IIIEE Theses 2015:21

Innovation and the Triple Bottom Line

Investigating Funding Mechanisms and Social Equity Issues of Living Labs for Sustainability

Steven Curtis

Supervisor

Yuliya Voytenko

Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, September 2015

THE INTERNATIONAL INSTITUTE FOR
INDUSTRIAL ENVIRONMENTAL ECONOMICS

Published in 2015 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.

ISSN 1401-9191

Acknowledgements

Challenge Your Perspectives has been a mantra I have adopted during my two-year stay in Sweden. It is curious to think how much a single decision can impact the trajectory of one's life. On a crisp fall day in October of 2012, I made a decision to attend the Idealist Grad Fair in Chicago, IL. There, I had the pleasure to meet Maria Lindblad, International Marketing Manager at Lund University. In that meeting, I learned of a scholarship competition called *Challenge Your Perspectives*, open to all US residents to study in Sweden. In just over a month, I had gone from a place in my life with great ambition but no clear path to having been awarded the single scholarship to attend the Environmental Management and Policy Master's programme at the International Institute of Industrial Environmental Economics. I am grateful for the opportunity to experience such diverse and varying perspectives from my host country, my professors and classmates in the EMP programme, my Swedish friends and my international friends who call Sweden their second home. I am appreciative to my host country, which has taught me so much about acceptance of all people. I want to thank the Swedish Institute for sponsoring the scholarship competition, the financial support that allowed me to come to Sweden, and the host of activities I was able to partake in which shaped my perspective. I will continue to *challenge my perspectives* in everything I endeavour to do.

I want to thank my family for their constant support. In particular, I want to thank my mother, Betty-Ann, a self-made woman who inspires me to be a better and more courageous person. She raised me with the notion to always be complete in the work that I do. Her insightful words guide me through my quest to be a better person and make a positive impact. She reminds me to "be the change you wish to see in the world" and suggests, "your greatest strength is your greatest weakness." It is her unconditional love and support that allows me to let my passion drive my work, giving me confidence to always be true to myself.

I appreciate the efforts of Yuliya Voytenko, my thesis supervisor, in her time and support she offered throughout the process. Moreover, I want to thank Kes McCormick for his support. It was a presentation he provided in October 2014 that sparked my interest in living labs. I am thankful for this inspiration.

A special thank you to those willing interviewees and survey respondents. Your input and perspective is appreciated and valued!

I want to thank my "Lund friends" Lotta Dahl, Zach Mooney and Nicholas Kaminski for their friendship and understanding during this "crazy" Master's programme. Further, thank you to Lotta and Zach for securing accommodation during the last two months of the Master's programme! Whether it was an extra apartment, a couch, or bed, I am grateful that you let me crash just about anywhere.

Lastly, I want to thank my friends within the EMP Programme. Your culture, knowledge, perspective, friendship and acceptance have meant the world to me. I am truly grateful for this experience and look forward to the many more memories we will have together.

Abstract

Cities face a host of challenges including urbanisation and climate change and must quickly adapt and integrate sustainability solutions to deal with these challenges. One platform seen as a mechanism to support innovation for sustainability in cities is the concept of the living lab. A living lab is a user-centred, open innovation ecosystem that seeks to engage academia, industry and municipalities along with the community in the processes of co-creation and co-generation of products, processes or services in a real-world context. On-going research seeks to measure the potential of living labs to support innovation for sustainability as they are often regarded as a mechanism to support rapid social and technological transformations.

The triple bottom line perspective guides this investigation to examine the environmental, financial and social aspects of living labs. Several methods are used in this study to analyse and triangulate data as it relates to the triple bottom line, namely, literature analysis of 118 living labs, thirteen respondents to a survey of living labs, five semi-structured interviews of funding partners and relevant stakeholders, and geographic information systems (GIS) analysis of living labs in the Netherlands, England and Wales.

Living labs for sustainability offer the promise of sustainability transformations in cities; yet, issues plague the viability of living labs as a platform to usher such transitions. The results show that living labs most often engage in projects in the fields of energy efficiency and smart city solutions; yet, they do not communicate the decarbonisation and environmental impacts of their actions. In examining the extent to which the funding regime supports living labs, it is clear that the current funding strategy focuses on the financing of short-term projects as opposed to platforms or processes such as living labs. Consequently, the current funding regime needs to develop mechanisms that support platforms and ecosystems for sustainable innovation that would allow for long-term commitment and trust to be built between living labs and the community. Lastly, while living labs are often embedded in disadvantaged communities, it appears that living labs tend to only engage those willing participants who represent a non-diverse and privileged section of society. This analysis suggests that living labs for sustainability shall seek to engage all people impacted and included in their sustainability purview in the development of sustainability solutions.

Keywords: living labs, innovation for sustainability, triple bottom line, funding of innovation, geospatial analysis

Executive Summary

This thesis investigates the funding mechanisms and social equity issues of living labs for sustainability. Living labs are described as a structured and organised multi-disciplinary network of actors and users that seek to develop products, processes or services through the process of co-creation within a real-world environment. While living labs can engage in any variety of fields including Information and Communication Technology (ICT), healthcare, tourism, among others, living labs for sustainability are elevated as a potential platform to drive urban sustainability transformations.

Despite this potential, efforts to measure and assess the impacts, both direct and indirect, of living labs for sustainability is needed. In doing so, researchers can begin to understand best practices and mechanisms to allow for the proliferation of living labs that may aid in such urban sustainability transformations. Therefore, the purpose of this research is to contribute to the on-going work surrounding living labs for sustainability by investigating the economics, the social mechanisms and the sustainability impacts associated with living labs for sustainability.

The triple bottom line perspective of sustainability serves as a powerful window to frame the research design and analysis. With a focus on *Planet, Profit* and *People,* this thesis seeks to ask research questions pertaining to these aspects of the triple bottom line:

Planet – RQ1: How do living labs engage with sustainability?

Profit – RQ2: How does the current funding regime support living labs?

People – RQ3: To what extent does social equity issues arise in the implementation of living labs?

This thesis seeks to employ various methods in the research and analysis of living labs, which allows for results triangulation. Firstly, literature analysis is performed as the primary means to identify living labs for sustainability. This serves as the foundation for the following research as it relates to the above research questions. Further, the literature analysis includes assessing the sustainability aspects of the living labs and projects for sustainability under consideration. A survey of living labs seeks to gather in-depth, qualitative data from those identified living labs; in total, thirteen respondents offered their candid perspectives and experiences. The survey questions are structured to collect biographical data about the living lab, the funding process and the user-engagement strategies from the perspective of the living lab. Five interviews with funding partners and relevant stakeholders took place to examine the current funding strategy of living labs. Finally, this research appears to be the first in using geographic information systems (GIS) to analyse living labs. In particular, this work seeks to perform community-based research to investigate the communities in which living labs for sustainability are embedded.

RQ1: Living Labs for Sustainability

Living labs for sustainability were found to exist throughout Europe with a focus on a variety of sustainability aspects. In total, 118 living labs for sustainability were identified, investigated and analysed. Further, these living labs for sustainability serve as the reservoir for the survey of living labs and GIS analysis.

Investigated living labs tend to focus on energy efficiency and smart city solutions. This aligns with current literature, which correlates the proliferation of living labs to the rise in ICT development. Interestingly, while many living labs engage in projects that benefit from ICT

development, the potential decarbonisation and environmental benefits are rarely discussed or highlighted as motivation for their activities. Instead, financial savings and innovation are among the leading motivations of living labs to engage in energy efficiency and smart city projects. However, living labs engage in a wide-variety of sustainability aspects across different sectors including transport, construction, low carbon futures, renewable energy, urban gardening, etc. Furthermore, living labs employ a wide-range of participatory methodologies to engage with end-users including co-creation workshops, interviews, surveys and email correspondence.

RQ2: Funding of Living Labs

Funding of research and innovation in the European Union (EU) is largely motivated by the need to increase global competitiveness, create employment opportunities and improve the standard of living. Literature analysis, interviews with funding partners and survey of living labs demonstrate the wide range of actors willing to fund living labs. EU-wide research and innovation funding from mechanisms such as FP7 or Horizon 2020 finance living labs throughout Europe. However, Joint Programming Initiatives, national funding agencies, municipalities, industry and private partners all fund living labs. Among the survey responses and literature analysis, no clear funding actor dominates the financing of living labs.

The current funding regime supports the financing of short-term projects, often three to four years. Projects seek to deliver a single outcome without the inherent ability to drive processes of change. The biosphere works in a cyclical and iterative process, while the funding of innovation for sustainability does not. Given the data and analysis, it appears that the funding regime does not adequately support living labs for sustainability. Living labs require "lots of trust from end-users," which is a timely process, requiring long-term commitments. However, projects that are funding on a short-term basis do not enable living labs to make these commitments, nor do they allow living labs to develop trust within the communities in which they serve. Therefore, funding partners need to reassess their funding strategies as it relates to living labs should they seek to develop truly transformative vehicles for urban sustainability transitions.

RQ3: Social Equity of Living Labs

This work appears to be the first of its kind to use GIS in performing community-based research that investigates the communities in which living labs for sustainability are embedded. Using GIS in this manner allows for a broader perspective in investigating social equity issues. As disadvantaged communities are most susceptible to the growing impacts of urbanisation and climate change, it is important to ensure solutions in cities benefit these communities and not only those with the financial means and higher levels of education who tend to be engaged.

Living labs in the Netherlands, England and Wales are investigated using demographic data that look at average household income, population density, level of education, crime, access to healthcare, etc. The community representing a two-kilometre radius around the investigated living labs were characterised using available geospatial data. Of those communities investigated, nearly all of the living labs (16 of 18) were found to be in disadvantaged communities in comparison to the average community in each respective country. Yet, in comparing the GIS data with the survey results, those living labs that responded admit that their activities struggle to engage diverse, low-income and less-educated community members. Further, men and more-established (older) individuals tend to be involved in living lab activities.

Recommendations

The analysis suggests that living labs do indeed have potential to lead to sustainability transformations in cities. However, living labs still struggle to proliferate throughout Europe and abroad. In order to increase the effectiveness of living labs, this thesis offers recommendations to improve the implementation of living labs.

- **Emergence of People as Driver of Innovation:** *Our Common Future* (1987) highlights the problems of urbanisation, resource depletion and environmental stress as it relates to social and economic disparities. The well-being of all people shall be a condition in which innovation is sought and developed, especially, in regards to environmental justice and sustainability. Current innovation theory builds on the concepts of open innovation and social innovation. Living labs, described as a quadruple helix consisting of public-private-people partnerships, are seen as a platform supporting open social innovation. However, findings suggest living labs need to be more inclusive to ensure tested solutions work for those communities that are most at need. Further, living labs focusing on citizen-centred innovation can promote sustainability transitions through increased knowledge integration and social learning.
- **Redevelopment of Funding Mechanisms to Support Living Labs:** An improved funding strategy of living labs shall include more stable and long-term funding mechanisms that allow living labs to develop rich networks, deep trust within the community and long-term commitments. A mechanism that supports long-term conditional funding or co-financing on the basis of a living lab meeting annual targets is an option funding partners were open to; however, funding agencies suggest that a platform that would receive such funding would need to have already been established with a long and successful track record. Further, as it relates to the motivation of funding partners (competiveness, employment, innovation, well-being), there is an incentive to ensure success of a funded living lab. The funding partners may serve as a receptacle of best practices to aid in the development of self-sustaining business models among living labs. Lastly, open and agile processes of funding are needed to suit the real-world context in which living labs experiment.

While living labs represent a pathway towards urban sustainability transformation, existing governance structures and regimes must possess the capacity to integrate and *maintain* sustainability initiatives in cities. It is important to continue to test a variety of pathways towards sustainability in cities; living labs only represent one tool to tackle the global and urban challenges we face as a society.

Table of Contents

List of Figures

List of Tables

Abbreviations

ENoLL – European Network of Living Labs

ERA – European Research Area

EU – European Union

FP7 – 7th Framework Programme for Research

GDP – Gross Domestic Product

GIS – Geographic Information Systems

GUST – Governance of Urban Sustainability Transitions

ICT – Information and Communication Technology

IIIEE – International Institute for Industrial Environmental Economics

JPI - Joint Programming Initiative

LSOA – Lower layer Support Output Area

RDI – Research, Development and Innovation

TEP – Test and Experimentation Platform

VINNOVA - Verket För Innovationssystem (Swedish agency for innovation systems)

WCED – World Commission on Environment and Development

1 Introduction

The first real discussion of the role of sustainable development in addressing our common future and challenges is credited to the Brundtland Report (1987), titled *Our Common Future,* as a result of the United Nations World Commission on Environment and Development. The report outlined common challenges including population growth, food security, biodiversity, ecosystem services, energy, industry and urbanisation (WCED, 1987). Not long after, sustainability and sustainable development began to permeate throughout cultural and political discourses. In 1994, John Elkington coined the term 'triple bottom line' and suggested that businesses and corporations need to take into account the three P's: *people, planet* and *profit* ("Triple bottom line," 2009). In doing so, corporations (and society at large) could measure the financial, social and environmental performance over time. He defines the triple bottom line as a view of sustainable development that "involves the simultaneous pursuit of economic prosperity, environmental quality, and social equity" (Elkington, 1997, p. 397).

While triple bottom line reporting has traditionally been reserved for business and corporations to reimagine business as usual, the triple bottom line perspective is being applied to other aspects of society. This perspective demonstrates the need, opportunity and ability of cities and communities to focus on social and environmental sustainability in addition to economic development (Rogers & Ryan, 2001). Literature has begun to develop a framework to evaluate community-based initiatives that address social and environmental challenges facing our global society (Fredline, Raybould, Jago, & Deery, 2005; Rogers & Ryan, 2001).

Among the greatest challenges, urbanisation is poised to continue throughout the 21st century. Megacities, those cities with twenty million or more people, are expected to continue to grow at impressive rates (Childers, Pickett, Grove, Ogden, & Whitmer, 2014). In fact, population centred in cities will grow from approximately 50% today to nearly 80% of the population living in cities in some parts of the world by 2050 (UN DESA, n.d.). The 600 largest cities globally generate 60% of global gross domestic product (GDP) and 75% of global carbon dioxide emissions (Lööf & Nabavi, 2013). The global population is expected to increase from seven billion to nine billion by 2050 with the total number of people living in cities doubling within a period less than four decades (Lööf & Nabavi, 2013). However, much of the forecasted population growth will occur in areas not yet urban or unaccustomed to such population growth (Childers et al., 2014).

With the concentration of people in cities increasing, issues such as transport, housing and production methods, which make up a large share of global greenhouse gas emissions, can be tackled due to greater proximity and centralisation of governance (Lööf & Nabavi, 2013). Cities must quickly adapt and integrate sustainability solutions to deal with their growing populations.

With growing population, the threat of climate change and worsening social inequality, new and innovative approaches are required to transition and transform cities towards sustainability (Murray, Caulier-Grice, & Mulgan, 2010). Sustainability transformation requires the creation and implementation of previously untested and unproven solutions which spur a fundamentally new way of living within the ecological, economic and social spheres (Westley et al., 2011). However, Westley et al. (2011, p. 772) posit, "… traditional, expert-driven, centralised, and top-down approaches to problem solving are not nimble enough to effectively address convergent, nonlinear, and rapidly changing global problems characterised by high uncertainty." In other words, systemic change that includes solutions supported by government, industry and civil society must work in tandem to address complex sustainability issues. This requires that many solutions need to be generated, experimented, developed and

scaled. To do so, test cases in cities represent a best-case scenario from which broader lessons may emerge (Childers et al., 2014).

One such approach, under investigation here, is the concept of a Living Laboratory. Many definitions permeate throughout literature (discussed in Chapter 3) but, conclusively, they agree that a living lab must consist of a structured and organised multi-disciplinary network of actors who involve users in the co-creation and co-generation of products, processes and/or services within a real-world environment (Mensink, Birrer, & Dutilleul, 2010). For example, SubUrbanLab is a living lab platform based in Botkyrka, Sweden and Riihimäki, Finland that brings together the municipalities with local business and communities. Example living lab projects include engaging youth in an urban gardening project, testing energy efficiency products and preferences in residents' homes, and developing community housing that is smart and sustainable.

1.1 Problem Definition

Living labs are heralded as an innovative approach to solve the urban sustainability crisis (Bulkeley & Castán Broto, 2013; Mensink et al., 2010; Veeckman, Schuurman, Leminen, & Westerlund, 2013). Evans and Karvonen (2011) suggest that living labs may be a method to inspire rapid social change towards technical and sustainable transitions. However, future work is needed to understand the impacts, both direct and indirect, of living labs in their local communities. Further, after understanding the types of interventions, their effectiveness in given contexts and their impact on social transformation, the living lab methodology can be scaled up and applied to a wider-range of sustainability challenges in more cities (Bulkeley & Castán Broto, 2013).

1.1.1 Living Labs for Sustainability

Living labs are described as "popping up" in cities; this is to say that, thus far, there is little coordinated effort to use living labs as an innovative strategy for sustainability (Veeckman & van der Graaf, 2015). While networks of living labs, such as the European Network of Living Labs (ENoLL), have attempted to capture these interventions occurring throughout Europe and the World, the variable and uncoordinated nature of living labs makes it difficult to do so. While literature focuses on living labs as case studies, it appears that a comprehensive database of living labs **for sustainability** is needed to serve as a reservoir of tested and accepted living labs for sustainability in order to answer conceptual questions and advance the living lab methodology.

Identifying living labs for sustainability allows further research in the evaluation of living labs as a mode of urban transition and sustainable development. In identifying living labs for sustainability, best practices can be determined and a living lab methodology focusing on sustainable transitions can be created. Such a repository will shed light on what aspects of sustainability living labs are working in, which actors are involved and how living labs engage with end-users. Moreover, more specific areas of investigation can occur including the impact of living labs on consumer behaviour, governance, alternative economic models, etc. However, no coordinated and comprehensive effort to catalogue living labs for sustainability has occurred to allow for further research in the potential of living labs for sustainability.

1.1.2 Funding of Living Labs

The greening of cities towards sustainability is complex; sustainability is not an outcome or endpoint of a project but an iterative and adaptive process (Childers et al., 2014). Meanwhile, the funding regime for sustainability in cities tends to dominate financing projects over processes. The technosphere in which we increasingly depend on to transition towards a more

sustainable society does not operate in the same cyclical nature as of the biosphere (Westley et al., 2011). Yet, funded projects are constrained in scope, time and space. In other words, the funding regime is linear in its sponsoring of complex, nonlinear sustainability issues. Would a more comprehensive and adaptive funding protocol of living labs benefit cities? In order to address these issues, an investigation is needed into the funding mechanisms sponsoring living labs for sustainability in order to assess to what extent the funding regime supports living labs and how it may be improved. This is especially relevant against the backdrop of the current underfunding and devolution of municipal governments (Childers et al., 2014).

1.1.3 Social Equity Issues

Laboratories in the traditional sense are seen as privileged spaces in society, often able to control the flows in and out of a system (Evans & Karvonen, 2011). Often, the privilege of creating a living lab within a community comes down to the ability to finance such projects. In interviews with municipalities in Estonia, Lepik, Krigul and Terk (2010) found that municipalities, countries and regions with more economic wealth could afford to test and experiment in cities while others could not. Not only is it a matter of which cities can benefit from living labs, but the questions arise as to who is engaged in living labs and who is benefiting. Innovations in cities tend to be stratified on the basis of ethnic and racial characteristics, income, education, age, gender, disabilities, etc. (Wolch, Byrne, & Newell, 2014).

Communities of colour, low-income residents and otherwise disadvantaged citizens are among the most vulnerable to the impacts of climate change and other environmental issues impacting cities (Bulkeley & Castán Broto, 2013; Wolch et al., 2014). Further, Evans & Karvonen (2014, p. 415) observe that "demonstration projects are simply 'dropped into' urban areas rather than integrated with their local contexts." If this is the case, community-based research is needed to examine who is being included and who is benefiting from living labs in cities. This enables research to understand the ways in which innovation in cities for sustainability include and benefit some while neglecting others (Bulkeley & Castán Broto, 2013).

Therefore, the purpose of this thesis is to contribute to the growing body of work investigating living labs, in particular, by understanding the economics, social mechanisms and impacts associated with living labs to advance those living labs for sustainability.

1.2 Research Questions

With this background in mind, this thesis takes a three-pronged approach to assess and evaluate the viability of living labs for sustainability. Much like the triple-bottom line view of sustainability in looking at environmental, economic and social aspects, the thesis addresses three questions targeting these three components of living labs for sustainability (Table 1-1).

Table 1-1. Research Questions and Sub-questions

Planet	
RQ1	*How do living labs engage with sustainability?*
Sub-questions	- *Which living labs engage with sustainability?* - *What is the sustainability focus of living labs?* - *How do they engage with end-users?* - *Who are the actors and what is the power structure among them?*

Profit	
RQ2	*How does the current funding regime support living labs?*
Sub-questions	- *Who funds living labs?* - *Why do they fund living labs?* - *How do they measure success?* - *What happens at the end of funding?*

People	
RQ3	*To what extent do social equity issues arise in the implementation of living labs?*
Sub-questions	- *How can the community in which living labs are embedded be characterised?* - *Who is engaged in living labs?* - *Who is benefiting from living labs?*

1.3 Overview of Methodology

This thesis uses a number of approaches to answer the proposed research questions. Keeping in mind *people*, *planet* and *profit*, the thesis employs **literature analysis** to identify living labs for sustainability and highlight in which aspects of sustainability they concentrate. A **survey** is sent to all identified living labs for sustainability to examine their funding history and user engagement patterns. **Interviews** with funding agencies, living labs and other stakeholders are conducted to understand the current level of support provided by the funding regime. Finally, **geographic information systems (GIS)** tools are used to explore the spatial characteristics of the communities in which living labs are embedded. For a more thorough explanation of methods, see Chapter 4.

