing. As a result, their ULL office space is managed by all partners, and citizens are free to stop by in its opening hours. The Asprela Living Lab is coordinated and run by three main organizations (including the municipality of Porto). However, all funding and overarching requirements is set by the EEA Grants. The Asprela Living Lab is run and coordinated by the three leading stakeholders from the private and public sector, the participants do however mention on multiple occasions how one of the biggest advantages of the ULL approach to them is having the opportunity, time, and economy to engage with the citizens opinions in real time, while also being able to influence their values of what a local energy transition means.

> *"The citizens are more involved in the Asprela Living Lab than what they normally would be in city planning because we have the condition to let them. We can offer time, our expertise in different fields, the ability to engage citizens, and to explain what the main value of an energy transition and what an energy community is* (Asprela Living Lab Interview 2, Central Partner Employee, April 13th 2022).

Future Lab in Ålesund is run by the municipality, but the overarching network and value foundation is influenced by the United Nations U4SSC Program. The participants from the case mentions the term "three-way-collaboration" between the municipality, the private sector and academia when speaking of the co-creation process in their ULL.

> *"We do not have a very big focus on citizens in the lab, for that we need other arenas like the Citizen Square which goes under Ålesund Municipality, where you are invited as a citizen to be part of a project. If you are a consumer in a specific project, you can be invited to the lab, but it is not an open space where citizens can enter as wished, the lab is not formed that way"* (Future Lab Interview 3, Central Staff, February 16th 2022).

The co-creation process and development of project ideas in Future Lab involves mainly the actors that are official partners in the lab (this however does not at all imply that citizens in the Municipality of Ålesund are not an important part and factor in the projects developed, see DatCo project), but they do not play an active role in the lab offices or in the internal Future Lab activities themselves. The respondent also reflects upon the stakeholder components (public, private, academia and citizens) often seen in research discussing the ULL approach, pointing out that their approach in Future Lab is very related to the ULL approach due to the U4SSC Programme, but that the one component perhaps lacking out of the four is the focus on citizen participation. Building upon this the respondent addresses that this requires caution and awareness on their part to not develop projects based on an "outsider" standpoint.

4.2.2 Advantages of Co-Creation in Urban Living Labs

When interviewing the respondents asking them what they find to be the main advantages with the co-creation process as a part of their ULL approach, the common advantages mentioned by several of the respondents were: broader knowledge when developing projects/solutions, the results are likely to please a larger range of societal groups, citizen involvement and less hierarchy in city planning.

One participant from Future Lab with employment background in the municipality, expressed how the municipality's role in being an initiating stakeholder is crucial to establish the project and get it started, set goals, involve partners, and enable funding. However, a point is made that the role of the municipality in the lab should not be large in excess to leave space for the other partners be as influential in the decision-making, if not the added value of the co-creation aspect can fade .*"Few actors in society have the opportunity to start a lab like this, therefore it is very*

important that the municipality initiates and establishes the lab and then gets it going. (Future Lab Interview 2, Central Staff, February 16th 2022)".

The participant expressed how their goal with the lab is to create an arena for co-creation where all partners, including the municipality as the main operators, have equal power and value in the lab as an institution. The equal power dynamics in the lab requires awareness, to "*not let the focus and the structure of the lab get too easily colored by the municipal structure"* (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022). One informant also a municipal employee expressed how there is often a clear expectation from other stakeholders that the municipality have an answer to everything when they enter the ULL. The informant continues by emphasizing the importance of allowing the municipality as an equal stakeholder to "*test before doing*" as well, and how this period of experimentation is very important (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022).

Lund (2018) discussed how there is a tendency of higher degree of citizen involvement in publicly initiated ULLs. The role of public authorities in ULLs are often characterized by being an enabler rather than a regulator, Bøker & Bylab points to this general description in many ways in terms of their ULL design. Bøker & Bylab is initiated by Trondheim Municipality and they create a physical arena where the major focus is to enable citizen involvement in city planning and create an opportunity for all partners to co-create in sustainability projects.

> *"After having a period of co-creation here in the lab for a project or proposal, it becomes a political case and where the project is put into the bureaucratic framework that allows for the politicians to make good political decisions. This process requires translation, where you move from the traditional municipal bureaucracy to doing some of the work through the lab, and then putting it back into the municipal framework again." Bøker & Bylab Interview 2, Central Initiator, March 9th 2022).*

Future Lab staff also enables communication, an arena as well as counseling to their partners. The lab also offers counseling to startups that are not necessarily a partner, as well as students.

> *"I often compare our lab with a gym, you won't see any results if you just buy the membership but never go to work out, you must go there. Future Lab works the same way, as a partner you must come to the lab and spend time here, and that's when we will see the good results. This is what the lab approach is supposed to be, a space where the partner stakeholders can come, meet other partners, and train their abilities to transform."* (Future Lab Interview 2, Central Staff, February 14th 2022).

Asprela Living Lab brings attention to how co-creation and citizen involvement can be beneficial in projects where the goal is to test out technological solutions. The participants from the case expressed how the variation of citizens in Asprela will allow them to test out the new systems created for renewable energy, while receiving response from citizens in real time. "*With the living lab we can affect all the different groups in the community, we can go and change the circumstances for a lot of people in the Asprela zone"* (Asprela Living Lab Interview 1, Central Staff, February 16th 2022).

4.2.3 Challenges of Co-Creation through Urban Living Labs

When asking the respondents about their straightforward way of co-creating in the ULL and why the approach is applied, questions about how/if methods of co-creation also creates challenges in the ULL approach. When asking informants from all three cases if there were any challenges with the co-creation process through their ULL approach, several topics came up in all cases. The main challenges that were brought up by the informants during the interviews was communication issues, differences in visions among stakeholders, sectoral differences in measuring results and sharing responsibility (all of these making processes more time consuming). Moreover, issues with getting commitment from stakeholders and financing of projects was brought up as challenging at times, sometimes in relation to each other.