1.4 Scope and Limitations

Research seeks to examine a system; as such, the system boundaries and scope need to be defined. For the purpose of this research, the focus is on interventions in cities for

sustainability. The method for identification of these interventions serves as the primary scoping mechanism while the main limitation is introduced as a result of the interventions identified. Undoubtedly, there are numerous types of interventions for sustainability transpiring in cities across Europe. However, only those contained within the European Network of Living Labs (ENoLL) and identified by the research team of the Governance of Urban Sustainability Transitions (GUST) are included in this study. This limits the number of living labs for sustainability investigated and excludes potential data points of interest for this study.

The definition of a living lab varies between disciplines, academics and practitioners. For the purpose of this study, it is chosen not to deal with the complexity of the term in filtering living labs under investigation; instead, only those interventions in cities that could be identified as living labs among any definition are included.

Living labs in cities and the subsequent field of research are evolving quickly. Information that exists online is static and may not represent what is happening in reality. Further, information pertaining to individual living labs is difficult to verify. Therefore, this study is limited to the secondary information provided online and the subsequent language translation that, in some cases, was necessary. When possible, information was verified through interviews and survey results.

Of course, limitations and the need to scope arise through the methodological choices that are made in any research design. For a more detailed discussion, please see Chapter 4.5.

1.5 Ethical Considerations

This thesis strives to honour and respect all survey respondents' and interviewees' anonymity unless they consented to information disclosure. Yet, comparing and correlating survey response data to interviews with funding agencies proved to be sensitive. There was a conscious effort to ensure that no information provided in the survey anonymously by living labs could impact their funding through conversations with their funding partner.

In working with socio-demographic data, the resolution of the dataset is often high, between 500 m and 5 km. As a result, it is important to acknowledge that the data does not describe a homogenous population but looks to generalise the population under investigation. Moreover, using data such as income, education and household value in no way seeks to make any characterisations about particular individuals other than to allow for an understanding of who may or may not be included and benefiting from living labs.

1.6 Audience

This thesis is written as part of the final semester for the Master of Science programme in Environmental Management and Policy at the International Institute for Industrial Environmental Economics (IIIEE) at Lund University in Lund, Sweden. The research conducted and conclusions purported support the Governance of Urban Sustainability Transitions (GUST) Project, of which researchers at the IIIEE are involved. The GUST Project is funded by JPI Urban Europe and includes partners from Lund University (Sweden), Dutch Research Institute for Transition (the Netherlands), University of Durham (the United Kingdom) and Joanneum Research (Austria) with the aim to examine, inform and advance governance and sustainability transitions through living labs ("Governance of Urban Sustainability Transitions," n.d.).

The research questions proposed in Chapter 1.2 seek to address conceptual questions associated with particular knowledge gaps regarding living labs. Answers to these questions have wide-ranging relevant audiences. For example, identifying living labs for sustainability and their areas of focus is relevant to other local, national and regional governments and networks in determining the usefulness in applying such methods to address societal issues within their own jurisdiction. Funding partners benefit in understanding various perspectives to better design funding models for nonlinear innovation ecosystems in cities. Social equity issues plague living labs; practitioners' benefit from understanding how pervasive this problem is in order to develop strategies to avoid it. Lastly, the knowledge generated benefits researchers who look to understand and advance the role living labs play within society to foster new mechanism for urban sustainability transitions.

1.7 Disposition

The thesis is a comprehensive account of many areas of study regarding living labs. As a result of quite specific and disjointed tasks associated with this research, a thorough literature review to aid in the understanding of living labs and subsequent analysis is presented in Chapter 2. In particular, emphasis on theory pertaining to knowledge integration, public participation, geography and innovation is discussed.

Chapter 3 unravels the complexity of the living lab concept and provides a history of the term, current schools of thought and specific examples while summarising the advantages and disadvantages of living labs as a tool for open innovation in cities.

Chapter 4 presents the four methods for data collection and analysis – literature analysis, surveys, interviews and GIS – that comprise the methodology used in this study.

Chapter 5 and Chapter 6 present relevant findings and contribute to the discussion in evaluating living labs against the triple bottom line.

Chapter 7 makes the case of integrating the triple bottom line with the concept of public-private-people partnerships, realising the focus on people is paramount to the future of sustainability transformation. Further, recommendations are provided to funding agencies and future research is considered.

Finally, Chapter 8 provides a summary of the conclusions found as a result of this thesis research.

2 Context and Theory: Linking Urbanisation, Knowledge and Innovation

Through public consultations, the European Union has identified priorities for future sustainable cities. A strategy for urban cities will include: to enhance competitiveness, innovation and research within the knowledge economy; to promote active labour markets; and to elevate sustainable development, greenhouse gas reductions and energy efficiency (Schaffers et al., 2011). This strategy forms the basis for the construction of future urban environments in Europe. In 2002, the Budapest Manifesto, a declaration from the attendees at the workshop *Science for Reduction of Risk and Sustainable Development of Society*, called for a European network that promotes social innovation with a citizen-centric participatory process (European Commission, 2014a). Many see living labs as such a mechanism to support the strategy of the European Union for sustainable urban futures with a focus on citizen-centred innovation.

To lay the groundwork for further understanding of living labs, this section includes a discussion surrounding the important theoretical disciplines that shape the future development and impact of living labs. First, this section seeks to contextualise on-going and future challenges within an urban environment. Next, a description of participatory methodology alludes to some tools used by living labs to engage end-users. This engagement leads to the exchange of knowledge, something that is intangible and needs further description. The role of place in cities is important to understand the impacts and development of experimentation and innovation in cities, something to be discussed at the end of this chapter.

2.1 Urban Challenges and Sustainable Development

Sustainable development is promoted as the cornerstone of the most recent Environmental Action Program by the European Union (European Commission, 2015). One of two priority objectives for the European Union is to make cities more sustainable (European Commission, 2015). However, the concept of sustainable development is not new. Widely recognised as the first mainstream definition of sustainable development, a report from the World Commission on Environment and Development (WCED) called *Our Common Future* was published in 1987 in dozens of languages (Pezzoli, 1997).

Our Common Future defines sustainable development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). The report goes on to discuss pressing sustainability issues pertaining to food security, biodiversity, ecosystem services, energy, industrial development, water scarcity, poverty, etc. while proposing institutional and legal changes to transition towards common action for sustainability (WCED, 1987). To exacerbate these problems, increased urbanisation challenges sustainable development where innovative and integrative policy tools are needed and needed quickly (United Nations, Department of Economic and Social Affairs, & Population Division, 2014).

The share of the world population found in cities is steadily on the rise, projected to increase to 66% of the total global population by 2050 (United Nations et al., 2014). Moreover, between 2014 and 2050, the world is expected to add 2.5 billion people to the planet; 90% of the growth is expected to occur in Asia and Africa (United Nations et al., 2014). Therefore, these cities will be expected to adapt quickly over the coming decades to transition infrastructure and lifestyles to support an increased population.

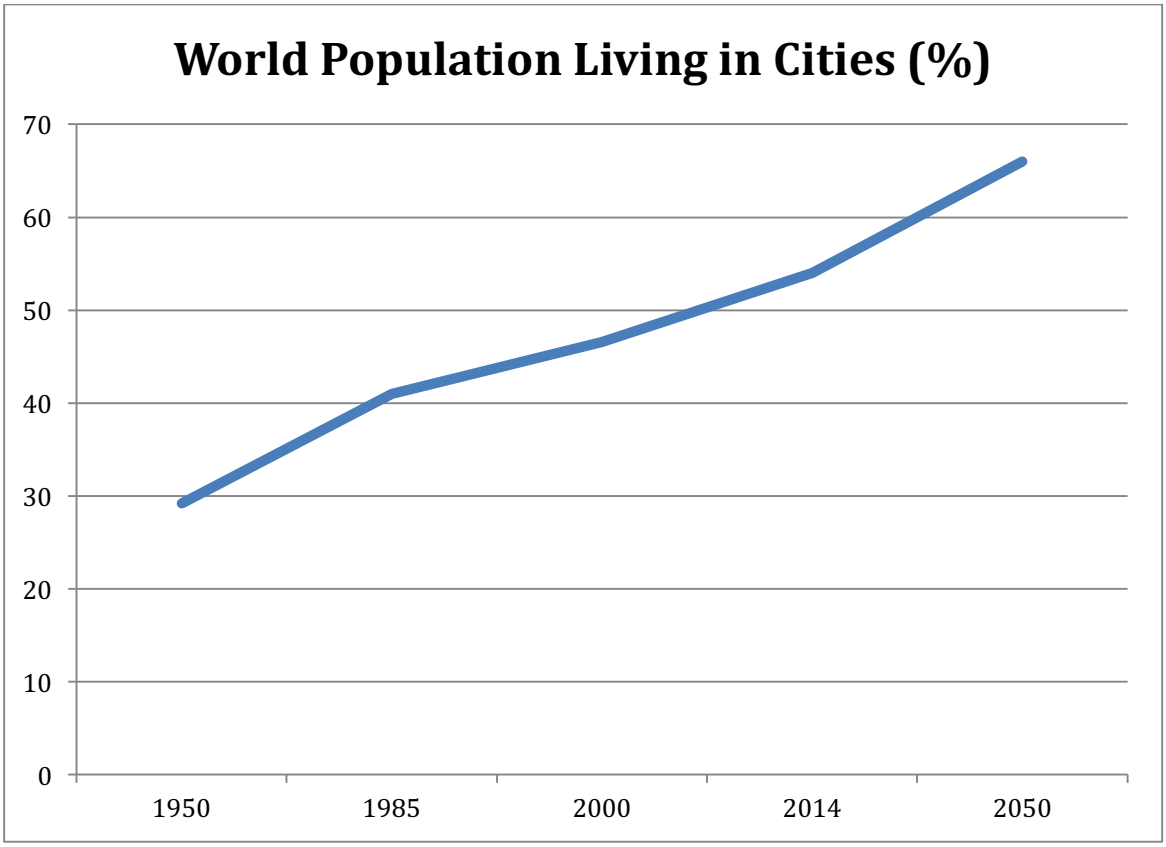


Figure 2-1. World Population Living in Cities Over Time

Source: United Nations et al., 2014; WCED, 1987

In Europe, as of 2014, the percentage of the population living in urban areas is 73% (United Nations et al., 2014). The European Commission estimates that number will grow to 80% of the population by 2050 (European Commission, 2013).

Industrialised cities of the past faced ecological and human-health issues due to their rampant and previously unchecked production; however, many of these cities have transitioned towards more comfortable and environmentally-friendly cities (Childers et al., 2014). This process has primarily occurred through end-of-pipe engineering solutions with substantial government involvement and significant public and private investments (Childers et al., 2014). Due to these centralised and rigid solutions, this approach is not inherently adaptive (Childers et al., 2014; Grove, 2009). As populations continue to rise rapidly and cities continue to grow, strategies that have worked in the past will not be able to solve future problems.

The generic city of today faces growing challenges including waste management, scarcity of resources, air pollution, human health issues, traffic congestion, poor infrastructure and, in particular, climate change (Chourabi et al., 2012). Increasing impacts of climate change trigger heat waves and drought, increased severe weather events, runoff and flooding, causing cities to reimagine existing infrastructure for future climate and urbanisation (Evans & Karvonen, 2011). Climate change is spurring the drive for innovative solutions within cities where new techniques of governance, processes and products are being cultivated.

With broad challenges, there are many opportunities for innovation in sustainability (Westley et al., 2011). These opportunities for innovations are important to harness at the local level (European Commission, 2014a), moulding solutions to the specific needs of local

communities taking into account culture, context and creativity. However, the large number of challenges touching numerous sectors and stakeholders make it difficult to coordinate and develop an integrated, systematic approach to addressing these challenges (Bulkeley & Castán Broto, 2013).

To address the challenges for the future, an urban systems perspective is required to examine urban ecosystems through an interdisciplinary lens focusing on biophysical and social-cultural exchanges (Childers et al., 2014). Therefore, in order to set the stage for experimentation and innovation in cities, this thesis looks to uncover some of the underlying theory driving the uptake of living labs in cities and the process and need for urban sustainability transformations.

2.2 Public Participation and Participatory Methodology

Increasingly, citizens expect public involvement in the decision-making process (Welp, 2001). With such engagement, access to information underpins the participation process; in other words, well-informed citizenry enables useful contributions in the decision-making process (Kranz, Ridder, & Patel, 2006). Access to information and public participation is closely tied to human-rights issues. Acknowledged in the 1992 Rio Declaration on Environment and Development, later with the Aarhus Convention and other international human-rights organisations in Europe and Asia, public participation is a cornerstone to a successful democracy (Ebbesson, 2011).

Public participation is defined by Rowe & Frewer (2000, p. 6) to include all "…procedures designed to consult, involve, and inform the public to allow those affected by a decision to have an input into that decision." It seeks to improve the decision-making process by including various stakeholders, raise awareness among those involved as to the issues and challenges facing society, and increase acceptance and commitment among those involved (Bush, Gillson, Hamilton, & Perrin, 2005). The public possesses local knowledge and expertise that is of interest to decision-makers and researchers, often with a more long-term view of a problem than politicians or businesses (Bush et al., 2005). It is this local knowledge that is of utmost important when seeking to develop context-specific solutions to urban challenges. Further, public participation seeks to adhere to the subsidiarity principle: that decisions should be taken as close as possible to those affected/impacted by a decision (Kastens & Newig, 2008).

Effective public participation requires a variety of resources to be in place: ability to have an open discussion; various tools and technologies for engagement; monitoring and evaluation of effectiveness; mutual trust among stakeholders; and long-term commitments (Kranz et al., 2006). Public participation has been described to be institutional (ex. voting, public consultations, town hall meetings, etc.) or non-institutional (ex. self-organised citizen activities, NGO activities, etc.) (Welp, 2001).

Various forums have been created and used to advance the participation among citizenry in the name of deliberative or participative democracy (M. Lee & Abbot, 2003). Among the most common, public consultations seek to gather public knowledge to inform decision-making process (Bush et al., 2005). Other forums for participation include road shows, stakeholder forums, workshops, electronic or telephone surveys, public meetings, among other methods. (Bush et al., 2005; Kranz et al., 2006; Lennard, 2005; Welp, 2001). The involvement of municipalities in funding and operating living labs suggest they see living labs as another forum to inform decision-making.

Numerous tools and toolboxes have been developed for public participation, namely, information and communication tools and decision-support tools (Kranz et al., 2006; Welp, 2001). These tools seek to develop methods that involve material resources, devices or software to support the engagement process with stakeholders (Kranz et al., 2006). Examples include scenario simulations, modelling, visualisations, role plays, gaming and mapping (Kranz et al., 2006; Welp, 2001).

The successful implementation of such participatory methodology and tools requires early engagement, clear information, transparency and mutual trust, understanding that effective participation does not transpire immediately but is a process (Kranz et al., 2006; Louka, 2008). Practitioners must be serious of the process and work to demonstrate commitment and build trust among those engaged (Kastens & Newig, 2008). Further, it is important to illustrate adequate feedback loops in which participation leads to noticeable impacts within a neighbourhood or community (Louka, 2008). If this is not achieved, stakeholders may become disillusioned by the process leading to lower levels of future engagement and lack of compliance to future policy tools (Kastens & Newig, 2008).

While public participation is an ideal to strive for, in reality, it is difficult to develop effective and inclusive participation. Participation can be fickle; factors such as weather, time, location and topic can impact who chooses to be involved (Lennard, 2005). Moreover, public participation is becoming proceduralised in environmental and social policy instruments (M. Lee & Abbot, 2003). Therefore, there is a growing concern of participation fatigue – an overall lack of enthusiasm among citizenry to engage in public participation due to the overwhelming ways in which to be involved (Louka, 2008). Participation fatigue is enhanced when the public already views the State as operating in the best interest of society and/or does not want to be actively engaged in decision-making (Louka, 2008). This is highlighted by the citizenry's view of the State in many European countries.

Inclusive governance seeks to involve the entire citizenry in an equitable and representative manner (Bulkeley & Castán Broto, 2013). However, true inclusivity is often unattainable (Lennard, 2005). Traditionally, public participation has suffered from a lack of inclusivity. Often, consultations and other participatory methods see predominantly white, middle to upper-middle class people taking part in participatory campaigns in cities (Lennard, 2005; Louka, 2008; Wolch et al., 2014). Participants often have a history of long-term public sector involvement, which leads to similar ways of thinking in decision-making (Louka, 2008). Further, there is often a lack of minority groups among participants (Louka, 2008; Wolch et al., 2014). With a lack of diversity, efforts to overcome this are being made; however, this raises the debate as to which stakeholder groups to seek, what incentives to offer and who is responsible for such social engineering (Louka, 2008). Ultimately, whose knowledge should be included (or excluded) in the participatory process?

Social equity issues can be enhanced when participation leads to co-opting. Co-opting sees interest groups or individuals taking command of a participatory approach to serve their own agenda (Louka, 2008). In particular, this creates an environment where engagement is stifled leading to a fear among a minority or a silent majority to speak up for their beliefs, making differences among stakeholder groups more pronounced (Louka, 2008).

Ultimately, participatory methods seek to engage, educate, empower and encourage local communities in a way that spurs resourcefulness and innovation (Edwards, 2009). In particular, excavating social learning and social memory through participatory methodology which relinquishes control but instead seeks to develop collaboration greatly enhances innovation to challenges and disasters (Barthel, Folke, & Colding, 2010; Westley et al., 2011).

2.3 Knowledge and Learning

Knowledge and democracy are being transformed by advancements in information communication and technology (Delanty, 2001). Broadly, knowledge is a precondition shaping a person's behaviour (Frick, Kaiser, & Wilson, 2004). We know that in order to address urban sustainability, individuals must be equipped with the knowledge of the inherent risk of doing nothing in order to change behaviour (Shiroyama et al., 2012). Therefore, the facilitation of knowledge transfer and learning is important to sustainability transitions.

Recognised as among the first frameworks to facilitate learning, the *Taxonomy of Educational Objectives* was published in 1956 (Krathwohl, 2002). The taxonomy, known as Bloom's taxonomy, introduced three domains of learning: cognitive (i.e. knowledge) – relating to the process of processing and applying knowledge; affective – the way one reacts and feels; and psychomotor – manual or physical skills (Bloom, 1956).

Since, Bloom's taxonomy has been researched and revised. The most recent and renowned revision to the original work came in 2001. They further examined the cognitive dimension of learning suggesting four types of knowledge: factual, conceptual, procedural and metacognitive knowledge (Kranz et al., 2006).

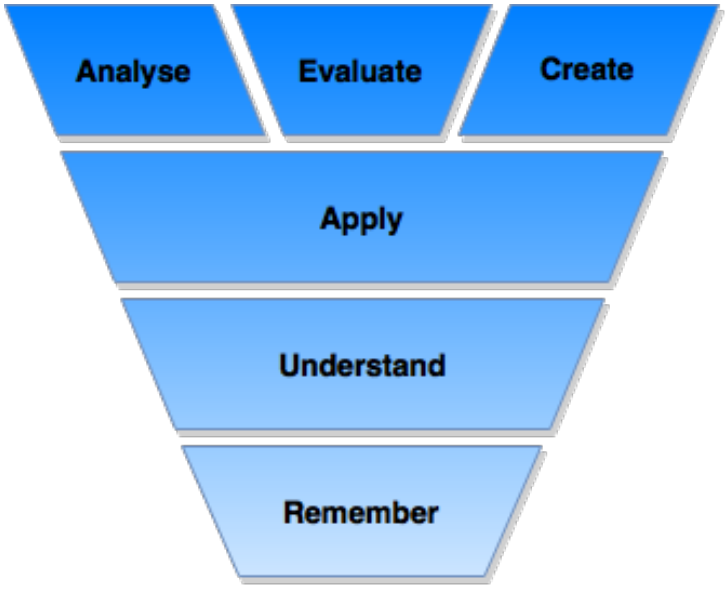


Figure 2-2. Processes of Knowledge Integration

Source: Anderson, Krathwohl, Airasian, & Bloom, 2001

The cognitive dimension creates a hierarchy of knowledge and cognitive processes including remember, understand, apply, analyse, evaluate and create (Figure 2-2) (Anderson, Krathwohl, Airasian, & Bloom, 2001). This hierarchy illustrates that learning processes such as analyse, evaluate and create better allow individuals to completely process and integrate knowledge.

Another important aspect of learning in society is social learning theory. Pioneered by Albert Bandura in the 1960s and 1970s, social learning theory reinforces that learning is a cognitive process but suggests that it takes place within a social context (Bandura, 1977). For example, one can learn by observing a behaviour or by observing the consequences of that behaviour, known as vicarious reinforcement (Bandura, 1977). Social learning is facilitated by modelling of behaviour including live modelling (an actual observation of behaviour), verbal modelling (vocal description of behaviour), and symbolic modelling (behaviour observed via movies, TV, internet, literature, etc.) (Bandura, 1977).

Social learning theory has been applied in many contexts including criminology, psychology, childhood education and business management. More recently, social learning theory has been applied to environmental considerations. For example, the European Commission funded a project called HARMONIsing COllaborative Planning (HarmoniCOP) with the express aim

to examine social learning theory in relation to river basin management planning (Kranz et al., 2006). The European Union Water Framework Directive seeks to include public participation in the development of river basin management plans. The HarmoniCOP project examined the role of social learning in the development of these regional plans. The study found that social learning theory applied to public participation in environmental management plans to be more adaptive and trust-building among stakeholders (Kranz et al., 2006). Interactions provided a good flow of information through open discussion and thought exchanges with all stakeholders viewed equally (Kranz et al., 2006). Kranz et al. (2006) show that social learning provides improved interactions between stakeholders and suggests social learning may support institutional change.

Efforts to conceptualise environmental knowledge have also been made. Environmental knowledge has been conceptualised as three forms of knowledge. The first, systems knowledge, describes environmental processes, ecosystems and environmental problems (Frick et al., 2004). Action-related knowledge describes the knowledge of behavioural processes and courses of action when faced with environmental damage or harm (Frick et al., 2004). Lastly, environmental knowledge is composed of effectiveness knowledge, meaning knowledge of the relative harm or benefit to the environment of our actions (Frick et al., 2004).

Public consultation events (discussed above) and living labs share similar questions of significance: whose knowledge to seek and engage? Again, this highlights the social equity issues inherent in knowledge transfer facilitating decision-making within cities. Keep in mind, the process of knowledge transfer differs greatly between private and public institutions where private companies are, for example, less incentivised to share innovations. (Massard & Mehier, 2005).

Geography plays a large role in knowledge transfer and integration. Knowledge transfer is increased due to physical/geographical proximity (Lagendijk & Lorentzen, 2007). In other words, knowledge exchange occurs more readily when the physical distance between the parties is reduced. Moreover, knowledge interaction is facilitated by participating parties when located in the same cultural boundaries or within the same local economy (Lööf & Nabavi, 2013). The role of geography, proximity and accessibility is discussed in the proceeding section.

With the large number of challenges facing our cities, there is an important need for knowledge integration among experts from interdisciplinary perspectives to address the multifaceted risks (Shiroyama et al., 2012). Integrating this understanding of the learning hierarchy (Anderson et al., 2001) and the concept of social learning theory (Bandura, 1977) in conceptualising living labs, it is clear they represent a powerful tool in facilitating knowledge transfer and integration to transition towards sustainability.

2.4 Geography, Proximity and Accessibility

The role of place and people is important in the designing and implementation of urban futures. In particular, this arises when discussing the inclusion, involvement and accessibility of urban public facilities (Tsou, Hung, & Chang, 2005). Spatial equity is a conglomeration of these ideas defined as equal access to basic pubic facilities, often measured in distance (Tsou et al., 2005). Often, measurements of spatial equity also include the freedom of choice including educational institutions, cultural events and job opportunities (Tsou et al., 2005). Tsou et al. (2005, p. 425) states "[t]he general connotation of spatial equity is that all residents should be equally treated, wherever they live. This idea is, theoretically, an extended form of social equity."

Much literature focuses on the role of geography, proximity and accessibility in understanding social equity issues in cities. This section looks to expound on these concepts, linking them to previous discussions surrounding knowledge integration, willingness of the public to engage, and issues of urbanisation.

2.4.1 Geography

Geography is, broadly, the study of the earth and its physical features as well as human activity including the distribution of populations and resources within political, economic and social boundaries. Geography is a powerful field of study that allows for the beginning of understanding how the spatial distribution of people and environmental features impact and relate to each other (Morton, Peterson, Speer, Reid, & Hughey, 2012).

Geographic information systems (GIS) is a growing trend in the social sciences of incorporating geographical elements of analysis. GIS refers to the suite of programs and tools used to investigate and visualise spatial and geographic data (Morton et al., 2012). It has been a valuable tool over the last two decades as a means to model a combination and variety of variables and data types including land characteristics, built environment, socioeconomic data and a variety of geographical attributes (Morton et al., 2012). More recently, GIS is seen as a tool to be integrated in community-based research as a method to investigate the nuanced impacts and correlations between community and individual activities and their physical environment and spatial attributes (Morton et al., 2012).

Along these lines, Lee & Wong (2001, p. 78-79) highlight the first law of geography, that "everything is related to everything else, but near things are more related than distant things." However, just because something is geographically close does not mean they are related. This forms the basis for the following discussion on proximity.

2.4.2 Proximity

Proximity is most simply defined as "nearness." Therefore, proximity can be thought of in many ways. Physical proximity may be the most common conceptualisation of proximity, the premise that two things are close enough to each other to interact and observe (Lagendijk & Lorentzen, 2007). Geographical proximity takes this thought a step further by describing distance between two things denoted by actual mobility and ease of interaction (Lagendijk & Lorentzen, 2007). Physical proximity, while important, can be overcome with the great advances in IT (Lööf & Nabavi, 2013). Therefore, two people that are not close to each other can still interact in a similar manner to as they would have if they were located physically near each other.

However, physical or geographical nearness does not imply interactions of ease. Other forms of proximity impact the ability for people to observe, engage and interact. For example, cultural proximity sees people of similar cultural, ethnic or religious backgrounds able to interact more easily than those with a different background (Lagendijk & Lorentzen, 2007). Proximity can describe cognitive, organisational, institutional, social and economic nearness among people and places (Lagendijk & Lorentzen, 2007). For example, a study on spatial equity in Tel Aviv, Israel found that, although residents lived closer to one park, they would travel a greater distance to another park that was located in their neighbourhood boundaries defined by their religious and cultural beliefs (Omer, 2006).

Municipalities and public authorities try to leverage proximity to promote innovation and diffusion of knowledge. For example, cities often see the clustering or localisation of innovative companies into zones, hence the term innovation cluster (Massard & Mehier, 2005). A motivation in doing so may be to reduce knowledge and technological externalities;

that is, reduce the gap between social return and private return of innovation (Massard & Mehier, 2005). However, this is not enough. Geographical proximity alone is not sufficient to induce technological spillovers (Massard & Mehier, 2005). This means that efforts, often complex and costly, need to support knowledge and technological spillovers of innovation in cities (Massard & Mehier, 2005).

2.4.3 Accessibility

Accessibility is a measure of spatial separation; in other words, it describes the relative ease associated with nearness or proximity of one place to another (Tsou et al., 2005). Spatial separation can be measured and quantified using GIS, often by looking at distance travelled via street network or by a straight-line distance, known as Euclidean distance, emanating from the location under study (Tsou et al., 2005). In assessing accessibility in urban environments, urban planners turn to a complicated measure of service and impact ranges of public facilities taking into account residents' needs, preferences and service standards (Tsou et al., 2005). Types of public facilities will have varying service and impact ranges: site-noxious facilities like landfills or abandoned sites; site-neutral facilities like schools; and site-positive facilities such as parks and museums (Tsou et al., 2005).

Further, public facilities are expected to provide for a varying number of people depending on their purpose, which dictates the service range for each facility. In other words, the public facility has a service range that describes the accessibility / spatial separation measured in distance. Municipal facilities, including town parks and universities, provide for a larger area and have a service range covering much of the city (Tsou et al., 2005). Community facilities, such as high schools and swimming pools, have a more restricted service range of roughly two kilometres (Tsou et al., 2005). Lastly, neighbourhood facilities include playgrounds and elementary schools. These types of facilities have a service range near one kilometre (Tsou et al., 2005). These service ranges vary slightly depending on the size of the facility and the traffic network (Tsou et al., 2005).

Growing urban centres face upcoming challenges as population expands rapidly. In particular, the existing built environment makes it difficult for urban planners to ensure accessibility and spatial equity to all citizens. Therefore, approaches to overcome this inability are needed and must also be inclusive in their nature.

2.5 Innovation and Experimentation in Cities

The role of innovation in our society has gradually changed overtime through the Enlightenment and the Industrial Revolution eras (Westley et al., 2011). Once, where continuity and tradition were valued, innovation and change have become the dominant preference within society (Westley et al., 2011). However, over this period of time, innovation has shifted from demand-driven to supply-driven; corporations and researchers innovate with the hope of stimulating and creating need (Westley et al., 2011). Moreover, new innovations rely on existing technology and product-delivery platforms. As a result, as ecological and social problems arise, existing path dependency and technological reliance compromise the ability to deliver technologies targeting these issues (Westley et al., 2011).

A recent shift in experimentation places the city at the centre of innovation and inquiry where the city becomes the object and venue being investigated and draws on both the field-site and laboratory approaches to experimentation from the scientific method (Gieryn, 2006). The city is increasingly seen as a testing-ground for innovative solutions to address the growing challenges facing cities (Chourabi, et. al., 2012; Evans, 2011).

Tantamount in the discussion surround innovation in cities is the growing concept of open innovation. Pioneered by Henry Chesbrough with his 2003 book *Open Innovation: The New Imperative for Creating and Profiting from Technology*, the concept has become widely adopted and accepted in the innovation literature. Open innovation describes "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, Vanhaverbeke, & West, 2006, p. 1). In other words, innovators make greater use of external perspectives and technologies to innovate while making unused internal ideas and innovations available to other external innovators.

Within the realm of open innovation, another integral concept of understanding innovation in cities is (open) social innovation. Social innovation is described as a product of an emerging social economy (Murray et al., 2010), but academics and practitioners do not have one set agreeable definition (Pol & Ville, 2009). The Centre for Social Innovation (n.d.) defines social innovation as:

> …the creation, development, adoption, and integration of new concepts and practices that put people and the planet first. Social Innovations resolve existing social, cultural, economic, and environmental challenges. Some social innovations are systems-changing – they permanently alter the perceptions, behaviours, and structures that previously gave rise to these challenges.

In examining this definition, social innovation seems to focus on developing innovations and solutions that improve the public good. In fact, the ultimate outcome of social innovation is to create a better future (Pol & Ville, 2009). While business innovation and social innovation do overlap, it is often described that social innovation addresses the "needs ignored by the market" (Pol & Ville, 2009, p. 880). Later, these concepts become important in understanding living labs as spaces for open innovation.

The discussion of open and social innovation highlights the changing mantra of innovation in business. Traditionally, business innovation is steered by high importance placed on profits, especially by investors and shareholders (Westley et al., 2011). This limits businesses to focus on innovations to those with satisfactory financial returns and less on the potential positive societal impact (Westley et al., 2011). Yet, with increased attention on open and social innovation, we are seeing an increasing number of companies relying on these innovation methodologies. For example, we see a growing trend among start-ups and small and medium size enterprises (SMEs) to address these societal challenges while fulfilling a need in the market. Even more so, there is an emergence of experimentation and innovation occurring in grassroots and collaborative spaces, especially within cities, to address these issues (i.e. living labs).

SMEs and other municipal actors in cities are engaged in experimentation for sustainability in cities through demonstration projects and test pilots (Ballon, Pierson, & Delaere, 2005; Evans & Karvonen, 2014). Evans (2011, p. 226) suggests that "cities have always been experimental, in the sense that new knowledges are tested in order to alter the way in which the city is administered." However, there is an increasing focus on cities to develop open innovation systems in the form of innovation clusters, living labs, learning alliances and other demonstration projects (European Commission, 2014a; Massard & Mehier, 2005; Robrecht, 2015). Meanwhile, it is important to recognise that these experimental capacities are not evenly distributed among the city (Evans & Karvonen, 2014).

To help foster a market for these innovations, collaboration amongst government, business and other civil society members is necessary (Westley et al., 2011). Westley et al. (2011, p. 771) find that "[i]nnovation occurs most readily where experimentation and exploration are encouraged and where innovative ideas, projects, designs, processes are connected to the institutional resources and opportunities that can give them broad impact and durability."

Lastly, despite the growing impetus on innovation, a growing paradox exists between innovation and (un)sustainability. That is, innovation is seen as the solution to sustainability; yet, it is often contributing to the current cause of unsustainability (Westley et al., 2011). Nonetheless, it will require clever and unique strategies proliferated by governments and civil society to incentivise business and others to innovate and to create enhanced social value over economic value (Loorbach, van Bakel, Whiteman, & Rotmans, 2010).

In this Chapter, we have discussed a wide-ranging set of knowledge and theory, including urbanisation and sustainable development, public participation, knowledge and learning theory, the role of geography, proximity and accessibility, and innovation in cities. This framework will lay the foundation for understanding and conceptualising living labs. Further, this knowledge will supplement the discussion of living labs in addressing the funding regime support and social equity issues surrounding living labs.

- 73% of Europeans live in cities, which is expected to rise to 80% by 2050. Cities must adapt quickly and sustainably to address growing societal challenges.
- There is growing importance for public participation in decision-making with a vast set of participatory methods discussed. However, public participation often is not socially equitable in that those participating do not accurately reflect the community.
- Cognitive learning theory develops a hierarchal process for learning: remember, understand, apply, analyse, evaluate and create. The last three – analyse, evaluate and create – are the processes that most impact learning and are paramount processes in living lab methodology.
- Social learning theory suggests that observing a person's behaviour or the consequences of that behaviour can lead to cognitive learning.
- GIS is a widely used tool in community-based research and can take into account proximity and accessibility in examining social and spatial equity issues.
- Open and social innovation theory is challenging existing business theory with the promise of more open, inclusive innovation for the betterment of society.

3 Living Labs: A Comprehensive Overview

Evans and Karvonen (2011, p. 12) write that living labs are "hugely powerful yet poorly defined." This characterisation seems accurate. In discussing living labs with people who are unfamiliar with the term, many envision a physical space in which people are living / inhabiting while others study their behaviour. This view is not entirely far from reality. However, there are many nuances and inconsistencies when understanding the definition of a living lab. This Chapter seeks to provide historical context, explore the many taxonomies used to describe similar types of interventions, provide tangible examples of living labs, highlight the reason for employing this approach and elaborate on existing knowledge gaps relevant to this thesis.

3.1 History of Living Labs

The concept of a living laboratory first appeared in academic literature in the 1990s (Veeckman et al., 2013). William Mitchell, a professor at the Massachusetts Institute of Technology, is often credited with first explaining and conceptualising the living lab (Mensink et al., 2010). His vision was to combine the growing use of sensory technology and computing power to execute *in vivo* (Latin for 'in the living') experimentation (Mensink et al., 2010).

Early definitions saw the living lab as a space for product designers and academic researchers to observe users in order to test a hypothesis through experimentation (Mensink et al., 2010). Such experiments sought to harness experimentation methodology in combining the benefits of working within a laboratory and at a field-site. Field-sites allow scientists to investigate reality but lack the precision and control afforded by laboratory studies (Gieryn, 2006). In contrast, laboratories allow complete control over variables under analysis where research materials are selectively chosen, filtered and manipulated to suit the scientists' needs. However, laboratories are often criticised for not representing reality (Gieryn, 2006).

These early definitions focused on living labs as a method for testing and experimenting with new products and services **for commercial use**. Early on, Ballon, Pierson, & Delaere (2005) situate the living lab approach as a part of the product testing platforms available including prototyping, test-beds, field trials, market pilots and societal pilots. At that point, living labs were different from other product testing platforms because the commercial maturity of products or services was less than in the other methods with a greater focus on product design (Ballon et al., 2005).

The use of living labs were spurred by contemporary trends including the increasing role of the consumer (from a consumer to a prosumer); shortened innovation iterations as a result of increased global competitiveness; and the development in the field of ICT (Ståhlbröst & Holst, 2012). But this early vision of a living lab has evolved over the years and was recognised as a mechanism to spur innovation and address social and environmental issues.

The European Union has placed a significant emphasis on global competitiveness, employment and innovation. The Lisbon Strategy, also known as the Lisbon Agenda, was outlined at the Lisbon European Council in 2000. The Strategy is motivated by the perceived difference in growth and innovation of the EU compared with the USA and Japan (Directorate General for Internal Policies, 2010, p. 11). Technological capacity and innovation were the driving force recognised to ensure EU competitiveness (Directorate General for Internal Policies, 2010). To do so, the EU sought the synchronisation and coordination of on-going and upcoming structural reform, building on the Luxembourg Process (European employment strategy), the Cardiff Process (integrating environmental issues in EU policy) and the Cologne Process (establishing social and macro-economic dialogue) (Directorate General

for Internal Policies, 2010). The Lisbon Strategy and underlying motivations set the stage for future policy prescriptions.

The Budapest Manifesto on Risk Science and Sustainability (2002) calls on scientists and researchers to involve and engage with the public to address global environmental challenges. The European Commission recognised the framework outlined in the Budapest Manifesto, a framework that calls for the creation and development of a European network that promotes social and territorial innovation with an underlying emphasis on citizen-centric participatory processes (European Commission, 2014a).

With the express interest in harmonising the European Union innovation system, the Helsinki Manifesto was issued as a result of the conference *Networked Business and Government: Something Real for the Lisbon Strategy Conference* (Finland's EU Presidency, 2006). The overarching call-to-arms states "…that new, concrete measures are needed for turning the Lisbon Strategy into a living reality and making Europe more competitive and innovative in a human-centric way" (Finland's EU Presidency, 2006, p. 1). The Manifesto outlines a seven-step roadmap that seeks to harmonise innovation pathways and financial eServices, harness ICT in enabling efficient working environment and increase EU interoperability of digital standards (Finland's EU Presidency, 2006). However, most importantly, the Helsinki Manifesto called for the creation and financing of the European Network of Living Labs (See Chapter 3.5.1).

Living labs have proliferated much more successfully in Europe; in part, they are seen as a mechanism to overcome the European Paradox (Veeckman et al., 2013). That is, the gap that exists in research leadership of innovation and sustainability with limited commercial success of innovation (Veeckman et al., 2013).

3.2 "What do you call it?"

The academic literature seeks to define a living lab but fails to agree on any one definition (Liedtke, Jolanta Welfens, Rohn, & Nordmann, 2012; Salter & White, 2014; Ståhlbröst & Holst, 2012; Veeckman et al., 2013). Not only is there a lack of a cohesive definition, the terms used to describe a living lab vary amongst academics and practitioners. Academics and practitioners conceptualise living labs through many terms including:

- Urban Living Labs
- Urban Labs
- Change Labs
- Urban Sustainability Transition Labs
- Urban Transition Labs
- City Labs
- Smart City Initiatives
- Community-Based Initiatives
- Territorial Living Labs / Cross-Border Living Labs

The lack of a clear term and definition is often alluded to in the literature with academics going as far to say that the advancement of living labs is inhibited due to the lack of clear definition and lack of research focus (Veeckman et al., 2013). These terms are explored in further detail in Table 3-1. Each term seeks to explain a type of socio-technical intervention. The following section (Chapter 3.3) seeks to break down the terms and agree upon many of the characteristics that make up a living lab.

Table 3-1. Table of Various Terms Used to Describe Largely Similar Interventions

Term	Definition	Source
Living Lab	"A Living Lab is a real-life test and experimentation environment where users and producers co-create innovations. Living Labs have been characterised by the European Commission as Public-Private-People Partnerships (PPPP) for user-driven open innovation. A Living Lab employs four main activities: 1. Co-Creation: co-design by users and producers 2. Exploration: discovering emerging usages, behaviours and market opportunities 3. Experimentation: implementing live scenarios within communities of users 4. Evaluation: assessment of concepts, products and services according to socio-ergonomic, socio-cognitive and socio-economic criteria."	(ENoLL, n.d.-a)
Urban Living Lab	"It is a forum for innovation, applied to the development of new products, systems, services, and processes, employing working methods to integrate people into the entire development process as users and co- creators, to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts."	(JPI Urban Europe, 2012)
Urban Lab	"In urb@exp, we use the generic term 'urban labs' to refer to City Labs and Living Labs." Urban labs are an approach "in which local governments engage in solving problems together with other stakeholders in urban development."	(urb@exp, n.d.)
Change Lab	"… change labs offer a place for creative, cross-sector and cross-disciplinary decision-making and innovation. The process is supported by careful design and facilitation and is resourced by research geared to the decision maker's needs. The focus is on those "wicked problems" that seem insoluble, and reconciling seemingly antithetical elements such as the need to grow the economy and to maintain environmental services, or to maximize both short term profitability and long-term sustainability	(Westley et al., 2011)
Urban Sustainability Transition Lab	"…they develop, test, and implement initiatives of significant change aimed at achieving sustainability in and across urban domains ranging from housing, land-use, and transportation to social cohesion and education."	(Wiek, Kay, & Forrest, in press)

Term	Definition	Source
City Lab	"City Labs are projects in which local governments and other stakeholders jointly seek to learn about and be involved in new ways of dealing with urban challenges … by emphasizing co-creation and joint learning…."	(urb@exp, n.d.)
Smart City Initiative	An opportunity that sees "[c]itizens … becoming actively encouraged to see the city as something they can collectively "tune", in a manner that it is efficient, interactive, adaptive, and flexible" and that "shifts the role of the citizen from a mere passive subject into an engaged actor."	(Veeckman & van der Graaf, 2015)
Community-Based Initiative	"…are place-based efforts that target a geographically bounded area to engage multisector stakeholders in fostering partnerships, enhancing local capacity for change, and working to improve outcomes such as education, health, employment, and poverty for local residents."	(Huber, Egeren, Pierce, & Foster-Fishman, 2009)
Territorial Living Lab / Cross-Border Living Lab	"…integrally applies the [living lab] approach to a territory and its citizens, its model of governance and its strategic plans for the future: in essence, it can be conceived of as a new model for regional development."	("TLL-Sicily," n.d.)
Learning Alliance	"Multi-stakeholder partnerships designed to enhance a process of shared learning and understanding in situations with a high degree of complexity and unpredictability. In a [Learning Alliance], researchers work closely together with stakeholders from the public, private sector and civil society to break down barriers between science, policy and practice."	(Robrecht, 2015)

3.3 Living Lab - Definition

Arguably, the rise of living labs in Europe is a direct consequence of the emphasis placed on innovation and employment to enhance and maintain European competitiveness. As discussed, advancements in ICT and the importance placed on innovation in today's society helped to steer development of living labs in Europe (Ståhlbröst & Holst, 2012; Westley et al., 2011). In the original context, living labs were seen as an approach at structuring research and commercialising products through the process of real-world testing for innovation (Ballon et al., 2005; Veeckman et al., 2013). In characterising the ICT sector in 2005, Ballon et al. (2005) described a system of various test and experimentation platforms (TEPs) for collaborative innovation including testing, prototyping and co-creating products for consumer use. Their study describes prototyping platforms, test beds, field trials, living labs, market pilots and societal pilots, and places them all within the context of in-house research, development and innovation (RDI), open innovation platforms or pilot testing (Figure 3-1).