Like discussed in chapter two a crucial element for success in co-creation is open communication (Mahmoud et al., 2021). Consistent implementation in public projects and policies requires the establishment of clear communication channels between all involved stakeholders and citizens. To achieve this clear communication and maximum relevance in delivery outcomes there is a need to overcome silo boundaries of communication enabling co-creation pathways. Mahmoud et al. (2021) highlights how communication can be facilitated

through cultivating a common language for communicating objectives and concepts, and how this can help create the baseline of alignment among the stakeholders. The issues of different communication skills were discussed by the majority of the respondents in relation to: 1) differences in visions among stakeholders, 2) sectoral differences in measuring results, 3) sharing responsibility, and 4) how these challenges can make the co-creation process time-consuming.

Respondents from all cases found it challenging to create a consensus on how to structure projects within their ULL, and to find a general understanding of how to measure results. In this discussion respondents stated how one of the main difficulties with co-creation through the ULL approach was connected to the different visions that all involved stakeholders have for the projects/the ULL itself due to fundamental differences in both incorporated value systems and sectoral traditions. The challenge of finding a shared vision and the challenge of finding common grown for measuring results and setting goals are seemingly interrelated by the common element of being accustomed to fundamentally different ways of working towards a project goal, nevertheless a sustainable city. One interviewee from Future Lab suggested that in order to make their *three-way collaboration* work, it is crucial to keep in mind how *different sectors are used to being "rated on different terms* (Future Lab Interview 2, Central Staff, February 14th 2022). To demonstrate the point the interviewee added how:

> "*Academia is rated on their publications and their knowledge producing, the private sector is rated on their net income, and the municipalities are in the end being rated based on the votes the local politicians get, and the politicians in return decides what the municipality is going to spend time and money on"* (Future Lab Interview 2, Central Staff, February 14th 2022).

When stakeholders join the ULL, an informant from Bøker & Bylab stresses how finding the *win-win* solutions in projects when stakeholders come from such different backgrounds is sometimes a difficult task (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). Followingly the informant adds how getting a commitment from a partner to join a *single co-creation project* in the ULL is easier than getting a commitment to become an official partner of the ULL, implying also being involved in financing ULL premises and other costs

> *"When coordinating projects in the lab, I sometimes get the feeling of being a coach for players in handball, soccer and basketball at the same time and I am sending them on to a new field where they need to create a completely new sport with new rules together. They all are used to such different ways of "playing", and they are used to being rated on different terms"* (Future Lab Interview 2, Central Staff, February 14th 2022).

Under the overarching challenge of finding common ground to facilitate communication between stakeholders in the ULL co-creation process, the challenge of shared responsibility is brought up. Respondents from Bøker & Bylab pointed out that there can sometimes be underlying expectations of *one stakeholder being more responsible for the project than others*, adding how often this expectation is put on the municipality (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). *"The issue with splitting the responsibility in projects and activities is very often related to the principle of "everyone is responsible, so no one is responsible"* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). When speaking of co-creation and the share of responsibility in ULLs, the respondent adds how the roles that each partner has in society might affect the expectations which can cause damage to the approach.

> *"As someone working in the public sector, we have to learn to "let go. We are used to entering a project as leaders with strict guidelines on who does what, but we can't do that in the lab. We have to learn to let go of the ownership of the entire process, if not the approach loses its effect"* (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022).

The last highlighted challenge informants brought up when discussing the co-creation process through the ULL approach, is creating commitment and a sense of ownership by stakeholders to the co-creation process and its outcomes. As previously discussed in the theoretical framework this can be linked to the specific time along the process in which the stakeholder is involved, and it can also affect the ownership to post-creation engagement in relation to upscaling of the solutions (Mahmoud et al., 2021). Getting *stakeholders to commit* to the ULL approach and *be a permanent* part of the ULL was mentioned as an occasional challenge by informants from Bøker & Bylab and Future Lab (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). A respondent from Bøker & Bylab stated how "*It´s a challenge getting all partners to commit when conversations about costs come up, everyone*

thinks it´s a good idea but few wants to pay for it" (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). The same informant followed their statement supporting the theory of involvement of stakeholders from an early stage being crucial for engaging ownership and follow-up: *"When involving relevant stakeholders from the very beginning of the process, and then co-create the project as you go along, you get a broader ownership to the results which also leads to a broader responsibility of the follow-up afterwards."* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022).

> *"People are trained to do what they are asked within their common framework, and in the lab we twist this around which can be very challenging for some but it has to be done. We need to create enough space in this lab to work outside of your own framework. On the other side we do need some structure and safe framework, if the partners become too unsafe then that won't work either, it is a very fine balance in order to make this work"* (Future Lab Interview 2, Central Staff, February 14th 2022).

Challenges related to communication and coordination of internal goals, projects and strategies could according to several respondents be prevented or diminished through a *coordination team of representants from each stakeholder*, *fulltime employee/s working as neutral coordinator* or a *developed ULL strategy/model/framework* developed internally in the ULL (Asprela Living Lab Interview 1, February 16th 2022; Bøker & Bylab Interview 1, February 17th 2022; Future Lab Interview 2, 14th 2022). The need for an overarching organizing component in co-creation through ULL networks correlates with the research of Mahmoud et al. (2021) discussing how it requires specific skills such as organization, facilitation, planning of activities, follow up and monitoring of outcomes.

The three leading stakeholders in Asprela Living Lab has a coordination team to help *pass the focus and main goal to the other partners* and help them see *the bigger picture* and *not only focus on details in smaller projects* within the lab (Asprela Living Lab Interview 1, Central Partner Employee, February 16th 2022). In Future Lab there is a fulltime hired staff that helps to coordinate projects, supervise, and develop co-creation tools.

In Bøker & Bylab there is no permanent fulltime coordinator or fulltime staff, however, there has previously been a municipal coordinator responsible for Bøker & Bylab part time. Informants from the ULL address the need for the coordinator with a continuous role at the lab

managing partnerships and facilitating projects, but that the lack of funding from the municipality prevents this.

The need for coordination and frameworks in the ULLs is however challenged by the entire purpose of the ULL approach one respondent points out, explaining how ULL are supposed to be arenas for new solutions and frameworks to burst innovation *"when using a lab approach, you can't have too much of a framework either because it would take away the purpose of the approach itself"* (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022).