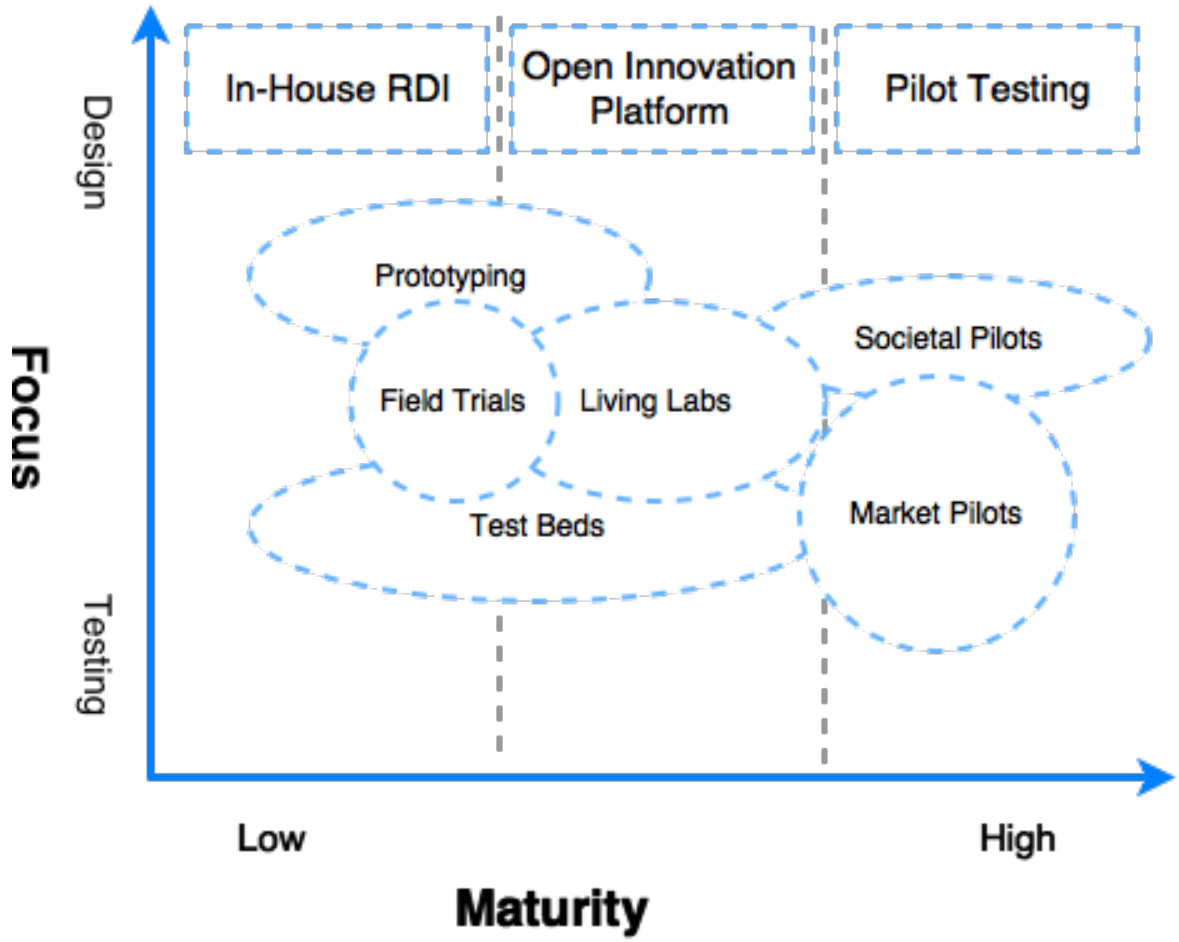


Figure 3-1. Test and experimentation platform (TEP) framework

Source: Ballon et al., 2005

The TEP Framework presented by Ballon et al. (2005) helps to distinguish a living lab from other experimentation platforms such as prototyping, field trials and test beds. This is important as many stakeholders (practitioners, academics, funding agencies) do not fully understand the term as something other than prototyping (Veeckman et al., 2013, p. 7); however, this is an important distinction. Living labs are a part of an open and user-driven innovation ecosystem or platform that are characterising socio-technical innovations (Schaffers et al., 2011). Although sometimes employed by companies and governments as an in-house approach to research, development and innovation (RDI), living labs are more than just testing and prototyping.

Living labs have been conceptualised as an environment, a methodology, an approach to innovation, a network and a system (Veeckman et al., 2013). For the purpose of clarity, in consulting with academic literature, living labs can be conceptualised as both an arena and/or an approach (Lepik, Krigul, & Terk, 2010; Mensink et al., 2010; Schaffers et al., 2011; Schliwa, 2013; Veeckman et al., 2013).

The living lab as an arena describes the environment in which co-creation and co-generation of solutions transpires (Mensink et al., 2010). For example, a living lab environment may describe a collective/public space (ex. airport, shopping centre, town square), private space (ex. user's home, office), experimental space (ex. creative space or laboratory) or as a digital

platform (ex. cell phone application, web portal) (Mensink et al., 2010). One can describe the living lab environment by looking at the technical infrastructure, the level of openness, the lifespan of the intervention and the size / scale of activities (Veeckman et al., 2013).

The living lab as an approach is a set of methodologies specific to the project within an environment being carried out (Veeckman et al., 2013). These methodologies describe how a living lab evaluates interactions and engages with end-users in a real-life environment through the process of co-creation (Veeckman et al., 2013). Living labs as an arena or environment can carry out one or more projects that use the living lab approach. The terms living lab approach and living lab methodology are often used synonymously.

In examining existing literature and reviewing several other research projects pertaining to living labs, Voytenko, McCormick, Evans, & Schliwa (2015) identify key characteristics that are essential to effectuate living labs in cities:

- Geographical embeddedness
- Experimentation and learning
- User engagement and co-creation
- Leadership and ownership
- Evaluation and refinement

These traits, along with the premise of user and stakeholder co-creation and co-generation of solutions, seem to be a common thread among the terms to describe various socio-technical interventions similar to that of living labs listed in Table 3-1. Co-creation is an important component, defined "as the act of creating value to the mutual benefit of two or more actors, beyond creating actual product or service innovation in a collaborative way" (Veeckman et al., 2013, p. 6) Further, the living lab sees co-creation as an engagement of the four P's, Public-Private-People Partnership, constituting a quadruple helix of actors (European Commission, 2014a; Schaffers et al., 2011; Veeckman et al., 2013). The quadruple-helix constituting the public-private-people partnership will form the basis of future recommendations in Chapter 7.

The definition provided by the European Commission (2014, p. 64) nicely summarises the discussion of a living lab, defining it "as user-centred, open innovation ecosystems based on a systematic user co-creation approach integrating research and innovation processes in real life communities and settings." For the purpose of this research, the term living lab is defined broadly to include socio-technical interventions in cities that could be classified as a living lab.

Maybe it is justified to paint living labs in such a broad stroke. They contain contextual elements that describe the environment (ex. community, technical infrastructure, lifespan, etc.) and methodological aspects describing the approach used in projects (ex. co-creation, role of the user, evaluation, etc.) (Veeckman et al., 2013).

The issue of multiple definitions and various terminologies to describe similar interventions arose at the 2nd European Climate Change Adaptation Conference. Jonas Bylund of JPI Urban Europe illustrated the benefit of an unstructured definition of a living lab. He argued, if the term is rigidly defined, the very innovative and adaptive nature of living labs would be impacted; in other words, living labs need to evolve to meet the needs of the communities they serve and shall not be measured, and are actually harmed, using such a formal definition (personal communication, May 12, 2015).

3.4 Examples of Living Labs for Sustainability

The role of the living lab in the open innovation system, in particular, when discussing sustainability, appears to have occurred much more recently. Living labs are highly variable in the arena in which they operate. For example, living labs can emerge on an undeveloped plot of land, a home or experimental space, a transportation corridor or a new city (Evans & Karvonen, 2011).

Living labs focus on many issues, not just sustainability, often leveraging recent advancements in ICT. For example, living labs are described by the European Network of Living Labs to conduct themselves within the following domains: digital cities, e-Manufacturing, energy efficiency and smart energy systems, e-Participation, future media and content delivery, health and wellbeing, and tourism (Mulvenna et al., 2011).

In drawing on literature regarding public participation, living labs are unique venues for public participation because they can operate both as institutional and non-institutional platforms for public participation (see Chapter 2.2). In other words, they can be municipality-driven, user-driven, research-driven, industry-driven, etc. and do not institutionalise the public participation process but allow for adaptive and iterative processes of innovation.

To further enhance one's understanding of a living lab, it is valuable to provide a few tangible examples to clarify what characterises a living lab. In this section, three brief examples will be presented: Corridor Manchester, Evomobile and Go:Smart / UbiGo.

3.4.1 Corridor Manchester

The City of Manchester, United Kingdom has the goal to reduce carbon emissions by 41% compared to 2005 levels by 2020. This endeavour has spurred innovation within Manchester, in particular, along the Oxford Road corridor within the city. This lifeline within the city accounts for 22% of total carbon emissions in Manchester and houses the University of Manchester, Manchester Metropolitan University, Central Manchester Hospital, an innovation science park and numerous places of cultural significance. (Evans & Karvonen, 2014)

In 2008, the Corridor Manchester Partnership was established between local government, universities and industry. The goal of the partnership was to pool resources, monetary and otherwise, to develop solutions for transport, environment and infrastructure, research and innovation, employment, and business and skills. The partnership sees the corridor as an experimental space with which to create ties between decision-makers promoting low-carbon along the corridor and those who will use the space. The project relies heavily on wireless data collectors for climatological data and user engagement with space along the corridor. Among many projects using the living laboratory methodology, the i-trees project works with citizens to explore which trees, grasses and soils reduce runoff while meeting citizen preferences of aesthetics and functionality. (Evans & Karvonen, 2014)

3.4.2 EVOMOBILE

Evomobile is a living lab based in Valencia, Spain. The project is based at the Science Park of the University of Valencia with local partners including Nissan and Renault car dealerships and support from the Municipality of Valencia, the Energy Agency of Valencia and the Institute for Renewable Energy and Energy Efficiency (IDAE). Evomobile seeks to promote electric vehicles as a sustainable mode of transport, to analyse existing and new business models that spur electric vehicle use and to test solutions at the University of Valencia that upscale electric vehicle usage. (Science Park of the University of Valencia, n.d.)

With partners at the University, Municipality and local car dealerships, the living lab provided university students, researchers and faculty the opportunity to use electric cars, scooters and bikes throughout Valencia. With significant input from participants, researchers looked at the impacts of electric modes of transport on people's behaviour. Together, they developed solutions to make charging stations accessible, to select the preferred charging point technology and to test business models for electric vehicle sharing. This living lab exemplifies the quadruple helix, Public-Private-People Partnership, for seeking solutions for sustainability. (Science Park of the University of Valencia, n.d.)

3.4.3 Go:Smart / UbiGo

UbiGo is a service developed as a result of the Go:Smart living lab. This living lab is based in Gothenburg, Sweden and seeks to "develop and test innovative services that facilitate and reward sustainable travel in urban environment." The project is led by Lindholmen Science Park, and partially funded by the Swedish research, development and innovation agency Vinnova along with dozens of participating parties including the Municipality of Gothenburg, Gothenburg Traffic Authority, Chalmers University, Volvo and PayEx. ("Go: Smart | UbiGo," n.d.)

The living lab has worked with partners and citizens to develop and test a mobility service housed within an easy-to-use cell phone application. The application allows users to charter vehicles among other users of the application. This reduces the overall need and number of cars needed within a city. The living lab relied on users to share experiences and make suggestions through surveys, interviews, travel diaries and focus groups. The living lab allowed users to make real-time suggestions to allow for improved successive app iterations. The application is expected to be upscaled within the region in the coming years. (UbiGo, 2015)

3.5 Existing Living Lab Actors

Numerous actors in academia and government are looking to expound on the miraculous promises offered by proponents of living labs. The European Commission (2014) has issued documents promoting the funding of living labs. Further, the European Commission initiated and financially supports the European Network of Living Labs. Research grants from regional and national governments continue to flow for those academics seeking to understand open innovation ecosystems, in particular, living labs.

For the purpose of this thesis, two initiatives are highlighted: the European Network of Living Labs (ENoLL) and the Governance of Urban Sustainability Transitions (GUST) Project. These groups will serve in providing a comprehensive, but non-exhaustive, list of living labs to investigate for this thesis (discussed in Chapter 4).

3.5.1 European Network of Living Labs (ENoLL)

The European Network of Living Labs (ENoLL) launched in 2006; the first phase included twenty living labs from fifteen Member States (Finland's EU Presidency, 2006). ENoLL was launched by the EU Presidency and supported by the European Commission (European Commission, 2014a; Mensink et al., 2010). ENoLL calls itself an "international federation of benchmarked Living Labs in Europe and world-wide" (ENoLL, n.d.-a). It operates as a platform for coordination and learning of best practices while serving as a repository of economically viable and socially acceptable examples of living labs (European Commission, 2014a). To date, ENoLL has had nine membership calls, known as waves, with more than 370 living labs operating in a variety of sectors including ICT, energy, elderly care and healthcare, mobility, rural development, etc. ENoLL is seen as the largest and most comprehensive living lab initiative in the world (Veeckman et al., 2013).

Through it's membership waves, ENoLL offers three membership levels: **associated** – for those organisations that support living labs but are not living labs themselves paying 5000 EUR/yr; **adherent** – living labs who wish to be a part of the ENoLL network but have no voting rights and pay an administration fee of 500 EUR/yr; and **effective** members – receive differentiation among other living labs, promoted via ENoLL, have voting rights in ENoLL governance decisions and pay 5000 EUR/yr (ENoLL, n.d.-b). ENoLL seeks to support living labs and offers services including communication and promotion, project development, brokering, policy and governance, and learning and education services (ENoLL, n.d.-b). Along with this, members are afforded the right to use the "Living Lab" label signalling proof of certification as a living lab by ENoLL (ENoLL, n.d.-b).

3.5.2 Governance of Urban Sustainability Transitions (GUST)

This project, funded by the Joint Programming Initiative (JPI) Urban Europe, runs through 2017 with the primary aim to examine, inform and advance living lab methodology and how it impacts governance of urban centres ("Governance of Urban Sustainability Transitions," n.d.). To do so, the researchers look to create a systematic framework to evaluate the design, practices and processes of living labs ("Governance of Urban Sustainability Transitions," n.d.). The project engages researchers at Lund University (Sweden), Dutch Research Institute for Transition (the Netherlands), University of Durham (the United Kingdom) and Joanneum Research (Austria).

Full disclosure: this thesis is conducted in collaboration with lead researchers associated with GUST including Dr. Yuliya Voytenko (Postdoctoral Researcher) and Dr. Kes McCormick (Associate Professor) at the International Institute for Industrial Environmental Economics, Lund University.

3.6 Potential Opportunities, Drawbacks and Knowledge Gaps

Living labs are being placed at the forefront of the European innovation agenda (European Commission, 2014a). There are many potential opportunities, yet unintended consequences, to using such an approach to spur economic development, increase employment, drive innovation and address sustainability issues facing cities.

3.6.1 Potential Opportunities

Living labs create a network of connected stakeholders, often complex and only possible to leverage through organic, meaningful dialogue (European Commission, 2014a; Mensink et al., 2010). Further, innovation research suggests that cooperation networks will form the backbone of future urban innovation (Schaffers et al., 2011). Networking of stakeholders within and between cities leads to high knowledge spillover effects with low transaction costs (Cooke, Davies, & Wilson, 2002). Living labs increase the cost efficiency of encouraging tacit and codified knowledge transfer between end-users and stakeholders (Mensink et al., 2010). This makes living labs a tangible tool that may be employed by municipal or regional governments with a limited budget to have real implications for sustainability.

Living labs are seen as creating niches that shelter innovations from political or economic pressures (Evans & Karvonen, 2011). Moreover, these interventions in cities are often highly visible and, thus, regarded as mechanisms to support rapid social and technological transformations (Evans & Karvonen, 2011). Given the appropriate conditions, living labs as special niches supporting innovation for sustainability can challenge regime dominance and impact urban governance structures in cities (Bulkeley & Castán Broto, 2013).

Among the successes of living labs, the inclusion of people in the creation and realisation of a shared vision for their city leads to more successful implementation of sustainability initiatives (Veeckman & van der Graaf, 2015). This form of participatory governance sees the changing role of the citizen from a passive subject to an active and engaged actor (Veeckman & van der Graaf, 2015). This seems to be connected to the wider trend of inclusion, participation and social equity in governance (Bulkeley & Castán Broto, 2013; Veeckman & van der Graaf, 2015). Moreover, living labs are seen as a solution to avoid path dependency and lock-in to existing socio-technical regimes (Mensink et al., 2010).

3.6.2 Social Equity Issues

While living labs are seen to provide immense benefits within cities, the benefits of innovations and living labs are not geographically or socially distributed evenly (Childers et al., 2014; Evans & Karvonen, 2014; Mensink et al., 2010; Wolch et al., 2014). Similar to those social equity issues that arise in the pursuit of public participation – as discussed in Chapter 2.2 – this same problem seems to hold true for living labs.

Living labs are seen as privileged spaces within cities (Evans & Karvonen, 2011); with low-income urban communities most susceptible to urban challenges including climate change (Bulkeley & Castán Broto, 2013), one may expect living labs to prioritise or at least address solutions for sustainability that help disadvantaged communities. However, this may not be the case.

As mentioned previously, living labs have been described as being "dropped into" communities, which local residents strongly resist (Bulkeley & Castán Broto, 2013). In part, Evans and Karvonen (2014) suggest that this is because there is often little effort to adapt to the local contexts of the community at large. Anecdotal evidence from the Corridor Manchester living lab sees the dominance of power being reinforced by using the traditional and existing networks of actors (Evans & Karvonen, 2014). While living labs promise to promote social and technical transformations for sustainability, it may be argued that they do not challenge the entrenched, unequal societal / structural issues that initially lead to unsustainability (Evans & Karvonen, 2014).

Meanwhile, living labs may only be seen as a suitable model in wealthy countries; these countries can afford to experiment and test with wide-ranging methods for sustainable urban development (Lepik et al., 2010). This includes investing both from the national/municipal governments as well as industry within the countries. This only further enhances the current discussion regarding social equity in living labs and innovation to transition cities towards urban sustainability.

3.6.3 Issues with Current Funding Regime for Living Labs

The European Commission (2014) is motivated to fund public interventions, including living labs, to push innovation and technology to improve standard of living and increase employment. The Commission (2014) sees this as a means to breakdown "compartmentalized approaches" between research institutions and innovation, aiding in the commercialisation and uptake of solutions. However, the funding regime supporting living labs has been described as responsive and "patchwork" (Bulkeley & Castán Broto, 2013).

What motivates funding from year to year changes: for example, a flood one year may correspond to an uptick in funding for water runoff solutions; the next year, a city sees migration protests in which cities respond with addressing social inclusion and assimilation; another year, there is a political scandal involving taxpayer money which prevents increased funding of initiatives. The unreliability of the funding regime supporting living labs makes it

difficult for these interventions to count on continued support (Schaffers et al., 2011). While living labs may seize on a "window of opportunity" (Bulkeley & Castán Broto, 2013), there is a real need for funding regimes to support the development of funding schemes or business models that institute long-term viability of living labs (Schaffers et al., 2011)

Social equity issues also arise in how living labs are being funded; low-income communities or communities of colour receive less funding for initiatives impacting their neighbourhoods (Wolch et al., 2014). Further, the growing emphasis placed on living labs within Europe and elsewhere sees a large number of projects that identify as living labs applying for funding. Unfortunately, many of these living labs have little end-user engagement and co-creation (Veeckman et al., 2013).

3.6.4 Rationalisation of Research Questions and Future Research

A cascade of other issues surrounding living labs exists, primarily, the role of management, strategies for effective communication, building the right network, transparency and uncertainty. While issues exist, these issues are often highlighted in an attempt to address and overcome them in order to develop a set of best practices for living labs. The transformative potential in socio-technical innovation and governance, although still unknown and not yet quantified, makes living labs an area of extreme interest for academics, industry and governments.

With this literature review in mind, the research questions arrived at for the purpose of this thesis are relevant and founded. Living labs for sustainability need to be identified and investigated (*RQ1*) in order to further research the potential of living labs to aid in urban sustainability transformations. Moreover, issues pertaining to the long-term financial viability (*RQ2*) and inclusiveness (*RQ3*) threaten to derail the proliferation of living labs for sustainability. Addressing these questions seek to respond to criticisms of living labs while seeking to advance living labs in cities.

Existing research projects, including GUST and others, seek to answer these questions and more. The answers provided through this research seek to lay the foundational framework in which to answer more complex and comprehensive questions far beyond what is feasible within this thesis:

- How do living labs impact urban governance?
- How do living labs in cities become internalised/incorporated into decision-making process?
- Crisis, collapse and societal transition all incentivise urban sustainability (Childers et al., 2014), but in what combination and to what extent do these represent sustainability triggers in cities?
- Can living labs as niche experiments "be scaled up to generate widespread changes in existing processes of urban development" (Evans & Karvonen, 2011, p. 12)?
- Which experiments lead to sustainability transformations/transitions (Bulkeley & Castán Broto, 2013)?
- How do experiments lead to sustainability transformations/transitions (Bulkeley & Castán Broto, 2013)?
- Broadly, how do aspects of ownership and access impact effectiveness (Westley et al., 2011)?
- How do living labs ensure transferability and interoperability in other contexts and urban settings (Westley et al., 2011)?

4 Methodology

The research questions proposed in Chapter 1.2 outline three distinct areas of investigation with overlapping methodology: the identification of living labs for sustainability; the investigation of funding partners; and the addressing of social equity issues. These three tasks lead to distinct deliverables with appropriate analysis and conclusions; however, the tasks complement and supplement each other throughout the research process, as discussed in this chapter.

Table 4-1 illustrates the three posed research questions, the sub-research questions and the methods used in addressing each question. This section discusses each method used as found in the table.

Table 4-1. Overview of Research Questions and Corresponding Methodology

Research Question	Method(s)
1. How do living labs engage with sustainability? - Which living labs engage with sustainability? - What is the sustainability focus of living labs? - How do they engage with end-users? - Who are the actors and what is the power structure among them?	Literature Analysis Survey of Living Labs
2. How does the current funding regime support living labs? - Who funds living labs? - Why do they fund living labs? - How do they measure success? - What happens at the end of funding?	Interview of Funding Partners Survey of Living Labs Literature Analysis
3. To what extent do social equity issues arise in the implementation of living labs? - How can the community in which living labs are embedded be characterised? - Who is engaged in living labs? - Who is benefiting from living labs?	GIS Analysis Survey of Living Labs

4.1 Literature Analysis

This method refers to the analysing of academic articles, books, grey literature and other online sources to identify and investigate living labs for sustainability. The purpose of this analysis is twofold: first, living labs for sustainability must be identified in order to steer the following research; second, living labs are investigated to determine the ways in which they engage with sustainability.

While living labs act in many fields, only those living labs for sustainability are included in this analysis. The current narrative about living labs looks to determine the impacts and transformative potential of living labs in addressing urban sustainability challenges. Using the definition for sustainable development alluded to in Chapter 2.1, living labs for sustainability will be selected to scope the analysis in looking at social equity issues as well as make up a segment of those living labs interviewed and surveyed regarding funding mechanisms.

To date, it is difficult to locate living labs for sustainability. In the past, living labs tended to originate organically driven by one or multiple actors in a city or region. More recently, efforts have been made to identify and catalogue living labs by governments, associations and research programs. Living labs for sustainability under analysis here will draw from the European Network of Living Labs (ENoLL) and those living labs identified by the GUST Project.

For the purpose of this examination, no determination as to whether a living lab meets the current academic definition was made; instead, any living lab that identifies itself as such was included. The sheer number of living labs under examination and the difficulty in assessing their organisational structure and engagement limited the ability to determine whether living labs meet the formal definition. Further, as discussed in Chapter 3, living labs are an emerging concept of urban innovation and defining the term too narrowly may limit or curb the current narrative and innovative potential of living labs.

Only those living labs within geographical Europe were included as the primary development of the living lab methodology is occurring within Europe and where much of the current literature is focusing. The living labs identified via ENoLL and GUST project represent a large geographical scope within Europe with a variety of actors, approaches and successes. Many of these living labs are regarded as leaders of the methodology within their respective cities and countries.

4.1.1 European Network of Living Labs

In order to determine those living labs for sustainability, an individual investigation of each living lab within the ENoLL database (http://openlivinglabs.eu/livinglabs) was required.

Within the ENoLL database, each living lab contained a description of the concept, an elaboration to their past and current projects along with a link to the living lab's website. Not all living labs within ENoLL had descriptions and/or websites. When this occurred or when limited information was included within the database, a cursory Internet search was conducted in which the first ten results in an Internet search was explored. Further, social media sites such as Facebook and Twitter were consulted to potentially provide missing information.

Each living lab was investigated using these search methods; living labs were separated based on their focus or field in which they operate. To determine this, keywords were used to search their online content and included *sustainability, sustainable, environment* and *green*. More specific words were used to identify a particular sustainability focus: *energy, efficiency, transport, climate* and *carbon*.

Living labs for sustainability were determined based on this search; if the descriptions contained any of these keywords, further investigation took place to verify they were living labs for sustainability. These living labs were noted and biographical data was collected including city, country, physical address, website, contact information and sustainability focus.

The investigation took place from February 25 - March 4, 2015. During the investigation, no attempt was made to contact any of the living labs investigated to verify activities for sustainability.

4.1.2 Governance of Urban Sustainability Transitions (GUST)

The GUST project looks to understand and advance living lab methodology as a means to impact urban sustainability and governance. In doing so, the team of researchers seek to provide snap-shots or summaries of living labs within their geographical purview. The project

has collated approximately fifty living labs to investigate as a part of their on-going research. In working with the team based at Lund University, this thesis aims to support their on-going efforts. Therefore, those living labs collected as a part of the GUST project were included in the analysis. The project had put together a preliminary list of living labs for sustainability with a primary focus on those in Sweden, United Kingdom, Netherlands and Austria as project collaborators are based in these countries.

With the living labs for sustainability identified, research followed to determine how living labs engaged with sustainability. This included looking at which aspects of sustainability living labs focus on, keeping in mind that many living labs have multiple projects and may focus on more than one sustainability aspect. In consulting academic literature and experts in the field, the sustainability aspects identified include: transport/mobility; smart city solutions / ICT; renewable energy; energy efficiency; construction; recycling/waste; low carbon futures/climate; housing; equity and societal issues; and other. Living labs and their projects were investigated and catalogued as to which sustainability aspects they focused on.

4.2 Survey of Living Labs

The aim of the survey was to seek qualitative data pertaining to the funding of living labs and the strategies they use for user-engagement. The survey took the form of a qualitative structured online questionnaire. In doing so, the survey sought to further understand the living lab/funding partner dichotomy, targeting practitioners of living labs to get a sense of what is happening "on the ground." Moreover, the survey provided the opportunity to gather qualitative anecdotes pertaining to social equity to be used to supplement and triangulate future analysis.

The survey was developed over the course of weeks using the methods suggested by Arlene Fink in *How to Ask Survey Questions (2003)*. The survey was administered in English and sought to avoid slang, technical jargon or other idioms that may be difficult for non-native English speakers. While there is much to learn about living labs, the survey has been designed to be concise with the hopes of reducing nonresponse. Prior to sending the survey to living labs, the survey was piloted and tested with researchers working on living labs and refined to ensure answerability among a varying field of living labs. The survey can be found in Appendix II.

The survey targeted those living labs identified as living labs for sustainability from the ENoLL database and the GUST project. Given the relatively large number of living labs targeted, the survey was administered via email. Two challenges exist when conducting mail interviews: getting to the respondent via accurate contact information and inducing the respondents to complete the task of filling out the survey (Fowler, 1993).

Securing the proper contact information was essential to ensure reliable survey results and to eliminate non-response. For those living labs identified, the primary mechanism in securing contact information was through the living labs online presence, most often via their website. When a living lab had no website, contact information may be found on social media, within application material to ENoLL and funding bodies or through professional connections within the field. This contact information was often to a generic contact email address such as info@livinglab.org; however, all attempts were made to direct the survey to a particular person (i.e. living lab coordinator, project manager, etc.). Contact information for some living labs was not available; therefore, these living labs could not be included in the survey.

Inducing the respondents to complete the survey often proves difficult in mail and email surveys. Fowler (1993) suggests a variety of ways to increase response rate: professional look;

personalised; attractive and easy to read; legitimate partners or endorsements; and the promise of something in return. Moreover, confidentiality may be important to survey respondents.

Nonresponse is inevitable in email survey methodology. Fowler (1993) suggests three mechanisms to correct for nonresponse including proxy respondents (i.e. survey another individual within the living lab), statistical adjustments and surveying non-respondents by statistically selecting a sample of non-respondents to represent those that did not answer. Apart from requesting the receiver of the email, if necessary, to forward the email to a more appropriate person, for the purpose of this thesis, it was chosen not to correct for nonresponse. In part, many of the answers provided by respondents are qualitative, not quantitative, and do not seek to make conclusions about the population.

The survey consisted of twenty-three open-ended questions and twelve close-ended questions, consisting of four pages of questions. As emphasised, these questions serve to begin to understand living labs for sustainability. It was not the intent of this survey or research to characterise the population of living labs for sustainability. The high number of open-ended questions is valid for a handful of reasons, as discussed by Fowler (1995). For example, the survey answers were expected to be varying and dependent on the respondent's ability to answer (knowledge, language, proximity to issues asked, etc.). For this reason, the plethora of choices for questions was unknown and could not be reduced to a few words in the form of a closed-ended question. Further, open-ended questions allowed the gathering of more comprehensive answers of relatively unresearched and complicated concepts facing living labs. This justification for open-ended questions in this survey design is supported by Fowler (1995). Further, given the large number of open-ended questions in a semi-structured way, Flick (2006) reframes this online survey as a structured online interview.

The survey sent to living labs was open for participation from July 6th – September 5th. An initial email to living labs was sent using an HTML template that enables the email to look professional and attractive. The email included introductory text and suggested why response was important. Also, the email drew connections to GUST project and Lund University to help legitimise the survey. The email included a link to a web survey tool with a modern feel and intuitive design while still maintaining professionalism. The survey tool used is offered by Lund University through the Artologik Survey & Report software.

In total, 134 email addresses were collected representing 101 unique living labs. Of the 134 total email addresses, eight emails were no longer active and did not reach the intended respondent. Another one person asked to be removed from the list of respondents for undisclosed reasons. Therefore, the total number of living lab practitioners identified as potential respondents to the survey was 125 individuals representing 98 unique living labs.

The first two emails, sent July 6th and July 20th, were generic emails sent to the entire list of living lab practitioners. A copy of the initial email sent to living labs requesting participation is included in Appendix III. These emails were followed by a personalised email sent to 62 of the 125 individual emails. Personalised emails included the individual's name, the living lab they are associated with and a short description of the relevant work their living lab partakes in of interest to the research. This seemed to elicit an increased response in survey responses. A final reminder was sent on August 11th with the survey closing on September 5th, 2015.

The survey tool tracked submissions as well as attempts. Therefore, it was possible to determine how many respondents started the survey but never submitted the survey. However, it was not possible to view incomplete survey responses. In total, thirteen responses were submitted and another nineteen surveys (not necessarily unique users) were started but

never submitted. This corresponds to a 13.3% response rate among individual living labs. Twelve of the thirteen respondents consented to being identified and are shown in Table 4-2.

Table 4-2. Living Lab Survey Respondents

Living Lab	Country	City
SubUrbanLab	Sweden / Finland	Botkyrka / Riihimäki
Maastricht-LAB	Netherlands	Maastricht
Design Creative City Living Lab	France	Saint-Étienne
Floworks Living Lab	Finland	Tampere
Go:Smart / UbiGo	Sweden	Gothenburg
WirelessInfo	Czech Republic	Litovel
Interethnic Coexistence in European Cities (ICEC)	Austria	Vienna
Greater Manchester Low Carbon Hub	United Kingdom	Manchester
Agro Living Lab	Finland	Seinäjoki
City-Zen	Netherlands	Amsterdam
KLIOLab	Italy	Lecce
Lorraine Smart Cities Living Lab	France	Nancy

4.3 Interviews with Funding Partners and Relevant Stakeholders

Five semi-structured, in-depth interviews were arranged with a focus on those funding partners supporting living labs. The interviews were requested among the funding partners discovered via the survey of living labs and those funding bodies already known to support living labs. These interviews were treated as expert interviews; an interview guide was developed to steer the conversation and ensure similar questions and content were discussed in each interview (Appendix IV). However, the guide was modified for each specific interview to reflect the interviewee's background and knowledge.

In order to find relevant interviewees, funding agencies that support living labs needed to be identified. Three methods served the basis for this: those funding agencies discovered through the process of the literature analysis, those funding agencies identified from those living labs who responded to the survey and those funding agencies who make up the membership of JPI Urban Europe. JPI Urban Europe is a consortium of fifteen countries and their national research and innovation funding agencies, among others. JPI Urban Europe has come out as an important supporter of living labs throughout Europe (and who funds the GUST Project).

Among the funding agencies discovered in this manner, points of contact were identified as potential interviewees after looking at each funding agency's catalogue of projects and seeking out those individuals who had been affiliated with funding of living labs. Relevant stakeholders were also interviewed; this included those stakeholders in a support role for living labs, researchers and practitioners. Moreover, proceedings from the 2nd European Climate Change Adaptation Conference that occurred May 11th through May 14th, 2015, in particular, the workshop *Addressing urban climate challenges: Climate Services, Living Labs and*

Learning Alliances, were included in analysis as several discussions focused on funding and implementation of living labs.

In total, nineteen individuals were contacted from fifteen different funding agencies throughout Europe. These potential interviewees were emailed at the beginning of July with subsequent follow-ups. Many declined to be interviewed for various reasons: some felt they were unknowledgeable and unable to help; others did not feel comfortable conducting an interview in English; while some were no longer funding living labs. Many others were out of the office due to the summer holiday occurring in Europe at that time.

Of those available for an interview, interviews were conducted between June and August 2015. A complete list of interviewees is found in Appendix I. The preferred method of interview was Skype; however, when this was not possible, phone conversations took place. In-person interviews were difficult to schedule due to the geographical location of funding agencies and stakeholders across Europe. Each interview lasted between thirty to sixty minutes. When conducted via Skype, a request was made at the beginning of the interview to record the discussion. This enabled the interviewer to focus on steering the interview and ask relevant follow-up questions rather than transcribing the conversation. Later, key information was transcribed from the recorded material; no effort to fully transcribe the interviews was taken as no analysis was conducted on social behaviour during the interview. In instances where the respondent did not wish to have the interview recorded, notes were taken during the interview. In all cases, the interviewee was provided a draft copy of this thesis prior to its publication.

4.4 GIS Analysis

Social equity and equality is a major issue concerning the living lab methodology. Literature describes living labs as being "dropped into" urban areas without being integrated into the local context and without taking into account who is participating and benefiting from their efforts (Bulkeley & Castán Broto, 2013; Evans & Karvonen, 2014). The questions arise as to who is engaged within living labs and which communities are impacted and affected.

In order to shed light on these questions of social equity, those living labs for sustainability identified for the purpose of this thesis will be investigated. With a large dataset of living labs and a tendency among living labs to be thoughtful in the information they make public, methods to address social equity issues needed to be developed taking this into account.

To examine social equity issues surrounding living labs, Esri's ArcGIS 10.3 was used to perform geographical analysis. This software enabled for the mapping of those identified living labs and an overlay of demographic data including any one or more datasets of average household income, poverty, unemployment, education and population density, when available. To do this, the addresses for the identified living labs had to be found and geocoded, meaning the physical address was converted into longitude and latitude to be used in GIS analysis.

The addresses for the living labs under examination were found through a variety of sources, often the living lab website or social media site. Other online sources were consulted including the ENoLL database, online news articles, funding organisation's websites, etc. Where addresses were not available for living labs, the address for the head organiser (individual or organisation) was used as a proxy. While this may introduce limited bias when discussing geographical proximity (i.e. the community located geographically near the living lab), cultural or social proximity dictates that the organiser may be acting within their channels of influence (as discussed in Chapter 2.4); therefore, looking at this location may be justifiable.

The geocoded locations of the living labs were plotted in the GIS window; demographic data was overlaid as a means to examine those communities who may be most closely engaged or impacted by living lab work. The spatial resolution of the datasets varied depending on data availability.

GIS is used extensively in literature to measure the equitable distribution of parks, to calculate environmental justice and fairness issues relating to environmental hazards, etc. (Omer, 2006; Tsou et al., 2005). Previous studies have observed that accessibility increases with income (Omer, 2006; Wolch et al., 2014). In looking at the methodology to assess social equity of urban public facilities, Tsou et al. (2015) used the service and impact range to measure spatial equity and fairness of distribution. Urban public facilities seek to provide services to residents and maintain the environmental quality of urban living (Tsou et al., 2005). Similarly, living labs seek to engage residents and strive to improve urban living. Drawing this parallel, the average service range as reported for urban service buildings within communities is two kilometres; therefore, this service range is used in measuring spatial equity of living labs within communities. Euclidean (aerial/radial) distance is chosen over network distance, the distance it takes to travel via the transportation network. In the study conducted by Omer (2006), both Euclidean and network distance were used; there appeared to be little difference in findings despite the large amount of work and needed data to compute network distance. Therefore, as done in Omer (2006), Euclidean distance of 2km is used in this instance, applying the method to investigating communities served by living labs. A 5km buffer was also applied as a control. Often, little observed differences were noted; however, in some instances, the 2km buffer seemed to more wholly capture the community. As a result, it was decided to proceed with the 2km buffer for this research.

For the purpose of this study, GIS data was obtained through the INSPIRE Geoportal hosted by the European Commission (http://inspire-geoportal.ec.europa.eu/) and from the data openly available on Esri's website, the developer of ArcGIS software. Data describing population density, level of education, poverty, unemployment and household income were sought to assess the communities in which living labs reside. Data availability differed among countries with varying degrees of quality and spatial resolution. While high-resolution data offers a greater window into neighbourhood characteristics, one cannot simply assume that all neighbourhoods are homogenous or cohesive (Omer, 2006).

Initially, the key countries under focus by the GUST project including Austria, Netherlands, Sweden and the United Kingdom were targeted for analysis. However, only data for the Netherlands and the United Kingdom (specifically, England and Wales) could be found to be included in this analysis. Georeferenced data is not openly available for every country; for example, while data exists for Austria, the cost to access the data was exorbitant and prohibitive for including it in analysis. Further, after consulting experts in the field of GIS, it was not possible to locate relevant data for Sweden.

4.4.1 Sample GIS Living Lab Analysis

To aid in the understanding of social equity issues that impact living labs, examples of the GIS analysis of living labs will be demonstrated. Those living labs investigated and highlighted in this research will be those living labs that completed the survey and fall within the geographical purview of the scope of the GIS analysis. The social equity analysis assisted by GIS tools can be triangulated with the information that these living labs provided through their responses to the survey. This aids in the understanding of the communities being engaged and impacted. Maps produced using ArcGIS 10.3 and subsequent analysis of these sample living labs will be included in Chapter 5.5.

4.5 Methodological Limitations

Limitations exist among the methods presented for data collection and analysis. However, these limitations are manageable and do not undermine the value of this work nor the validity of the results presented.

The literature analysis provides the foundation for the future work for this thesis. The two living lab initiatives, GUST and ENoLL, are used to identify living labs for sustainability. However, this surely does not represent all living labs for sustainability. Therefore, the analysis does not consider any others that may be important or relevant to study. Despite this, there were no other examples of living labs for sustainability discovered in the literature and it is clear that these 118 living labs for sustainability represented a comprehensive overview of the phenomenon.

Literature analysis also included examining academic literature, grey literature and living lab websites. Therefore, it is important to recognise that much of online information represents the author's perception of reality without being verified or considering the motivations for its purpose (Flick, 2006). Flick (2006) suggests triangulating data online with other methods whenever possible, focusing on real-world encounters including interviews and surveys. For the purpose of this research, this is done through the introduction of a survey of living labs and interviews with funding partners.

The number of survey responses and interviewees gleaned a vast array of interesting and pertinent data. Respondent availability introduced a limitation to the number of people able to answer the survey and respond to interview requests. While more survey data would always be welcome, the data served as a qualitative and anecdotal perspective regarding living labs for sustainability. Meanwhile, interviewees largely agreed on the problems facing funding for living labs. For the purpose of this research, the amount and level of detail of data is sufficient; however, in the future, more interviews could be done with a larger selection of national funding agencies.

This work, to the best of the author's knowledge, is the first to employ GIS analysis in analysing living labs for sustainability. Due to data availability, GIS analysis was limited to just the Netherlands, England and Wales. Living labs analysed represent 20% of all identified living labs for sustainability where geolocated addresses were found. Moreover, this work builds a methodology to investigate the communities in which living labs are embedded and serves as a foundation for future work and adaptation.

A reflection of these methodologies is included in Chapter 7.3 and suggests areas of future research as presented in Chapter 7.4.

5 Results

In this Chapter, the results from the four methods of analysis are presented: literature analysis, survey of living labs, interviews of funding partners and relevant stakeholders, and GIS analysis. The results presented in this Chapter serve as the basis for the subsequent analysis and answering of the presented research questions in Chapter 6 that lead to reflections in Chapter 7.

5.1 Results from Literature Analysis

The literature analysis served two purposes: to identify living labs for sustainability and to investigate the ways in which they engage with sustainability. The living labs for sustainability were found through the process of consulting ENoLL and GUST project databases of living labs and determining which interventions focus on areas of sustainability. These living labs are presented in Appendix V.

These living labs served as the focus for the subsequent research surrounding sustainability focus, funding and social equity issues. For those living labs that did respond to the online survey, they were analysed using this method to determine their sustainability focus. The various aspects of sustainability were transport/mobility; smart city solutions / ICT; renewable energy; energy efficiency; construction; recycling/waste; low carbon futures/climate; housing; equity and societal issues. Figure 5-1 shows the percentage of projects that deal with a variety of sustainability aspects among those living labs that did not respond to the online survey.

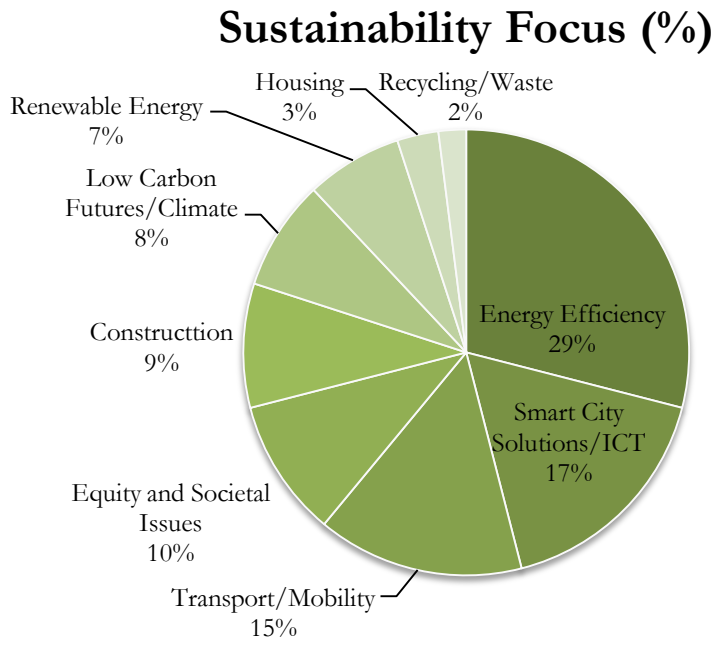


Figure 5-1. Sustainability Aspects of Investigated Living Labs

Of those living labs in which their online presence was analysed (i.e. those that did not respond to the survey), the largest sustainability focus of living labs was energy efficiency with 29% of living labs communicating, at least one project, their focus as energy efficiency. As reported in the literature, living labs and their proliferation are closely tied to the development of the ICT sector and the increasing connectedness of our society (Ståhlbröst & Holst, 2012).