The cross-case difference that should be noted in this context is how the role of a coordinator/team is not necessarily a "neutral" component in the ULL, and in the publicly initiated ULLs in this study the coordinators are in theory municipality employees. The Asprela case is organized differently here due to being an EEA grant funded project where the municipality is a leading stakeholder however not formally the initiator but rather an enabler. An interviewee from Future Lab mentioned how the role of a coordinator/facilitator in the ULL also can help diminish the problem the lack of commitment and dedication to the ULL approach by *"demonstrating and communicating how much value the concept has and make partners want to join in"* (Future Lab Interview 3, Central Staff, February 16th 2022).

When asked further about how the learning process of problem solving evolves in the ULLs, informants from all three cases emphasized how the communication challenges in the co-creation process was only a concern mainly in the startup of the ULL implementation itself, or in the starting phases of new projects between stakeholders within the ULL. *"Challenges can occur if the lab doesn't take its time in the beginning in the planning phase to set a clear goal, and what they want to achieve"* (Bøker & Bylab Interview 2, Central Initiator, March 9th 2022). This adds to the argument concerning a necessity for an organizing element specially in the ULLs starting phase. Informants from Asprela Living Lab expressed how they also experienced difficulties in the very beginning of the ULL planning and co-creation stages due to differences between stakeholders, but "*With the ongoing of the project this dilemma will of course disappear, and things will go more smoothly"* (Asprela Living Lab Interview 1, Central Partner Employee, February 16th 2022). Adding to this a respondent from the latter case added that being a EEA Grants funded project involves a lot of paper work, reporting and bureaucracy[14]

[14] It was however unclear if these factors were a result of the EEA Grants program, the Portuguese state bureaucracy, or those two combined.

All respondents point out how the co-creation process in their respective ULL case is very time consuming due to the factors highlighted above. Communication across sectors and projects in an unfamiliar setting (in the beginning) will slow down the process. However, respondents from all cases heavily emphasizes that despite the co-creation experiences they have in their ULL setting being time consuming, even exhausting at times, the results that evolve are much better than what they would be without the cross-sectoral collaborations.

To summarize this section analyzing the characteristic of co-creation and citizen involvement, the co-creation process in the three cases is all based on variations of multiple stakeholder- and citizen collaboration. All co-creation processes in the selected ULL cases are aimed towards environmental, social and/or economic sustainability in some way. Common for informants from all three ULL cases is that the implementation of co-creation between stakeholders is viewed as one of the main determining elements of the ULL approach. The role of citizen involvement in the selected ULL cases is used both as an active tool to co-create *with* citizens, and as a tool to co-create *for* the citizens and the role of citizens in the ULL shows some variations in the comparison of the three cases.

The main advantages with the co-creation process through the selected cases in the analysis were: broader knowledge when developing projects/solutions, the results are likely to please a larger range of societal groups, citizen involvement and less hierarchy in city planning. The main challenges that were brought up by the informants during the interviews was communication issues in terms of: differences in visions among stakeholders, sectoral differences in measuring results and sharing responsibility, issues with getting commitment from stakeholders and financing of projects was brought up as challenging at times, sometimes in relation to each other.

4.3 Added Value of the ULL Approach in the Three Labs

When asking informants about what the main added value of the ULL approach is to them and their ULL case, several topics were mentioned repeatedly. The topics that were brought up by several informants from the three cases are the following: Co-creation brings broader knowledge when developing projects/solutions, the results are likely to please a larger range of

societal groups and the environment, citizen involvement, neutral physical arena for co-creation, less hierarchy, result evaluation in real time, easier to transfer solutions to other geographical areas, and more funding for projects. The added value of the ULL approach as a whole in the cases studied needs to be seen in relation to the previous chapter on co-creation and citizen involvement through the ULL approach, due to the elements of added value pointed out by the informants being mostly related to this topic.

Firstly, addressing the two cases initiated by municipalities and how the informants perceive the added value of the ULL approach in their case, emphasis was put on how the municipality can be more actively involved in projects with the private sector and academia, and not only be enablers in form of funding for projects. In addition, the value of collectively having the possibility to test solutions through pilot projects without other stakeholders expecting the municipality to "*always have the answer*, is brought up (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). When talking to informants representing other stakeholders in their ULL case than their respective municipality, the main added value of the ULL approach is collectively related to the access to broad knowledge through the stakeholder collaborations, but also the experimentation and testing of solutions and products while having the condition to interact in real time with citizens due to time and funding. Asprela Living Lab is the one case in this study that is not firstly initiated by a municipality, this makes the cross-case comparison interesting in regards of perceptions of the added value the ULL approach brings to the sustainability projects projects. Added value of the experimentation characteristic is not only related to the physical solutions created through the ULL approach but several informants refer to the "experimentation" term pointing back at testing out ways of co-creating with involved stakeholders, to collectively find the right methods and structures to produce innovative solutions.

When respondents from the cases studied were asked about what benefits they saw in implementing an ULL approach when working towards a sustainable city, several informants brought up how the threshold to communicate between stakeholders is lower because of the ULL arena facilitating it.

> *"The public sector, private sector and academia all benefit from communicating, but it is not always easy. We are accustomed with doing research "about", instead of "with",*

> *and the public and private sector don't always understand each other which this lab approach can help happen."* (Future Lab Interview 1, Central Staff, January 19th 2022).

One of the topics mostly referred to by participants from two of the cases when speaking of added value in the ULL approach, was how the ULL is a physical and neutral arena for co-creation. Informants from both Future Lab and Bøker & Bylab explained how what made the physical ULL office space unique for them, is how it was a "neutral arena for collaboration". One informant described their ULL office space together with their partner stakeholders and methods, as being its own *infrastructure* (Future Lab Interview 2, Central Staff, February 14th 2022). The informant further emphasized how seeing the ULL as a completely new and neutral infrastructure is a crucial element in order to produce innovative solutions.

> *"When we have a physical space for this collaboration and a more network-based mindset, we are able to start projects, partnerships and experiment in completely new ways that leads to innovative solutions we wouldn't have reached otherwise. We are already seeing good results from this in Trondheim, especially in regards of +CityxChange and the Centre for Sustainability"* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022).