Therefore, it comes as no surprise that smart city solutions and ICT development are also key focuses of living labs, with 17% communicating on-going projects.

There were other areas of focus living labs were found to be working in. While these only represent one or two projects (sometimes more), it is important to consider the wide array of projects that deal with sustainability perpetrated by living labs. In this way, it is demonstrated the potential living labs have in addressing numerous challenges in cities. The themes discovered through analysis in which living labs also focus were:

- Agriculture
- Sustainable Production
- Diversity
- Maritime Environmental Protection
- Green Public Procurement
- Sustainable Development
- Environmental Risk
- Land and Water Management
- Eco-Innovation
- Cleantech
- Rural Sustainability
- Biodiversity
- Urban Gardening
- Urban Development

It is important to note that many of these sustainability aspects relate and overlap. For example, often, energy efficiency and smart city solutions lead to a lower carbon future. Moreover, many sustainability aspects improve the lives of those living within the community and address equity or societal issues. However, only those living labs that expressly communicated their sustainability aspects in an explicit manner were included as contributing to their sustainability focus. Moreover, living labs under examination often had more than one project that dealt with a variety of sustainability aspects. For the purpose of this analysis, all projects easily identifiable through their online presence were considered by the living labs to be among their sustainability focus.

5.2 Results from Survey of Living Labs

Thirteen respondents to the survey provided a plethora of qualitative and quantitative data to be examined. Remember, the primary value of the survey is in the detailed reflections and perspectives to the large number of open-ended questions. The survey was constructed with three parts: living lab information, user involvement ad funding of living labs. The following sections proclaim the results from these themes contained within the survey.

5.2.1 Living Lab Information

This section of the survey sought to gather biographical information about the living labs or interventions in cities that may be considered living labs. Not all of the identified projects refer to themselves as living lab; this section also introduced the definition of a living lab to motivate the respondents to think of themselves in that way while answering the survey.

When asked in what year their project started, all living labs began no later than 2009. At any time since they initiated, 25% of those surveyed did not refer to their intervention as a living lab. Instead, they refer to their interventions in some other manner (ex. city lab, hub, using living lab approach but not a living lab). In part, those respondents that did not identify as a

living lab mentioned the strong influence from industrial partners that created an industry-driven approach over that of user-driven.

Living labs were asked to state their primary research focus: products, processes, services, systems or something else. Many of the living labs stated that they work in more than one of these areas but most focused on improving services and processes. Only 25% saw product design and innovation as among their primary research focus. Given the opportunity to elaborate, one living lab stated they lacked any focus on research. Another stated they work on improving policies impacting cities.

Nearly all (83.3%) of respondents said that the local municipality was deeply involved in the delivery of their living lab. Naturally, the private sector and universities also played a large role along with, to a smaller degree, civic society, national government, the European Commission, and NGOs. When asked which organisation took ownership or had the most influence, no stakeholder group emerged as the dominant influencer.

Among the most relevant questions, living labs worked in a variety of areas for sustainability. For those living labs that did respond to the survey, energy efficiency, once again, seems to be the dominant focus. Other focuses included smart city solutions, transport/mobility, renewable energy, low carbon futures and climate change, housing, and equity and social issues in order of the number of projects found.

5.2.2 User Involvement

This section of the survey was the most poorly responded section amongst the three sections. In part, this may be to question design, language barrier or a lack of knowledge with regard to the questions being asked. When asked, on average, how many engagement activities and how many end-users your living lab engaged with each month, many living labs said it was difficult to quantify. In part, the living labs surveyed worked on several projects at once, which made it difficult for them to report in a survey. Living labs that engaged in multiple projects reported that short-term projects engage with fewer people in different ways than long-term projects. However, in asking this question, three-fourths of the living labs elaborated on their answers. In doing so, it was clear there is a wide-ranging definition of what constitutes end-user engagement and participation. One respondent used the example of the number of people who receive their newsletter as a mechanism to measure engagement.

Those living labs that responded also varied in the co-creation and engagement mechanisms in which they deployed. Only one living lab reported to be using sensing equipment or ICT tools to measure user's behaviour or responses. Common engagement activities included co-creation workshops, interviews, online discussions, informal discussions or meetings, prototyping workshops, etc. Understanding what these mechanisms entail and their effectiveness requires further research.

When asked about the level of difficulty in engaging with end-users, more living labs (66.7%) had found it to be more difficult than easy to find end-users willing to engage. Respondents highlight that it "depends on the topic and the living lab" but found "engagement to be time consuming" and "scheduling [to] be disproportionately stressful". Living labs also struggled to identify which stakeholder should take ownership of engagement activities and which end-users to engage in the process.

Drawing on literature from Evans & Karvonen (2014, p. 415), a question asked "*Some living labs have been described as "demonstration projects [that] are simply 'dropped into' urban areas rather than integrated with their local contexts." How would you respond to this characterization?"* Surprisingly, many

living labs agreed with this characterisation. Overwhelmingly, they see this as one of the main difficulties with the living lab approach. One living lab characterised themselves as selecting the projects to run and how to measure success. A few others expressed frustration that there were "… a lot of 'testbeds' [that] are considered as Living Labs" but state that often, in these instances, users were only testers of products or guinea pigs in the process and should not be considered a living lab. As for those living labs that responded, some said this was true of their living labs. Yet, they try to engage and integrate with their communities by involving them at an early stage and ensuring the activities of the living lab correspond to local needs. Some see their role as to inspire and stimulate public debate while others spend a lot of money on marketing and public relations to recruit "test-customers" and create a lot of buzz about activities.

When asked specifically about demographic information regarding end-users in the living lab, many struggled to answer. The survey asked specifically about gender, age, income, education, ethnicity and distance to travel to living lab. A higher percentage of men engage in the surveyed living labs than women: the mean percentage of men was 52.7% and women 47.3%. The ages involved in living lab spanned from 17 to 66 with the average age reported to be 36 years old. Most of those engaged had some formal education including college-level education. Others reflected that they engaged with few less-educated people and immigrants. Others described their participants as "typical to persons living in" the region. When asked to elaborate, many indicated that this was difficult to say and largely dependent on the activity itself. This demographic data only represent reported data by respondents, which may or may not be representative of reality.

5.2.3 Funding of Living Labs

Funding is an important condition for the implementation of a living lab. Of those surveyed, 16.7% of living labs have since concluded and are no longer active. 75% had project-based funding with a definite end, 16.7% had conditional or rolling funding (often through the lead stakeholder of the living lab such as a university). Only 25% of living labs surveyed indicated that they planned to seek further funding at the end of their funded projects.

Some living labs see themselves as "temporary vehicles" in which their funding will end when they are no longer needed. When asked if funding had been a problem for the living lab, 75% indicated that it had been at least a minor problem. Living labs find they "do not have the ability to invest resources quickly" and that they "constantly struggle for project funding to implement [their] plans".

It was clear that the funding comes from a myriad of sources with no one actor providing the bulk of the funding. Local governments, national governments, the European Commission and private sector companies all play a significant role in funding of those surveyed living labs.

When asked if the process for seeking funding has changed over time, most indicated that it had not become any easier. In fact, many saw the funding from local government being reduced due to the need for significant budget cuts at a local and municipal level.

Survey respondents reported a wide-ranging level of requirements placed on living labs by their funding partners. Vinnova (Sweden) is seen as requiring only small project updates from their funded living labs. Others ask for annual reports, sharing of results within the community, updates should things change and deliverables for the next funding stages. Living labs see funding partners motivated by a variety of reasons including employment, generating new business, innovation in local communities, sustainability and to develop an open innovation platform for bottom-up initiatives.

5.3 Results from Interviews with Funding Partners and Relevant Stakeholders

Prior to the beginning of this research, it was imagined that interviews would serve as the bulk of the data collected with regard to funding support of living labs. However, quite quickly, it became apparent that it would be difficult to find willing interviewees. This research challenge will be discussed in further detail in Chapter 7.3.

Five interviewees responded to requests for an interview. Further, discussions from the 2nd European Climate Change Adaptation Conference in Copenhagen, Denmark from May 11th – 14th also served as important context in discussing living labs. The information gleaned from interviews and discussions were analysed on the basis of three areas: funding of living labs; social equity and inclusivity of living labs; and the future of living labs for sustainability.

5.3.1 Funding of Living Labs

Much of the information reported by interviewees pertained to the funding of living labs given that many of the interviewees hailed from national and EU funding agencies. To begin, Kristina Björnberg is Senior Research Officer at Formas, a Swedish national funding agency focusing on funding of basic and need-driven research pertaining to environment, agriculture and spatial planning. She discussed at length the ways in which funding agencies develop and formulate research programmes. Formas does not fund living labs directly but is among the national funding agencies involved in JPI Urban Europe. These agencies are responsible for contributing to the development of the Strategic Research and Innovation Agenda. There is great debate among these member countries due to varying national goals and strategies (K. Björnberg, personal communication, August 19, 2015). Further, an interviewee mentioned the importance small countries (ex. Cyprus) play in the the development of the strategic agenda despite limited financial contribution and total size of population.

Open calls are the primary vehicle for funding of any initiative for innovation or research, often related to the broader strategic agenda (K. Björnberg, personal communication, August 19, 2015). These open calls tend to be broad in design, making them applicable and appealing to a wide-array of actors working within the particular field the call is targeting (R. Engström, personal communication, August 21, 2015). As a result, it is often difficult to find evaluators with the necessary breadth of knowledge to holistically evaluate all proposals submitted within an open call (R. Engström, personal communication, August 21, 2015). Moreover, to fund projects of high scientific and societal value, evaluators should have experience with academia / research as well as practical experience in industry / society (K. Björnberg, personal communication, August 19, 2015). Therefore, the successful proposals tend to favour those that include a research component, alienating SMEs and innovators.

Interviewees indicate that their funding agencies tend to fund short-term projects, yet they widely recognise the disadvantages in doing so. One interviewee went as far to say as it is their personal opinion that projects (in reference to living labs) need to work for a longer period of time to enable living labs to learn, grow and become involved in a community in order to achieve tangible success. The current funding regime largely supports linear innovation processes that see innovations developed in seclusion and the need for re-entry into the market. Bylund suggests that non-linear models for funding need to be developed that spur innovation and that are developed in the real-world context, avoiding the need for re-entry into the market (personal communication, June 19, 2015).

5.3.2 Social Equity of Living Labs

Social equity is an important issue pertaining to innovation and the funding of interventions that support innovation. The funding agencies represented by those interviewed all have detailed social equity criteria used in the assessment of each proposal for funding. For example, Formas has five total criteria to assess the validity of a proposal under consideration for funding, two of which pertain to social value (K. Björnberg, personal communication, August 19, 2015). They include the societal value associated with the project as well as the means in which the results are communicated and integrated with society (K. Björnberg, personal communication, August 19, 2015).

Further, social equity plays a role in how projects are evaluated *ex post* at the end of the funding period. Alexander Alvsilver is the Senior Programme Manager at Vinnova, the Swedish national funding agencies for innovation. He elaborated on the role of the funding agency in collecting and disseminating valuable information associated with the funded projects to society. While Vinnova does collect best practices that reflect the outcomes of funded projects, it is recognised they can improve this process (A. Alvsilver, personal communication, August 27, 2015).

Jarmo Eskelinen, the former President of ENoLL and CEO of Forum Virium Helsinki, a platform that uses the living lab methodology, was interviewed for the purpose of this study. He sees social equity issues as important area to research regarding living labs. While he recognises the importance of social equity, he does not think living labs should be measured on the basis of their inclusivity. In part, living labs need to be less concerned with the ongoing debate as to what constitutes a living lab and shall seek to engage with the necessary individuals pertinent to their work (J. Eskelinen, personal communication, August 11, 2015). However, he does note the importance in dealing with issues that relate to privacy, as living labs continue to develop around ICT with increased monitoring and surveillance.

5.3.3 Future of Living Labs

Funding agencies still see living labs as an unproven tool to be used for innovation in cities (K. Björnberg, personal communication, August 19, 2015; A. Alvsilver, personal communication, August 27, 2015). However, they recognise it is a concept that could be developed and prove to be a powerful tool in transforming cities towards sustainability (K. Björnberg, personal communication, August 19, 2015).

Previously, Vinnova had used the terminology 'living lab' in their open calls, now it is absent from their vocabulary (A. Alvsilver, personal communication, August 27, 2015). It was not a conscious decision; Vinnova has opted to use terms such as "test beds" and "test environments" instead to describe collaborative interventions in a real-world context (A. Alvsilver, personal communication, August 27, 2015).

Despite these viewpoints, interviewees agree that the living lab concept will continue to proliferate throughout Europe. They express a variety of trends they believe will continue regarding living labs into the future:

- Living labs for sustainability will continue to focus around cities (A. Alvsilver, personal communication, August 27, 2015)
- The living lab process will become more formalised and integrated into the status quo of governing cities (A. Alvsilver, personal communication, August 27, 2015; J. Eskelinen, personal communication, August 11, 2015)

- Living labs will continue to develop around ICT (J. Eskelinen, personal communication, August 11, 2015)
- Living labs will focus more profoundly on the 'Smart Cities' concept along with the associated sustainability benefits (J. Eskelinen, personal communication, August 11, 2015)
- There will be increased collaboration among national funding agencies to fund broader programs and bridge funding gaps to benefit living labs (J. Bylund, personal communication, June 17, 2015)

However, there is considerable pressure on national funding agencies to fund more research with equal pressure to fund more innovation (R. Engström, personal communication, August 21, 2015). It remains to be seen how funding agencies will respond to this pressure and what impact this will have on the funding of living labs in the future.

5.4 Results from GIS Analysis

GIS proved to be a powerful tool when performing community-based research in assessing the communities in which living labs are embedded. The GIS analysis sought to include the most recent georeferenced data available. However, data availability and resolution became a problem as different types of data and varying spatial resolution exists throughout Europe. The INSPIRE (Infrastructure for Spatial Information in the European Community) Directive, entering force on May 15, 2007, aims to create and harmonise an EU spatial infrastructure to support seamless spatial information across Member States (European Commission, n.d.-a). However, the Directive is being implemented in phases with full implementation required by 2019. While the INSPIRE Geoportal (http://inspire-geoportal.ec.europa.eu/) is a valuable resource for georeferenced data, it lacks a complete and harmonious picture across Europe. As a result, limited available data existed for this research.

Further, while sought data included population density, household income, education, poverty and unemployment, the means in which data was collected and visualised varied greatly among countries. For example, the Netherlands presented data in $100m^2$ and $500m^2$ grids; England and Wales used their own form of georeferencing called Lower layer Super Output Areas (LSOAs), which corresponds to approximately 1,500 people per area but varies in size and shape. The complexity of the data makes it difficult to compare between countries but trends among living labs can be inferred based on the data. The following sections present the detailed GIS analysis as it relates to the Netherlands, England and Wales.

5.4.1 Netherlands

Data availability for the Netherlands included household income and population density.

Private households (excluding students) are classified according to disposable household income (i.e. income available after taxes) into three categories: low, middle and high. To do so, all private households within the Netherlands are catalogued in ascending order based on household income. The lowest forty per cent (0-39%) are classified in the low disposable income category, the next forty per cent (40-79%) corresponded to the middle and the highest twenty-per cent (80-100%) of private households represented those with high disposable income. In 2010, those classified with low disposable income took home less than EUR €25,070 annually, middle with EUR €25,071 to EUR €46,949 and high disposable income earners greater than EUR €46,950 annually. The data represented annual disposable income concluding on December 31, 2011 with spatial resolution of $500m^2$. (Centraal Bureau voor de Statistiek, n.d.)

Population density data had high spatial resolution of 100m^2. Data included the total number of people per 100m^2.

Using GIS tools, the average household income and population density of those communities in which living labs are physically embedded were examined. Using Euclidean distance of 2km as a proxy to assess the community, the average of the grids that fall within the 2km buffer was determined for each living lab (Table 5-1).

Table 5-1. Living Labs Investigated in the Netherlands

Living Lab	City	Low Income (%)	High Income (%)	Population Density (people / 100m^2)
City-Zen	Amsterdam	50	13	107
Living Lab Buiksloterham	Amsterdam	53	16	103
Veerkracht Carnisse	Rotterdam	60	8	115
Eindhoven Living Lab	Eindhoven	51	15	68
Urban Gro Lab	Groningen	60	10	100
Maastricht-LAB	Maastricht	52	15	69
Concept House	Rotterdam	56	10	86
Open Ebbinge Lab	Groningen	60	10	99
Stadslab Leiden	Leiden	41	23	88
Foundation the Hague Innovation Motor (HIM)	Rotterdam	51	17	130
	Living Lab Average:	52	15	97
	Netherlands Average:	37	21	30

In every instance, the communities in which the investigated living labs were embedded have a higher percentage of low-income earners compared with the Netherlands average. In fact, the communities, on average, saw 15% higher population of low-income residents compared to the Netherlands average. Further, the living labs were embedded within population-dense communities, often in urban environments in comparison to the rest of the Netherlands. This suggests that living labs are embedded within disadvantaged communities, at least communities that fall below the average of the Netherlands population as a whole. However, this does not mean that these communities are being engaged or impacted as a result of the living lab (see Chapter 6.3).

5.4.2 England and Wales

England and Wales have produced a complicated index that measures deprivation from multiple indicators called the Index of Multiple Deprivation (McLennan et al., 2011). The

indices are produced by the Department for Communities and Local Governments as a tool to help in identifying the most disadvantaged areas (McLennan et al., 2011). Deprivation in this instance is a measure of the lack of material benefits considered to be basic necessities in society. However, the Index of Multiple Deprivation 2010 recognises there is more than just income deprivation but include seven dimensions: income, employment, health, education, housing, crime and environment.

The Index of Multiple Deprivation is geo-referenced and applied to Lower layer Super Output Areas (LSOAs). LSOAs are described as "homogenous small areas of relatively even size containing approximately 1,500 people" with the intent of "…develop[ing] the Index of Multiple Deprivation and supplementary indices at as small a spatial level as is possible to ensure that pockets of deprivation are not overlooked" (McLennan et al., 2011, p. 15). LSOAs vary in shape and area depending on the population density.

To determine the level of deprivation of each LSOA, indicators are used for the seven dimensions that are included in the Index of Multiple Deprivation. Each indicator corresponds to a quantifiable number of people that meet that indicator. These people are summed for each indicator and each dimension (i.e. income, employment, health). Finally, this total number of people meeting deprivation dimensions is divided by the total population in the LSOA providing a proportion of the population deprived. For example, the dimension income has five indicators: adults and children receiving family income support; adults and children in families receiving unemployment benefits; adults and children in families receiving government pension; adults and children in families receiving a child tax credit and below 60% of the median income before housing costs; and asylum seekers in England in receipt of subsistence support, accommodation support, or both. All people, adults and children, who receive any of these benefits or are in families receiving these benefits, are summed for each LSOA to be used to create a proportion of multiple deprivation. This process is done for each indicator of the seven dimensions making up the index. Then, each LSOA is ranked in order from most deprived to least deprived. There are a total of 32,482 LSOAs in England and Wales. (McLennan et al., 2011)

The data that makes up the Index of Multiple Deprivation relate to data from 2008 and, in some cases, data from the 2001 census (McLennan et al., 2011). The next iteration of the Index of Multiple Deprivation is set to be released in September 2015.

The data that makes up the Index of Multiple Deprivation includes only a rank for each LSOA from 1 to 32,482. For the purpose of this analysis, those LSOAs that fell within the 2km Euclidean buffer surrounding living labs under investigation were identified. An average of the LSOAs' rank within this range was documented for each living lab in accordance to the procedure outlined in *The English Indices of Deprivation 2010* Guide Book in averaging ranks for districts of LSOAs (McLennan et al., 2011, p. 54).

However, the average rank of those LSOAs that makes up the community under examination does little to enable analysis. Therefore, the data was translated into percentiles (Table 5-3). The analysis of living labs in England and Wales shows that six of the eight living labs investigated fall below the 50th percentile, meaning that those six living labs are embedded in communities that are more deprived than average communities in England and Wales. Of note, those living labs investigated in London are within communities that have more deprived populations on the basis of housing in comparison to the rest of England and Wales. Housing indicators include household overcrowding, homelessness, affordability, and proximity to hospital, grocer, primary school and post office (McLennan et al., 2011). This makes sense given London's notorious housing shortage along with high cost of apartments. Crime, living

environment and health services are among the deprivation dimensions in which the communities served by living labs in England and Wales fair the worst in comparison to the average.

Table 5-2. Living Labs Investigated in England and Wales

Living Lab	City	Index of Multiple Deprivation	Income	Employment	Health	Education	Housing	Crime	Environment
Greening Wingrove	Newcastle upon Tyne	54%	61%	62%	21%	70%	62%	46%	43%
Greater Manchester Low Carbon Hub	Manchester	26%	39%	44%	18%	46%	35%	10%	31%
Corridor Manchester ('Lighthouse Project')	Manchester	23%	34%	40%	17%	45%	35%	16%	31%
Newcastle Science City	Newcastle upon Tyne	21%	28%	29%	7%	25%	51%	34%	42%
Muswell Hill (Haringey) Low Carbon Zones (one of 10 London Low Carbon Zones*)	London	45%	53%	64%	56%	88%	9%	24%	29%
City Lab Coventry	Coventry	29%	33%	36%	27%	40%	31%	25%	15%
The Selby Trust: The Community Energy Lab	London	12%	7%	19%	35%	34%	10%	12%	19%
York Without Walls	York	57%	63%	63%	62%	71%	67%	23%	21%
	Living Lab Average	33%	40%	45%	30%	52%	37%	24%	29%

5.5 Living Lab Social Equity Analysis – Examples

Three living labs are investigated further: Maastricht-LAB, Amsterdam City-Zen and Greater Manchester Low Carbon Hub. These living labs include those that fall within the GIS analysis in the Netherlands, England and Wales, the two areas for which GIS data was available. Further, these three living labs responded to the survey. The survey sought to ask questions regarding social equity within the living labs. As discussed in the Methodology Chapter 4.4.1, we can triangulate the information gleaned from the GIS analysis with the information provided by the living labs to begin to make determinations about living labs and their integration within the communities in which they are embedded.