One respondent stated the big value in having a space outside all the stakeholders' usual offices, separate from the colleagues you see every day The respondent continues by discussing how meeting with new people and groups that see things in different lights, will widen the horizon for innovation and lead to new solutions. "*We as humans are creatures of habit, and the lab approach is about changing these habits. To reach a transformation in the sustainability field we need a change of habits"* (Future Lab Interview 2, Central Staff, February 14th 2022). During the pandemic Future Lab used digital solutions like web-meetings as a replacement for not being able to physically be joined at the office.

A different respondent also with a municipal background expressed how the lab approach gives them "quicker access" to stakeholders with interests in specific societal aspects partly due to the physical space for collaboration. "*There is a lot of added value in involving the stakeholders that are relevant to a project in the problem-solving"* (Future Lab Interview 3, Central Staff, February 16th 2022).

Several informants touched upon how the ULL approach often is chosen by international stakeholders when developing funding programs for sustainability measures. One informant was asked the question of what they think is the main reason that specifically ULL projects receive funding from actors like the EU or the UN, one respondent with municipal background reflected upon the large amount of funding that goes out to these types of projects regarding sustainability and technology for smart cities. The respondent also reflected upon how these international organizations are not immune to *"trending concepts"*, and the idea of creating entire package solution and labels.

> *"There are huge amounts of money being spent on concepts and approaches without there being very many people that can explain what they actually are. Frameworks promoting sustainable cities are very sellable, they have a clear icons and labels"* (ULL X, Interview X).

One informant mentioned that by looking at projects funded through large international organizations, their impression is that the ULL approach brings more *choices* on how to work in the projects, but also more resources in the form of *funding* available to make the project happen (ULL X, Central Staff).

To conclude this section, even though variations in the main emphasis of discussions regarding the value of the ULL approach in the selected cases do occur, there is undoubtably a general opinion of co-creation and the multiple stakeholder partnerships/collaboration bringing the most value to sustainable city projects in the selected cases. Another benefit much referred to was how the ULL was perceived as a neutral arena for collaboration. The ULL approach has been described as an arena and an infrastructure providing a neutral space for co-creation where the access to broad knowledge and insight to different societal groups is provided. Like discussed in chapter 2 (Lund, 2018), the concept of co-creation and participation is not new, nor is the idea of cross-sectoral collaboration, however, can the ULL approach through this analysis according to informants from the selected cases be an approach facilitating the co-creation process in sustainable city projects.

4.4 Chapter Summary

The analysis of the data material has discussed the three ULL cases and their design according to the characteristics geographical embeddedness, experimentation and testing, and participation citizen involvement. Followingly an analysis of the three cases implementation of co-creation through the ULL approach in their work towards sustainable cities was presented. Concludingly a presentation of the three cases and their identified added value in the ULL approach was provided. The next chapter will reflect upon the main findings of the analysis while addressing the research questions with reference to the theoretical framework.

5. Discussion

5.1 Urban Living Lab Approach - Design & Goals

This study is based on academic literature who describes the ULL approach as being designed according to the three main characteristics: geographical embeddedness, experimentation and testing, and participation and citizen involvement. The following section will bring together the analysis to address the first research question: *How is the ULL approach articulated and applied in the selected projects, and what characterize their design and goals?*

The goal of all three ULL cases is related to solving problems related to the three dimensions of sustainability (Hatuka et al., 2018). Both Future Lab and Bøker & Bylab are equally open to all projects related to the SDGs being developed in their ULL, Asprela Living Lab has a primary environmental focus by aiming to create a renewable energy transition in Asprela, however the ULL also plans to implement projects related to other aspects of sustainability as well. In accordance with the examples provided by Hatuka et al. (2018) on the spatial meaning of a sustainable city, the cases are concerned with the reconstruction and transformation of societal infrastructures on areas like energy efficiency, transportation, and housing on a municipal to neighborhood level. All ULL cases studied has emerged as a response to the pressing challenge of achieving both environmental sustainability and wellbeing of citizens like stated by Marvin et al. (2018), while also being aware of the need for collaboration by stakeholders to solve sustainability related issues (Gollagher & Hartz-Karp (2013).
Like discussed by Steenbergen & Frantzeskaki (2018), the geographical embeddedness as a characteristic of the ULL design is usually situated in regions, cities or neighborhoods/districts. The selected ULL cases in this study are all in line with this trait. Future Lab is limited to Ålesund Municipality, Bøker & Bylab focus on the Elgeseter area in Trondheim, and Asprela Living Lab is embedded in the Asprela neighborhood.

Westerlund & Leminen (2011) argues that ULLs can be both physical regions or spaces, or "virtual realities", meaning that the co-creation and activities does not necessarily occur in one physical office of premise dedicated to the ULL (like in Future lab and Bøker & Bylab), despite solutions or projects being implemented in a limited geographical area. Asprela Living Lab has no dedicated office space for their ULL, however their network of stakeholders is still co-

creating solutions for a limited area like literature on design characteristics imply (Voytenko et al., 2016). The three areas in which the cases are embedded share the qualities of being physically close to universities and competence centers with high concentrations of knowledge and technology. Asprela Living Lab is embedded in the Asprela neighborhood due to it being the place with the highest concentration of knowledge in Porto, as well as the large societal representation of local citizens adding to the benefits of testing technological solutions in the field of renewable energy (like when addressing energy poverty). Bøker & Bylab is located in Elgeseter due to the big changes that are planned in the area, it is also close to the knowledge cluster of the NTNU Campus. Future Lab is located in Ålesund due to it being the biggest merge of municipalities in Norway, and expectations on a national level to actively work towards sustainability, making its physical location logical due to proximity to NTNU and NMK.

The characteristic of experimentation and testing is also visible in all three ULL cases both in the geographical area of focus, and within the internal co-creation processes. A common trait in the three ULLs is the goal to create innovative solutions through co-creation. The experimentation in Future Lab is connected to technology in large degree, working with stakeholders to develop technological tools (like digital twins) to visualize sustainability issues and future scenarios related to city planning and SDGs. The lab also experiments by testing out different activities and co-creation methods between stakeholders internally in the ULL to find what frameworks and tools work best in different projects and scenarios. Asprela Living Lab is planning to experiment mainly with solutions for renewable energy solutions where the neighborhood will be self-sufficient on energy production (mainly solar). Bøker & Bylab experiments mainly through different forms of citizen participation in the ULL premises inviting whom might be interested to debates, information meetings, workshops among others, regarding topics on sustainability and city planning in the Elgeseter area.