5.5.1 Maastricht-LAB

Maastricht-LAB began in 2012 as an initiative of the Municipality of Maastricht to examine urban (re)development in the city. The LAB is very much a platform for projects in the city that look at improving vacant buildings, parks or other public spaces. The LAB has outgrown its experimental phase and has been scaled up since 2014 to be more involved in the urban development of the city. The LAB itself does not initiate projects; instead, the lab looks to find and source project ideas and partners from the community, including students from the local university. Past projects include the development of a stretch of road devoted to small business and creative spaces called Temporary Lane, the neighbourhood outreach that focuses on creating green urban gardens called Operation Stonebreak, and the development of new park space in Maastricht called "Park of the Future". Recently, the living lab has initiated Citymakers Maastricht, an open network bringing together "thinkers and doers" to share resources, time and knowledge for the betterment of the city. The living lab engages with partners from various sectors and receives financial support from Creative Industries Fund NL and the Cultural Heritage Agency of the Netherlands, among others. Further, the LAB is the basis for on-going research by URB@EXP, a JPI Urban Europe funded research project looking at urban labs as a pathway towards sustainability. (Maastricht Lab, n.d.)

Maastricht is a city of approximately 120,000 residents. As of 2013, Maastricht University had nearly 16,000 students, 47% of whom were international students. In looking at the analysis of the Maastricht-LAB, 52% of residents within the 2km community buffer are considered low-income households making less than EUR €25,000 annually. This percentage of low-income earners is 15% higher in comparison to the Netherlands average. It should be noted that the initial GIS data collected does not include students so the presence of a large student population is not considered here. This further suggests that the community the living lab is embedded within is of lower socio-economic status than other areas of Maastricht and the Netherlands as a whole. In looking at Figure 5-2, the LAB is located in the heart of Maastricht and away from some of the suburbs that see households of higher income.

However, when asked to characterise the end-users engaged in the living lab, the respondent stated that the end-users tended to be highly educated including Dutch citizens but also many international students from the nearby University. The respondent specifically stated that they did not engage with "many low educated people and immigrants…". This suggests that, while the living lab is embedded in a community that is characterised as having a lower income in comparison to the average of the Netherlands, the end-users engaged in the living lab may not be representative of the community involved.

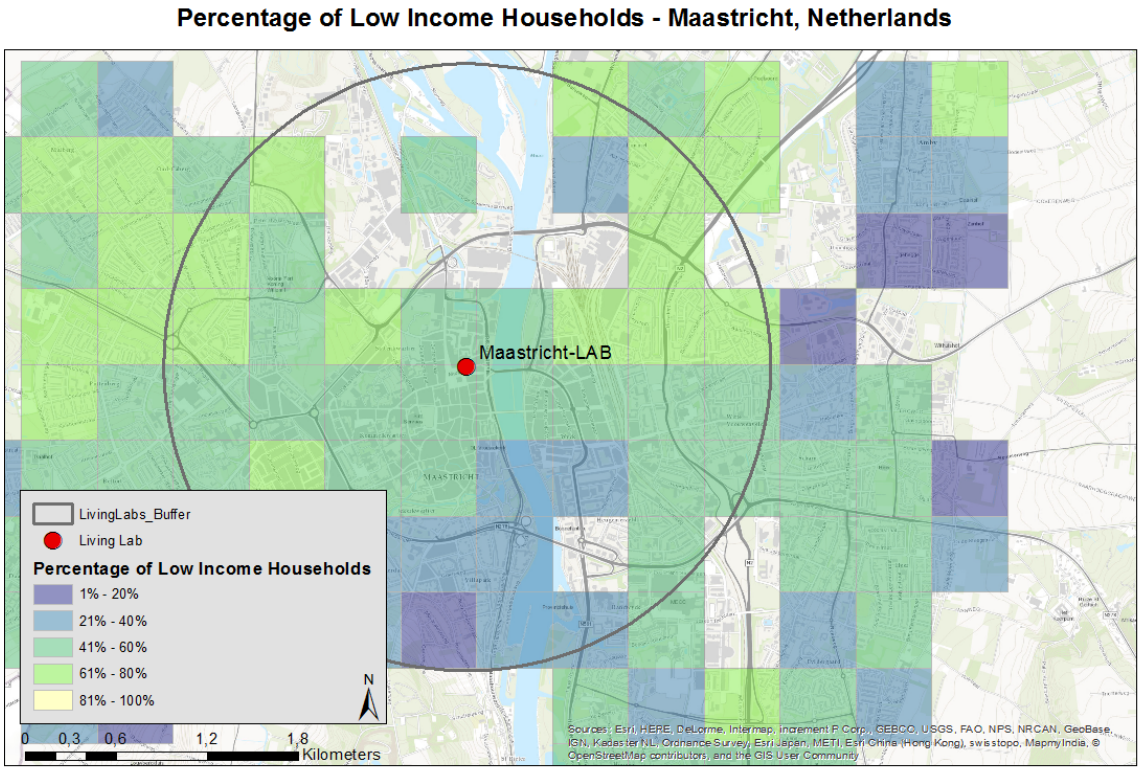


Figure 5-2. Map of Maastricht, Netherlands Illustrating Social Equity

5.5.2 Amsterdam City-Zen

City-Zen is seen as a large-scale platform testing innovative solutions in smart grid technologies, heating networks and sustainable housing. The two districts of Nieuw-West and Grenoble have been engaged, in which residents and users have a central position in testing and creating all solutions. Projects focus on sustainable transport, smart parking, car sharing, heat recovery, drinking water, renewable energy, etc. The project began in March 2014 as a five year project funded by the 7th Framework Programme for Research with twenty-three partner organisations and an overall budget of EUR €40 million. The platform hosts many projects, of which some are active living labs. The goal is to reduce carbon emissions by 59,000 tons per year. (Amsterdam Smart City, n.d.)

The survey revealed that the living lab claims that they engage with a large section of society. This includes people from many different educational backgrounds and ethnicities. In part, this is due to the demographics of Amsterdam, which is characterised as heterogeneous with many multinational corporations employing skilled workers along with a large immigrant population. Further, the respondent reported that there is strong collaboration among local governments and communities along with a large partner pool that position the living lab to provide services tailored to the community needs.

In looking at the GIS analysis, 50% of the community surrounding the living lab is characterised as having low household income. The visualisation in Figure 5-3 shows pockets of more extreme areas of low and high income supporting the position of a highly variable involved community. Furthermore, the living lab sits in a highly populated area of Amsterdam with an average population density of 107 people per 100m^2. With such a large population centre, it is difficult to engage everyone. The online presence and the survey show that efforts

are being made to be as inclusive as possible, employing a wide-range of participatory methodologies.

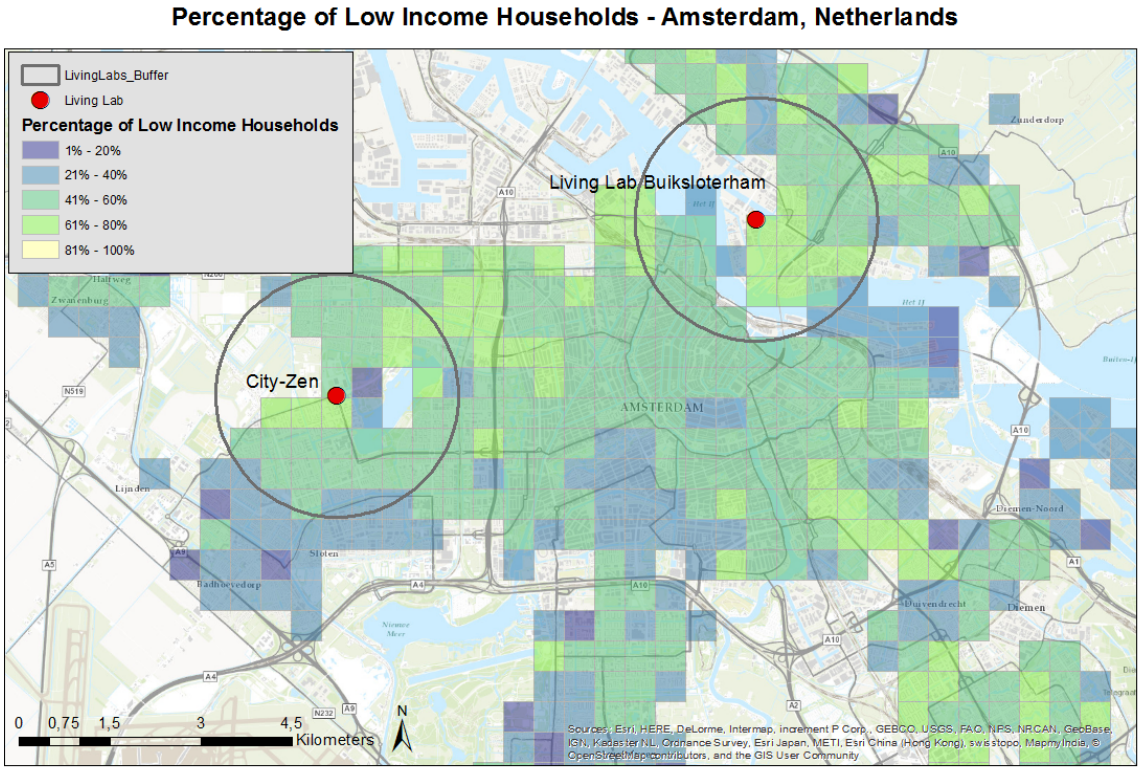


Figure 5-3. Map of Amsterdam, Netherlands Illustrating Social Equity

5.5.3 Greater Manchester Low Carbon Hub

The Greater Manchester Low Carbon Hub does not describe itself as a living lab; however, when presented with the definition, the respondent agreed that it might meet the definition of a living lab. The Hub was established through the 1st City Deal in 2012. This deal was reached between Manchester City and the UK National Government in which the City of Manchester committed to GBP £1.2 billion to invest in infrastructure and economic growth programmes with the National Government allowing for the city to retain GBP £30 million from taxes to reinvest in an infrastructure fund (Smulian, 2012).

The respondent to the online survey expounded greatly on the efforts of the Low Carbon Hub. The Hub seeks to drastically reduce their carbon emissions over the coming years. In order to do so, the Hub leverages the knowledge of local universities, local innovators in business and the strong history of public governance to provide tested solutions to meet these targets. The Hub regarded five themes: buildings, energy, sustainable consumption, transport and natural capital. The Hub engaged with the community through thematic meetings, workshops and consultations with members of the community. Further, the respondent concluded that "[t]he Low Carbon Hub is part of the fabric of the local governance of Greater Manchester City Region."

As of 2014, the City of Manchester had 520,000 residents with 2.7 million people in the Greater Manchester metropolitan area. The Greater Manchester Low Carbon Hub is located along the same corridor as the previously discussed Corridor Manchester project, the corridor

which houses the University of Manchester, Manchester Metropolitan University, Central Manchester Hospital, an innovation science park and numerous places of cultural significance.

The Greater Manchester Low Carbon Hub has an Index of Multiple Deprivation in the 26th percentile, with the health and crime being among the most impactful dimensions of deprivation. Despite the Hub and the surrounding community having a lower-than-average deprivation in comparison to other districts, the Hub is located in close proximity to many areas of significance including universities, hospitals and businesses. The visualisation in Figure 5-4 shows those LSOAs located closest to the Hub being in a higher percentile than the 2km buffer average. It is important to mention that the data here only represents those households located within the 2km buffer and does not take into account those who may travel or commute from these areas of higher economic significance to take part in the work of the living lab.

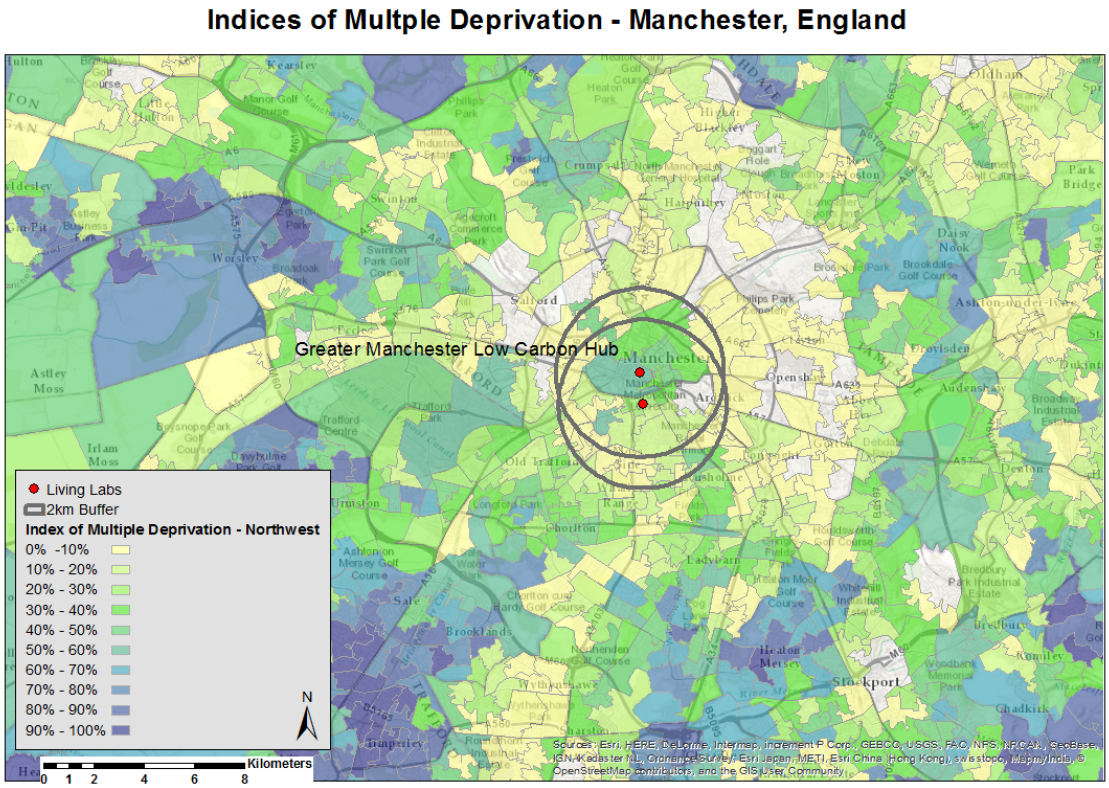


Figure 5-4. Map of Manchester, England Illustrating Social Equity

6 Discussion and Analysis

The discussion seeks to answer the posed research questions and sub-questions based on the findings presented in Chapter 5. Using the triple bottom line conceptualisation – *Planet*, *Profit* and *People* – the analysis will be structured in addressing these components of working towards sustainable development. Reference Table 4-1 as it outlines the research questions, sub-questions and methodologies used to answer these questions.

6.1 Living Labs – Planet

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report clearly dictates that climate change is occurring, that it is influenced by humans and that there is an increased likelihood of severe weather and climate events (Intergovernmental Panel on CLimate Change, 2013). Quite clearly, efforts to mitigate and adapt to the impacts of climate change are needed, especially as population growth continues, in particular, in cities.

Elkington (1997) suggests that in order to make meaningful changes to improve the environment, more solutions are needed than just introducing environmentally-friendly technologies. Mechanisms that support dematerialisation, energy efficiency and knowledge transfer are needed to spur the types of innovations required (Elkington, 1997, p. 72). Living labs can be positioned as one mechanism to do just that, to address and promote sustainability in cities. In this way, living labs can be seen as a tool that addresses the first pillar – *Planet* – of the triple bottom line.

But to examine the role and potential of living labs to impact *Planet*, we need to answer the first research question:

RQ1: How do living labs engage with sustainability?

Living labs for sustainability have been identified by investigating all living labs contained within the European Network of Living Labs and those identified by the GUST Project. Supported by literature and conversations with academics, the living labs were identified to be operating or supporting projects that fall into ten categories:

- Transport / Mobility
- Smart City Solutions / ICT
- Renewable Energy
- Energy Efficiency
- Construction
- Recycling / Waste
- Low Carbon Futures / Climate
- Housing
- Equity and Societal Issues
- Other Sustainability Issues

Supported by the literature analysis and the survey of living labs, living labs engage in sustainability in a variety of ways; the most common projects pertain to energy efficiency and smart city solutions. These aspects dominate the sustainability domains in which living labs for sustainability are operating.

Energy efficiency is seen as a highly useful strategy to enable cities to meet their targets for lowering energy use and reducing greenhouse gas emissions (Kramers, Höjer, Lövehagen, & Wangel, 2014). In particular, energy efficiency and the emergence of ICT as a means to

dematerialise, demobilise and decarbonise six different sectors including power, transportation, agriculture, building, manufacturing and consumer and services (Kramers et al., 2014). Similarly, smart city solutions leverage ICT to help cities build beneficial urban-based technological innovations that lead to competitive advantage (Kramers et al., 2014).

The significant focus of living labs on energy efficiency and smart city solutions makes sense; the expansion of living labs are seen as result of the development within the ICT sector (Ståhlbröst & Holst, 2012). With the significant impact ICT has in the development of energy efficiency strategies and smart city development, it is no coincidence that living labs, which often employ methods using ICT, tend to focus on these areas. Many seem to employ sophisticated monitoring and sensing technologies as a method to observe and interact with end-users, similar to the previous example of Corridor Manchester.

As expected, the living labs investigated here build on the public-private-people partnerships previously discussed. Through the survey, the majority of living labs involved actors from government, academia, industry and civic society. The actor most often reported to be involved in the development of living labs for sustainability was the local government particular to the communities in which the living labs were embedded. Further, no dominant actor-group emerged as the actor wielding the most influence in living labs. When asked which organisation or actor had the most influence, each living lab responded differently. Some living labs had one actor with the most influence, others had two actors with equal dominance and others saw their living lab as all actors equally involved in the decision-making process.

In examining the actors involved and the subsequent power structure, this shows that living labs depend very much on their local context. Of course, this suggests that living labs are not just "dropped in" to their local contexts using the same set of methodology as any other living lab. Instead, it seems from those living labs sampled, there is a conscious effort to adapt to the local context in which these living labs work. While this is obviously a positive attribute, for researchers, this suggests that it may be more difficult to simply examine existing living labs to understand mechanisms in which can be harnessed and scaled up to impact sustainable transformations in cities. However, continued research can lead to a database of best practices in which living labs can draw on to inform their local operations.

When examining how living labs engage with sustainability, it is important to consider how they engage with end-users, those involved in the process of co-creating solutions for sustainability. The online survey showed a wide-range of participatory methodologies employed by living labs. Workshops and interviews seem to be the most dominating methodologies. Informal conversations and surveys make up other methods commonly employed.

One question in the survey sought to understand how many end-users are *involved* in each living lab. It turns out, it is difficult for living labs to answer this question. In part, the word *involved* was not defined in such a way that allowed for universal understanding and continuity in analysis. However, many living labs provided comments to elaborate on their understanding of the word. This highlighted the varying degrees in which living labs imagine end-users to be involved. This meant anything from end-users embedded within a living environment in which they lived their lives to end-users who received the living lab's quarterly newsletter. Once again, this demonstrates the varying contexts in which living labs operate and how difficult it is to generalise amongst living labs for sustainability.

This also begs the question: what is a living lab for sustainability? As discussed previously, living labs for sustainability seek to engage end-users in co-creation and co-generation of

solutions for sustainability. Co-creation was previously defined "as the act of creating value to the mutual benefit of two or more actors, beyond creating actual product or service innovation in a collaborative way" (Veeckman et al., 2013, p. 6). From the definitions respondents provided regarding their *involved* end-users, it is clear that many of these do not achieve this definition of co-creation.

However, interviewees suggest that this should not matter. The former President of ENoLL, who is heavily involved in the European discussion regarding living labs, stresses the harmfulness in continuing the discussion surrounding what constitutes a living lab (J. Eskelinen, personal communication, August 11, 2015). He finds this discussion counterproductive to the ongoing work of living labs in Europe. He feels that living labs, while it is important to hold them accountable, need to be concerned with the business of creating solutions instead of engaging in theoretical debates regarding their worthiness as interventions in cities.

Perhaps most interesting, few living labs seem to directly communicate their work as working towards sustainability or low carbon futures. Yet, energy efficiency and smart city solutions often lead to decarbonisation. However, these strategies also lead to cost savings and employment opportunities. Less than 10% of living labs through the online literature analysis and 25% of living labs through the survey were found to be communicating their projects as reducing greenhouse gas emissions for low carbon futures. This suggests that other factors, outside of sustainability, may be motivating living labs to engage in these areas. Given the dominant nature of the European Commission in highlighting, promoting and funding living labs, the strong commitment to increased innovation, competitiveness and employment may be stronger drivers than that of sustainability.