Like discussed in chapter 2 the two terms living labs and urban living labs can be seen as two interchangeable notions in this study with reference to the definition provided by Westerlund & Leminen (2011). However, interesting to note is how two of the cases studied (six of nine respondents) take no formal standpoint to weather they identify as a living lab or an ULL, due to lack of knowledge on academic definitions and research among initiators and staff. Despite this I argue with reference to chapter 4 that all three cases are within the academic framework of the living lab/ULL definitions provided in this study. To elaborate further on the third characteristic of the ULL design in the three cases, participation and user involvement is

presented in the next section as well as the topic of co-creation addressed in *research question 2*.

Lastly, important to keep in mind is how the three main characteristics all heavily influence each other as they are part of the same interactive approach, separating data into characteristics in this study should not be mistaken as a suggestion of for their mutual exclusivity, but on the contrary as an attempt of picking the approach apart to better understand its structure and interrelated nature

5.2 Co-Creation Through Urban Living Labs

Co-creation is undoubtably a crucial element in the ULL approach, merging stakeholders from different sectors in projects. The following section will address research question 2: *How is co-creation applied in the ULLs, and what are identified as the main advantages and challenges of co-creation through ULLs in work towards sustainable cities?*

The application of co-creation elements in the three selected ULL cases occur through different variations of multiple stakeholder collaborations from the public sector, the private sector academia/universities, and citizens like in to research performed by academics (Voytenko et al., 2016; Bulkeley et al., 2018; Marvin et al., 2018). In the two ULLs based in Norway Future Lab and Bøker & Bylab the co-creation between stakeholders mainly takes place in the office space specifically dedicated to the ULL, allowing for a neutral arena encouraging innovation to the informants. The co-creation processes in the ULLs occurs mainly through the projects developed within the ULL, where the ULL *infrastructure* acts as an enabling space allowing for involved stakeholders to engage with each other to develop innovative solutions.

The methods of co-creation applied in the projects vary, and in the selected cases the most common forms of engaging in co-creation is through coordination meetings with all relevant stakeholders, workshops, presentations and debates as well as the selected ULLs with their own premises view their space as a co-creation tool in itself. Specific examples include free seating concept, podcast room for collective use and activities designed to engage the stakeholders to share their views and current sustainability status (referring to Future Lab). Two of the selected cases (Asprela Living Lab and Future Lab) has “councils” and “coordination teams” with representants from each organization that are particularly involved in planning and discussing

projects/topics of relevance. It is important to note how all the selected cases are still in an early stage, making their development of co-creation activities varied and developed at differing degrees. Asprela Living Lab are still in their planning stages and co-creation processes are mainly manifested as meetings and workshops between leading stakeholders at this point in the process, however their views and plans for co-creation and citizen involvement through the ULL approach are well established. Future Lab and Bøker & Bylab are both more established with a repertoire of activities despite implications due to the pandemic.

The common advantages with co-creation through the ULL approach pointed out by several of the respondents were: broader knowledge when developing projects/solutions, the results are likely to please a larger range of societal groups, citizen involvement and less hierarchy in city planning and overall better/more innovative results. Respondents from all cases express how co-creation through ULLs in their work towards sustainable cities allow for involving all the relevant stakeholders and implementing measures together leading to better results, while in addition making all parties more content. A big value with this in the selected cases is also the very broad knowledge range that influences the results. In the analysis there were also points being made on how the respondents with background in the municipality see the transition, which seemingly has made big changes in their regular roles as enablers like discussed in Lund. These changes were mainly seen as positive and encouraging, despite the adapting process of learning to let go of control was present in the beginning in a couple of the participants with municipal backgrounds.

The main challenges with co-creation through the ULL approach that were discussed by the informants were communication issues in terms of: differences in visions among stakeholders, sectoral differences in measuring results and sharing responsibility (all of these making processes more time consuming). These tendencies rises the point being made by Wyborn et al. (2019), stating how the co-production term is being presented as a "*panacea*", pointing at value conflicts and the low public accountability that occurs when processes blur boundaries between sectors (p. 323), pointing back at the quote made by an informant: *"The issue with splitting the responsibility in projects and activities is very often related to the principle of "everyone is responsible, so no one is responsible"* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). A point was also made on how the project proposals generated through periods of co-creation usually goes back into the bureaucratic framework of the public sector before being passed on to the politicians. This raises questions on what benefits of the co-

creation process might be lost in strict frameworks and predetermined habits, with reference to Nesti (2018).

Moreover, issues with getting commitment from stakeholders and financing of projects was brought up as challenging at times, sometimes in relation to each other. In the three cases the main challenges with co-creating through the ULL approach could in broad terms be characterized communication issues, like discussed by Mahmoud et al., 2021, and the respondents themselves listed solutions to many of the problems also in accordance with the researchers' suggestions. Problems with communication due to the challenges listed above, could according to informants be prevented or diminished through *a coordination team of representants from each stakeholder, fulltime employee/s working as neutral coordinator or a developed ULL strategy/model/framework developed internally in the ULL* (Asprela Living Lab Interview 1, February 16th 2022; Bøker & Bylab Interview 1, February 17th 2022; Future Lab Interview 2, 14th 2022).

Within the discussion of co-creation and patterns, there is a varying degree of citizen participation. Two of the cases have a larger focus on engaging citizens as active part of their ULL approach, and the third having a larger focus on the public-private-academia collaboration when creating projects. Tendencies discovered in the analysis suggest how role of citizen participation in the selected ULL cases is used both as an active tool to co-create *with* citizens, and as an indirect tool to co-create *for* the citizens. All ULL cases are concerned with citizens, but in different ways and degrees. Critical views on participation are often related to power inequalities and the risk of ignoring affected groups in the implementation of incentives (Lund, 2018; Butzlaff, 2020; Mahmoud, 2021). These critiques are highly relevant in the discussion of the ULL approach, however the concepts need to be seen in tandem with focus the specific ULL claims to have. As discussed in the analysis, various factors like size of the ULLs geographical embeddedness and the purpose of the sustainable city projects can be assumed to effect of the extent and role of citizens in the ULL approach. To demonstrate this reflection a parallel can be drawn to the selected cases: Future Lab who seemingly is characterized by a three-way collaboration (public, private & academia) in their project development, has big focus on developing technological tools to make city planning as a whole better suited to reach the SDGs. When comparing the size of the Ålesund Municipality area and project focus to Bøker & Bylab who is mainly focused on one small area of the city's infrastructure, and Asprela Living Lab who is focused on a neighborhood and mainly renewable energy, it rises questions

of the parallel between geographical embeddedness (area size), and capacity for citizen involvement.

This specific discussion on weather an ULL does or do not engage in citizen involvement/participation through their co-creation approach, is not to be seen as a critique to the ULLs lacking the matter, but rather as an example of how ULL designs can take many different forms while remaining all key characteristics presented in this study. Weather the co-creation process through the ULL approach is mainly concerned with cross-sectoral collaborations with direct citizen engagement or not does not interfere with its belonging in the three characteristics presented in this study. Nevertheless, it does demonstrate nuances in how co-creation is applied in the selected ULL cases adding to existing research on the topic.

To conclude this section, interviewees from all three cases express that despite the co-creation process through the ULL approach being time consuming and requiring skills in coordination and communication, the results that emerge from the process as projects/solutions/frameworks are much better and adapted to a bigger variety of societal groups than what they would have been without the cross-sectoral collaboration. In this context this was highlighted as crucially important for all dimensions of sustainability in urban contexts.

5.3 The Added Value of Urban Living Labs

The two sections above demonstrate how the ULL approach is designed in the selected cases, and their application of co-creation through the approach. The following section will concludingly address last research question: *What is the Urban Living Lab approach seen to add to sustainable city-projects in the selected cases?*

Firstly, looking into why the ULL approach is selected for the purpose of sustainable city measures, attention should be brought to informants firmly acknowledging the need for change in structures and habits to solve sustainability issues like pointed out by Bulkeley et al (2019). As stated by one of the informants "*To reach a transformation in the sustainability field we need a change of habits"* (Future Lab Interview 2, Central Staff, February 14th 2022). The same informant also expressed how this can only be done by collaboration between multiple stakeholders in line with the point of Gollagher & Hartz-Karp (2013).

Respondents from all three cases expressed how the biggest value of the ULL approach in their case was related to the co-creation process with multiple stakeholders and citizens addressed in depth in the previous sub chapter. There is a general consensus among the informants upon how solutions and projects developed within the ULL approach are more innovative, and the results are adapted to a broader range of societal groups. When working towards solutions to create a more sustainable city, the multiple stakeholders bring more knowledge from different aspects, which in the end will lead to better and more sustainable results. "*Co-creating like this is about always about finding the win-win solutions that benefit all actors, this can result in negotiations and discussions, but the result that comes from it is better."* (Bøker & Bylab Interview 1, Central Municipality Staff, February 17th 2022). One respondent did also mention the capacity given to the citizen participation was possible due to sufficient time and funding, this being a value, or a factor allowing for the ULL to exist. However, despite access to or the possibility of applying for funding when initiating an ULL, another informant pointed out the challenge of financing their ULL, suggesting different tendencies in funding systems.

The experimentation characteristic is also brought up as adding value to the projects, in relation to testing with citizens in real time, and less expectations for the municipality to have all answers. However, experimentation is not only related to the physical solutions created through the ULL approach, but several informants refer to the "experimentation" term indirectly pointing back at testing out *ways* of co-creating with involved stakeholders, to collectively find the right methods and structures to produce innovative solutions. Translating this parallel can also add to findings pointing in the direction of different variations of co-creation between stakeholders and citizens being the biggest added value of the ULL approach in the selected cases. When looking at the data collected from the participants employed by the municipality, tendencies suggest that the ULL approach is engaging municipalities to find new solutions to urban challenges, comparable findings as presented by Nesti (2018). The selected cases initiated in the public sector expresses along the same lines how the ULL approach helps the employees in the municipality to move away from their old habits and bureaucracy. Also comparable to Nestis (2018) findings were the public employees experience it being difficult to break these pre-determined habits

After analyzing tendencies and concluding on co-creation seemingly being the biggest common component of added value through the approach in the cases, discussions should also be pointed as to *how* and *why* this becomes to be such a big value. What different factors are present in the

ULL approach that allows for this process of facilitated co-creation, leading to increased communication and collective drive? Common traits in two of the cases is the physical space neutral to all parties where the intention of collaboration is established already when entering the space, knowing the presence of cross-sectoral interactions will arise. One of the cases studied is still in a planning phase, however it does not currently have a plan for a physical ULL office space. In this case reflections needs to move beyond the physical premises and move towards the very beginning of the analysis where the ULLs aside from co-creating all have a collective goal in a set geographical area motivating the process as a whole. Do note this reflection does not imply collective goals across sectors and stakeholders does not exist and occur outside of the ULL approach, but it is suggesting that the ULL approach based on the findings in this study can be used as a method for channeling, structuring, and engaging in cross-sectoral sustainability goals.

Critical views on the approach are often concerned with the large networks creating projects that are too "broad brush", that the approach is similar to already existing methodologies and some researchers simply point out that there is too little research on the approach, its variations and the results that are produced over time (Marvin et al., 2019; Voytenko et al., 2016).
Reflections can also be made upon if the ULL approach in some cases does prove to be too general in their projects in the sustainable city context (like developing general solutions for sustainable city planning/infrastructure), while other being very specific (like developing projects focused on sustainability aspects of a neighborhood or building), perhaps these variations in focus, size of area, co-creation approaches and ways of experimenting can be a benefit to society on multiple levels despite difficulties of creating one universal definition and framework for the approach. The increasing "trend" of the concept and the funding provided by international organizations is both applauded and criticized partly due to the lack of research based on results the ULL approach bring (Voytenko et al., 2016: Marvin et al., 2018).

However, there is a general agreement on the need for collaboration between a varied set of stakeholders on both a national and international level to create sustainable cities, and how disconnections between institutions, governments, the private sector, and the community are a major barrier to reaching the matter (Gollagher & Hartz-Karp, 2013). The same reflection as made above can be brought in here, even though the ULL approach is a "trending" concept in need for further research, it can nonetheless contribute to raising awareness and engagement on the importance of co-creation in creating sustainable cities, on both a global and local level.

This is however reflections based on a small sample of ULL cases, moreover extensive research on causes, design, and results of ULLs need to be conducted before such conclusions and parallels can be drawn.

6. Concluding Remarks

Through examining three ULL cases (Future Lab, Bøker & Bylab and Asprela Living Lab), this thesis has discussed the design of the ULL approach according to three main characteristics identified in academic literature: geographical embeddedness, experimentation and testing, and participation and citizen involvement (Voytenko et al., 2016; Bulkeley et al., 2018; Marvin et al., 2018). Further analysis investigated the application of co-creation through the ULL approach in the cases and investigated its advantages and limitations in their work towards sustainable cities. Lastly, the thesis addressed what the ULL approach is seen to add to sustainable city projects in the study.

Findings in this research suggest how the concepts of geographical embeddedness, experimentation and testing, and participation and user involvement characterize the ULL design in the three cases studied in line with literature. Furthermore, analysis based on semi-structured interviews points Tendencies in the findings also points to how co-creation in the ULLs is characterized by partnerships between sectors (public-private-academia-citizens), and collaborations working towards a common goal of tackling sustainability issues. Tendencies suggest that main advantages of co-creation through the ULL approach in the cases was tightly linked to the big knowledge exchange occurring in cross-sectoral communication and citizen involvement, seen to increase the likelihood of producing better solutions for society and the environment.

Furthermore, findings point to a significant overlap in seen benefits and added value of the co-creation concept through the ULL approach, and the added value of the ULL approach in its entirety. Main findings in the overlapping value identified are related to the ULL being a "physical neutral arena" for collaboration, facilitating innovation for all groups in society. However, findings do also point to a problematic nature with the cases co-creation process through the ULL approach, mainly identified as communication issues related to different value systems and predetermined habits of each stakeholder. Interviewees do on the other hand express that these challenges are mainly experienced in the beginning of the ULL initiation or in the start of a new project.

Important to note in this study, is how the three main characteristics identified in the ULL design all heavily influence each other as they are part of the same interactive approach.

Separating data into characteristics in this study should therefore not be mistaken as a suggestion of the characteristics mutual exclusivity, but on the contrary as an attempt of picking the approach apart to better understand its structure and interrelated nature

Concludingly, the topic of the ULL approach in sustainable city contexts is increasing in popularity, still there is a presence of underdeveloped literature on co-creation through ULLs and its effectiveness in a long-term perspective (Nesti, 2018; Voytenko et al., 2016). Future challenge for researchers and academics would be to further research the concept of co-creation through the ULL approach focusing on its effectiveness on improving the capacity of sustainable city projects. Furthermore, extensive research needs to be performed on ULL design and how co-creation takes place through the ULL-approach like also suggested by Puerari et al. (2018), additionally how the ULL approach is positioned in relation to other similar approaches to provide a further depth understanding of ULLs academic positioning.

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Appendices

Appendix 1: Interview Guide

Appendix 2: Informant Letter

Interview Guide

Name:

Organization/Position in ULL

Case Affiliation:

Questions

1. Introduction to the lab & Added value

- What is your role in this ULL project?
- What is the main goal with your project?
- What values do you put in the lab-label of the project?
- How were the different stakeholders involved in the project?
- Who is funding the project?
- Do you think a lab approach be a better way to reach a sustainable city, in comparison to other ways of co-creating for sustainability? Why? How?
- When comparing the lab approach to how you are used to working in similar projects, how is the lab approach different? If not, why is it not different?
- What is in your experience the biggest value the lab approach has brought to your project so far?
- Do you think co-creation through this type of lab approach produces different results then without? Better/Worse? How is it different then how you usually work in the municipality/your organization?

2. Co-creation & Experimentation

- What kind of activities or projects are you planning to perform in the lab, that is influenced by the typical “lab” approach? Examples?
- By using a lab approach, what are the differences in the solutions/results produced? Better/Worse? Why?
- If there are disagreements on how to solve something or what the project should look like, who has the end say, who decides? Or do you always agree?

- When you and the other main partners are co-creating ideas and working together, what does this process look like?
- How do you implement co-creation in the lab? Through what methods?
- What are the main advantages of a project with multiple actors working together and co-creating for sustainable cities?
- Are there any limitations or difficult parts in being multiple actors co-creating? Elaborate.
- Do you think co-creating between multiple stakeholders make difficult to set specific goals or not?
- What are the advantages of testing sustainable solutions in cities locally? What are the limitations?

Notes:

Are you interested in taking part in the research project

”Urban Living Labs – An Approach to Green City Transition ” ?

This is an inquiry about participation in a research project where the main purpose is to explore the Urban Living Lab approach in the light of green city transition. In this letter we will give you information about the purpose of the project and what your participation will involve. The research is for my master thesis in the international master’s programme Globalisation and Sustainable Development at NTNU.

Purpose of the project

In my thesis I want to contribute to the Urban Living Lab research by exploring how Urban Living Labs are utilized in green city transitions. To do so I ask the following research questions:

- How is the ULL approach articulated and applied in the selected projects, and what characterise their design and goals?
- How is co-creation applied in the ULLs, and what are identified as the main advantages and challenges of co-creation through ULLs in work towards sustainable cities?
- What is the Urban Living Lab approach seen to add to sustainable city-projects in the selected cases?

In the thesis I want to go in depth on a few urban living lab cases, and interview 3 respondents involved in each project. Through the semi-structured interviews, I hope to gain knowledge that will help me answer my research questions and help fill gaps in this research field.

Who is responsible for the research project?

The department of Geography at NTNU is the institution responsible for the project. My supervisor from the institute is Hilde Refstie.

Why are you being asked to participate?

You are being asked to participate because it seems you have some involvement in a living lab project, that I would love to hear more about. I have selected a sample of respondents through the following criteria:

- The person must have/have was involved in a living lab project with sustainability goals in either one city or multiple.

- The person can answer questions about the living lab initiative and the start-up process, as well as measures and frameworks within the lab (stakeholders, experiments etc.)

What does participation involve for you?

For this study I will be conducting semi-structured interviews. This means that I will be asking some pre-selected questions, but that the interview will be structured more like a conversation. I will be sound recording the interview and taking notes by hand.

The information collected in the interview will be according to my research questions, and they will not require talking about any personal subjects or matters outside of the research topic. I will not use any names or personal information in the thesis. However, since the information given is about a specific living lab case, the level of anonymity might be affected by the size of the project. This is something we can discuss together in advance of the interview.

- If you chose to take part in the project, this will involve that you make yourself available for an interview. It will take approx. 30-45 minutes. The interview includes questions according to my research topic described above. Your answers will be recorded electronically.
- I will also be collecting general information about each case online beforehand. This will be only information found in public reports/on websites that belong to the project.

Participation is voluntary

Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data

We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- The people that will have access to the data is me (Wida Angela Wingsnes), and my supervisor from the institute for Geography Hilde Refstie.
- Data will be stored on my personal computer together with information on each case. All raw- data will be deleted after the finalization of the project (June 2022).
- The degree of personal recognizability in the thesis will depend on the size of the living lab (if the project is small, it might be easier to recognize the individual respondent), but all information is intended to be presented in a general manner with focus on the specific living lab case, not the respondent.

What will happen to your personal data at the end of the research project?
The project is scheduled to end in June 2022. After the finalization of the project all recordings and hand-written notes from the interviews will be deleted.

Your rights
So long as you can be identified in the collected data, you have the right to:
access the personal data that is being processed about you

-request that your personal data is deleted
-request that incorrect personal data about you is corrected/rectified

-receive a copy of your personal data (data portability), and
-send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?

We will process your personal data based on your consent.

Based on an agreement with NTNU, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?

If you have questions about the project, or want to exercise your rights, contact:

Wida Angela Wingsnes *****

Or supervisor: X

- Our Data Protection Officer: NICE-1, NTNUs file storage area for shielded data.
- NSD – The Norwegian Centre for Research Data AS, by email: (personverntjenester@nsd.no)

  or by telephone: X

  Yours sincerely,
  Wida Angela Wingsnes

  Student at NTNU

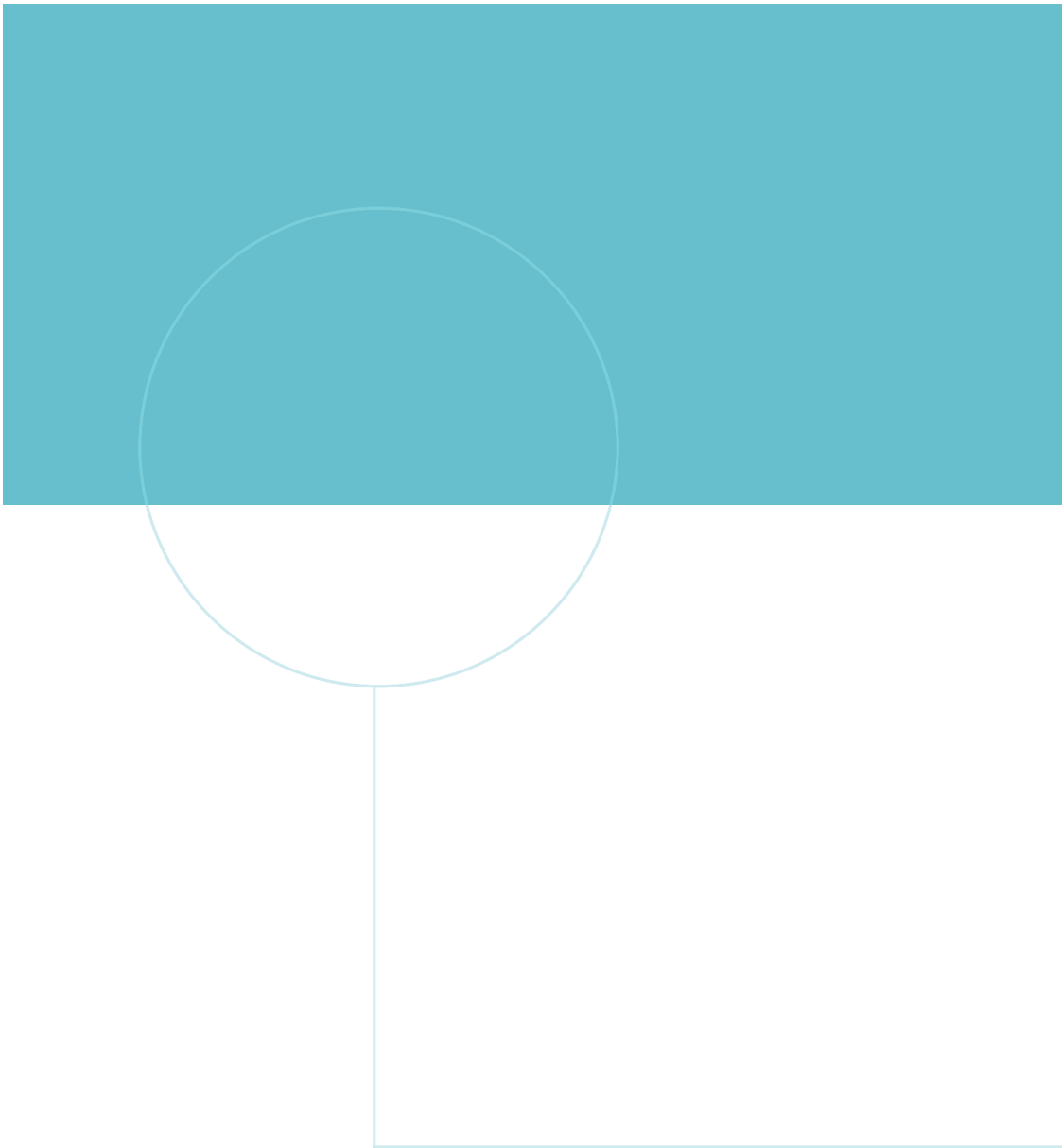
Consent form

I have received and understood information about the project "Urban Living Labs – An Approach to Green City Transition" and have been given the opportunity to ask questions. I give consent:

• to participate in an interview about urban living labs
I give consent for my personal data to be processed until the end date of the project, approx. 1.june

2022

(Signed by participant, date)



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