6.2 Living Labs – Profit

In examining *profit*, Elkington (1997) highlights the various types of capital to consider when looking at the triple bottom line. Of course, the two main forms of capital are thought of as physical capital (infrastructure and equipment) and financial capital (monetary assets) (Elkington, 1997, p. 74). Two other forms of capital are often considered when assessing the *profit* of an organisation and their activities: human capital (employee's collective experience, skills and competencies) and intellectual capital (patents, processes, internal competencies) (Elkington, 1997, p. 74). However, when one starts to think with a triple bottom line perspective, natural capital and social capital, which contribute to *planet* and *people*, also play a role (Elkington, 1997). The importance of economic sustainability and wealth creation in achieving the triple bottom line is often overlooked (Elkington, 1997). That is to say, *planet* and *people* are important but without a viable business model, no effort to achieve the triple bottom line is possible.

With this in the background, we can begin to address questions surrounding living labs with regards to their economic viability as a long-term intervention in cities. In particular, we can discuss who is funding living labs, how they are funded, why they are being funded, how their success is measured and what happens when the funding period ends. Answers to these questions will form the answer to the second research question:

RQ2: How does the current funding regime support living labs?

In order to address this research question, it was important to understand the formal funding landscape throughout the EU. The European Commission has long since funded research and innovation within Member States and projects that support regional and Union level development. Over the years, the funding mechanisms have changed to support the

formulated research strategy as it relates to the changing overall strategic strategy of the European Commission (K. Björnberg, personal communication, August 19, 2015). The EU 7th Framework Programme for Research (FP7) and Horizon 2020 are among the most recent funding programmes operating in Europe to fund research and innovation. The FP7 ran from 2007 to 2013, providing more than EUR €50 billion in support over those seven years (European Communities, 2007). Projects like *Business Model Innovation for Living Labs* (BUMILLA) and *ICT in Low Resource Settings: Innovating for Africa and Europe through Living Labs* (LRIT4EA) were among the projects funded under the FP7.

Horizon 2020 is the largest financial support package ever geared towards EU research and innovation with nearly EUR €80 billion set aside for funding of projects between 2014 and 2020 (European Commission, n.d.-c). Horizon 2020 is an initiative of Europe 2020 – EU's growth strategy for the coming decade – that, once again, stresses the importance of increased global competitiveness (European Commission, n.d.-c). This is also in line with the Lisbon Strategy and the Helsinki Manifesto, which set the stage for living labs as previously discussed in Chapter 3.

One such mechanism supported by the Horizon 2020 Research and Innovation Programme is the European Research Area (ERA), a concept that sees the European Union as an open space promoting knowledge and growth (European Commission, n.d.-b). The ERA sees partnerships as essential in fulfilling their research and innovation objectives, bringing together the Commission, Member States, and research organisations (European Commission, n.d.-b). One such mechanism is Joint Programming: seen as a process "to pool national research efforts in order to make better use of Europe's precious public R&D resources and to tackle common European challenges more effectively in a few key areas" (European Commission, n.d.-b). Thus far, there are ten Joint Programming Initiatives (JPIs) ranging from JPI Neurodegenerative Disease Research to JPI Water. However, two JPIs deal with sustainability transformations in cities: JPI Climate and JPI Urban Europe.

The aim of JPI Urban Europe is " …to create attractive, sustainable and economically viable urban areas, in which European citizens, communities and their surroundings can thrive" (JPI Urban Europe, n.d.). Recall, the GUST project is funded through JPI Urban Europe. JPI Urban Europe, an open consortia of national funding agencies, seeks to coordinate research to make better use of public funds that support research and innovation that transform urban centres, improve transport and logistics systems, improve social cohesion and integration while reducing ecological footprint of the city (JPI Urban Europe, n.d.; J. Bylund, personal communication, June 19, 2015). Currently, fifteen committed Member States, their subsequent national funding agencies and other committed funding bodies coordinate to meet national and European strategy goals for research and innovation in cities (J. Bylund, personal communication, October 8, 2015).

This overview illustrates there is a variety of actors that provide support and funding to living labs. These actors range from the European Commission, to regional support and JPIs, to national governments. Municipalities and industry are also funding living labs that relate to their strategic research and innovation strategies. To say one actor dominates in the funding of living labs would be untrue. Of those living labs surveyed, local governments, national governments and the European Commission equally finance living labs.

Of course, it is clear that the European Commission is working with a significantly larger budget; however, their strategic focuses varies widely with a strong focus on academic partnerships and collaboration in research, as opposed to platforms such as living labs. This focus on research may be due to the evaluators chosen who are responsible for reading

through the proposals for funding; the evaluators largely come from a scientific and research-driven perspective (J. Bylund, personal communication, June 19, 2015; K. Björnberg, personal communication, August 19, 2015). Further, some funding agencies (ex. Formas in Sweden) are restricted within their mandate to fund industry or municipality ventures without some level of co-financing among them (K. Björnberg, personal communication, August 19, 2015). However, this expectation of co-financing may be a deterrent to industry or municipal involvement in the funding of living labs due to the increasing budget crisis and devolution of the municipality in Europe (Childers et al., 2014).

As discussed in Chapter 3, living labs for sustainability are called many different things. The individuals interviewed representing the various funding agencies agreed that, despite the lack of clarity in describing the term living lab, the projects are assessed on the basis of their merit: what the project sets out to do and how they see to do it. However, in discussion with those practitioners applying for funding and through the survey, many discuss living labs as a buzzword that helps in the selection of projects for funding. This is supported by literature, too; with extreme interest in living labs as a vehicle for sustainable transformation in cities, more and more proposals for funding are including the living lab methodology despite limited user-engagement (Veeckman & van der Graaf, 2015). Despite this, Jarmo Eskelinen from ENoLL says that living labs are way past being a buzzword and he sees living labs as a strong and rising trend in smart city development that is likely to continue (personal communication, August 11, 2015).

Why do funding agencies support living labs? If you ask the funding agencies, these answers vary. Of course, they see living labs as one tool that allows them to meet their mandates of improved social and environmental status along with prioritising competiveness, innovation and employment (European Commission, n.d.-c; European Communities, 2007; JPI Urban Europe, n.d.; Vinnova, n.d.). However, at this point, there is no consensus as to if, in fact, living labs are capable of creating tangible impacts that improve and enhance cities (K. Björnberg, personal communication, August 19, 2015). For the time being, funding agencies see living labs as an opportunity to test various tools to help lead towards a sustainable future, realising that no one strategy is the silver bullet but a plethora of tools are needed.

Living labs were also asked in the online survey of their views of why funding agencies support their efforts. Living labs mentioned more frequently the promise of open innovation, social innovation and bottom-up innovation as drivers for why they saw their projects being funded. Some also pointed out the importance of having need-based, demand-driven products, services and processes as opposed to supply-driven solutions to sustainability.

Interestingly enough, one interviewee representing a funding agency reflected on the discussions among those involved in developing the strategic vision for JPI Urban Europe. This person said the group as a whole saw urban living labs as an *undeveloped* tool to be employed in cities; however, they recognise the concept needs further crafting and understanding before any conclusions can be made on their transformative potential for sustainability in cities.

Along the same lines, when asked how living labs are evaluated, all interviewees referenced their standard project evaluation criteria for assessing the outcomes of a funded project. Living labs reported through the survey that they were often required to provide annual reports, work packages, publications, attending conferences and meetings along with engaging within the community. Many funding agencies said it was too soon to draw conclusions on the success of funding living labs. In part, each funding agency has too few projects labelled a living lab to draw any conclusions yet. Moreover, there seems to be little coordination among funding

partners as to sharing of success stories. With no common pool of projects, it is difficult to assess the success and effectiveness of living labs and the funding provided. This may be an area in which ENoLL can facilitate given their access and proximity to the issue.

Funding through JPI Urban Europe and others typically look to fund *projects* for three years (J. Bylund, personal communication, June 19, 2015; K. Björnberg, personal communication, August 19, 2015). Of course, this means that those living labs seeking traditional funding will see an end to their funding unless they continue to reapply for funding or develop a self-sustaining model (J. Eskelinen, personal communication, August 11, 2015). All interviewees were asked about the rigidity of the funding regime in supporting projects for a limited time as opposed to supporting the platform or processes that initiate projects. While funding partners see the problem of a limited source of funds for living labs focused on projects, there was no consensus on how to solve the problem.

On the other side of the coin, living labs report the constant struggle to gain access to funding. Once again, Eskelinen suggests that the current funding regimes do not well serve innovators and SMEs (personal communication, August 11, 2015). He suggests that the large European and National calls are for funding geared towards those organisations with the capacity and existing knowledge to navigate the maze of bureaucracy surrounding the current funding regime. In other words, the funding support does not allow for the quick and agile processes that living labs often employ through their activities.

More than half of surveyed living labs reported problems with finding funding. Many others saw their living lab coming to an end when their funding concluded after only three or four years. Living labs reported funding as a "constant struggle" that leads to the "inability to invest resources quickly". One living lab concluded that "direct regional funding for [their] living lab has stopped" forcing them to seek alternative ways of self-financing. To conclude, while substantial financial resources exist within and throughout Europe, the mechanisms of support do not best suit living labs and their activities in promoting sustainable transformations in cities. Further discussion on how to improve this process is included in Chapter 7.2.

6.3 Living Labs – People

For years, *people* have formed the basis of sustainable development. The report, *Our Common Future* (1987) by the World Commission on Environment and Development, stressed quite clearly and defiantly that equity, in particular inter-generational equity, is a cornerstone to sustainable development. Later, this foundation was built upon in triple bottom line.

Elkington (1997) stresses the importance of progress with regard to the social bottom line in determining the success of sustainable development. Therefore, there is a need to consider social capital as it relates to the overall societal and environmental health and wealth. Frances Fukuyama (1995, p. 10), in his book *Trust: The Social Virtues and the Creation of Prosperity,* described social capital as a measure of "the ability of people to work together for common purposes in groups or organisations." In so many words, living labs are a means in which to grow social capital through the successful implementation of projects with a multi-stakeholder approach.

Building on the concept of living labs as a platform centred on end-user engagement, they live up to the characterisation of Public-Private-People Partnerships. Yet, more is needed to understand the inclusive nature of living labs and their transformative potential in the communities in which they are embedded. This section seeks to characterise those

communities in which living labs are embedded in order to understand who is engaged and who is benefiting from living lab activities.

RQ3: To what extent do social equity issues arise in the implementation of living labs?

The ranging terms and definitions used to describe living lab-esque interventions in cities – presented in Chapter 3 – share few things in common: primarily, the focus on human-centric innovation. This human-centred research and development approach seeks to bring end-users into the fold of innovation (Lepik et al., 2010). However, living labs for sustainability tend to focus on processes, products and services that serve the greater community, as demonstrated in Chapter 6.1. Evans and Karvonen (2011) describe living labs as highly visible interventions due to there "purported ability to inspire rapid social and technical transformations" in society as a way to generate more useful knowledge. For example, living labs with projects that focus on energy efficiency and smart city solutions often seek to engage all relevant citizens in a community to realise benefits of dematerialisation and ICT. To contrast living labs for sustainability with living labs of other focuses (i.e. elderly care, tourism), one would expect a living lab for sustainability, which sees benefits for the whole community, to be more inclusive than a living lab geared toward particular industries and actors in the community.

Living labs for sustainability engage in many different participatory engagement techniques, as found in Chapter 6.1, that mirror the public participation techniques used in decision-making processes discussed in Chapter 2.2. Like public participation in decision-making, literature had suggested there were issues of social equity included in the implementation of living labs (Evans & Karvonen, 2014; Mensink et al., 2010; Veeckman & van der Graaf, 2015).

This thesis sought to investigate those communities involved in and benefiting from living labs for sustainability. Two assumptions, as discussed in Chapter 4.4, steered this portion of research: first, the use of GIS as a method of analysis assumes that the community involved in and benefiting from a living lab is located within close physical proximity; secondly, that the end-users making up the community tend not to travel great distances to be involved. These assumptions are justified as Mensink et al. (2010) suggest that the cost of users' time in engaging with living labs often exceeds the benefits in which they receive by being involved; further, work by Tsou et al. (2005) discusses the service and impact range of facilities in cities as being as little as one kilometre, depending on context. This justifies the approach in using GIS to investigate the communities in which living labs for sustainability are embedded.

In looking at eighteen living labs for sustainability in the Netherlands and the United Kingdom that were analysed using available demographic data, the surrounding communities tended to be more deprived than the 'average' community in both countries. Only two living labs, both in the United Kingdom, were embedded in communities that were better off, based on the chosen indicators, than the average community. In the Netherlands, the communities surrounding the investigated living labs, defined as those living within two kilometres of the living lab, had significantly higher proportions of the population with low-income earners and were more densely populated than the average community in the Netherlands.

Using this approach alone, in line with the assumptions previously discussed, suggests that the living labs are seeking to address sustainability issues impacting low-income and disadvantaged communities due to their physical embeddedness in these communities. However, the information gleaned from the GIS analysis was triangulated with the data gathered in the survey. In doing so, it is clear, that despite living labs being embedded in disadvantaged communities, they do not equally engage all end-users within the community.

Living labs reported engaging highly educated individuals with a lack of diversity. Those involved are more often male, the average age reported to be roughly 36 years old. Living labs, in discussing their participatory methods, did not actively seek to engage with a wide variety of individuals, many electing to engage in smaller, select groups over co-creation workshops, etc. Living labs discussed the difficulty in engaging with end-users; 66.7% of respondents suggested it was difficult to do so. They report it is time consuming and difficult to find the right points of access to the community, in part, because it is difficult to motivate and integrate into the community.

Therefore, while living labs for sustainability seem to be embedded in disadvantaged communities, in practice, they are unable to engage a diverse subsection of the communities in which they seek to serve. As a result, social equity issues arise in whose knowledge is being included in the co-creation of solutions for sustainability. If disadvantaged communities are not included in the dialogue and the creation of solutions, their needs and knowledge may not be included in the outcomes of living labs. This is particularly salient since disadvantaged communities, low income families and communities of colour are more likely to be affected by the impacts of climate change (Bulkeley & Castán Broto, 2013).

Finally, one respondent to the survey stated, "there is still a need to open up the living lab concept to a more socially-oriented perspective."

7 Reflections

This thesis was ambitious; it sought to answer a variety of interesting questions with the use of different methodologies. In doing so, there are a host of reflections on the methods used in supporting this research. But first, given the answers to the posed research questions, I can make recommendations with regard to improving the living lab approach, both from the perspective of social equity and funding.

7.1 Emergence of People as Driver of Innovation

Urbanisation and the impacts of climate change threaten the fabric of the city. By 2050, 80% of the population of Europe will be living in cities (European Commission, 2013). With increasing mega-cities and urban centres, challenges include transport, energy, food security, air pollution, water scarcity, etc. *Our Common Future* (1987, p. 44) discusses at length social equity and "the common interest" stating that "…many problems of resource depletion and environmental stress arise from disparities in economic and political power." Addressing these issues of social equity among people promises to aid in transforming cities towards sustainability.

Years later, the concept of open innovation and open social innovation, as discussed in Chapter 2.5, emerged as a perspective which integrates social equity, technological and social innovation, and user-driven, needs-based solutions that can be leveraged for sustainability transitions in cities.

Stuart Hart, former Director of the Corporate Environmental Management Program at the University of Michigan introduced an intriguing paradox: the social and political problems that face our society due to environmental degradation and climate change exceed the mandate and responsibility of any corporation to greatly impact or interfere (Elkington, 1997). However, it is these corporations that are poised to be the only organisations with the right set of resources, technology and global reach to allow them to adapt quickly to achieve sustainability (Elkington, 1997). In part, this is due to corporations' ability to quickly adapt and integrate new solutions, motivated by cost efficiency. Similarly, Westley et al. (2011) sees commercial actors as holding the capacity in which to innovate and drive technological and sustainable change; however, the public sector is a necessary and crucial actor in fostering innovation for sustainability through policy and programmes (Westley et al., 2011).

With the emergence of public-private-people partnerships in the form of living labs, the mandate for the government and the ability of companies to achieve sustainability can be integrated. While living labs are characterised as a quadruple helix – a public-private-people partnership – often, living labs are initiated with one stakeholder wielding power over strategic direction of the lab. Living labs for sustainability with a focus on ICT tend to be perpetuated by commercial actors while those living labs initiated by public actors tend to focus on public good over economic value (Veeckman & van der Graaf, 2015). For example, living labs for sustainability may also address poverty, human rights, social justice and well-being (Westley et al., 2011).

In reflecting on the work of this thesis, the promise and prominence of public-private-people partnerships can be aligned closely with the triple bottom line of *people*, *planet* and *profit*. By integrating the triple bottom line perspective in the mandate of public-private-people partnerships, the benefits of collaboration and open innovation can be expanded to consider financial, environmental and social indicators (Figure 7-1). In looking at these two concepts, *people* overlap warranting further discussion on the importance of people in user-driven, open innovation, in particular, through living labs.

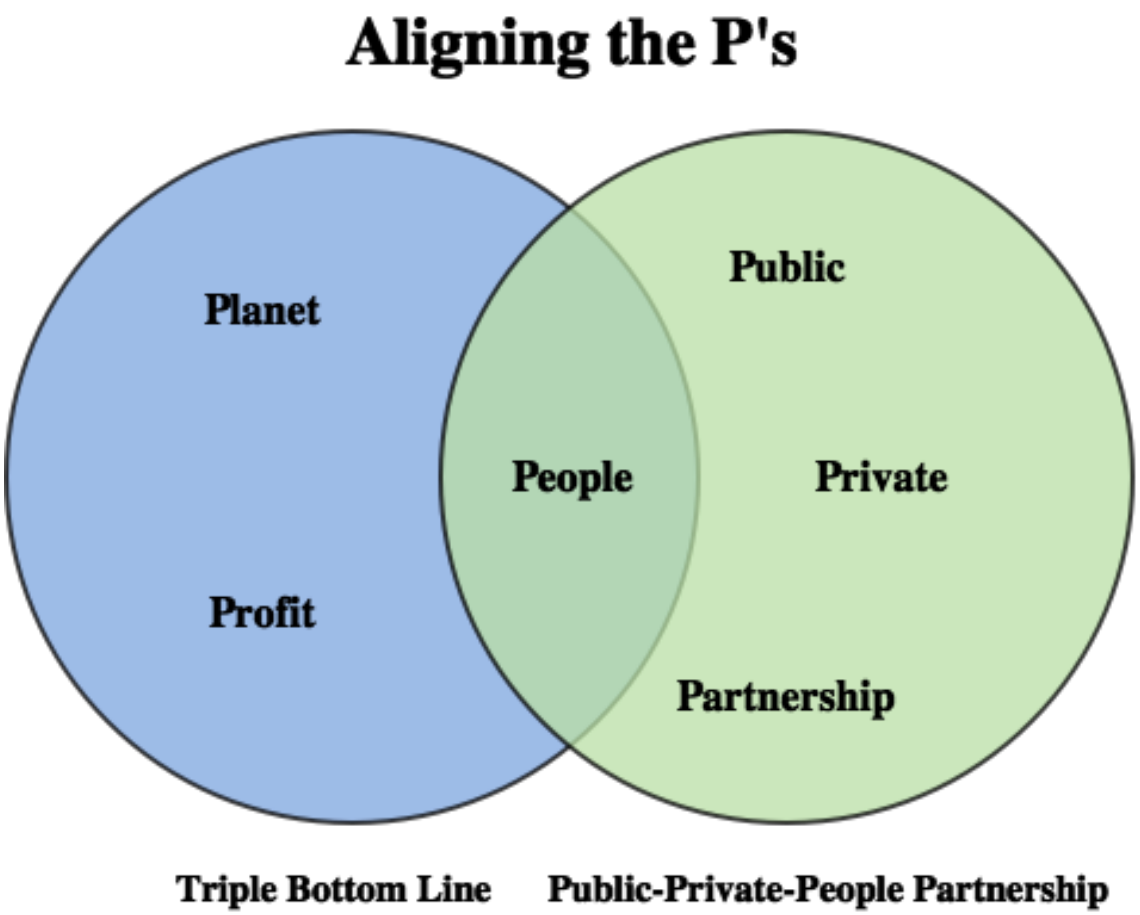


Figure 7-1. Integrating the Triple Bottom Line and Public-Private-People Partnerships

Harkening back to the quote from *Our Common Future* at the beginning of this section, the focus on people and social equity issues may lead to improvements in resource use, environmental degradation and sustainability. Therefore, it is suggested that people should be the focus of public-private-people partnerships and the triple bottom line perspective. For the purpose of this discussion, and drawing on literature presented in Chapter 2, living labs that elevate the status of end-users and people can be a vehicle for innovation and sustainability, improving knowledge integration, utilising social learning theory that can reduce the knowledge-action gap and lead to sustainability transformation in cities.

Improved knowledge integration processes employed by living labs may have the ability to impact and overcome the knowledge-action gap. While we often think of innovation as progress, we do not fully understand the environmental impacts of our continued innovation (Westley et al., 2011). However, we do increasingly know the impacts of continued use of fossil fuels, overuse of water in industrial agricultural production, unsustainable resource use driven by consumer behaviour, etc. If science and logic dictate change, that sustainability is important, and we as a society know this to be the case, then why don't we make the necessary changes? This is what is referred to as the knowledge-action gap (Meimeth & Robertson, 2012).

Living labs for sustainability focus on co-creation processes that allow end-users to analyse, evaluate and create solutions. These processes inherent within the methodology see engaged individuals contributing to improving cities while also providing the opportunity of living lab practitioners to teach and educate end-users. These processes relate to the cognitive

dimension of knowledge and allow for greater and more complete processes of understanding and knowledge integration, as discussed in Chapter 2.3. Further, living labs can be seen as platforms that promote social learning, allowing for end-users to observe and adopt behaviours and practices developed in living labs.

Westley et al. (2011, p. 776) states that "[n]ew forms of knowledge integration and generation that support planetary stewardship are required, capable of integrating a much richer diversity of ideas and viewpoints and of bringing action and research into closer proximity". Living labs may just be one of these new forms of knowledge integration, bringing actors from academia, municipalities and industry together to generate action. While new forms of knowledge integration that focus on sustainability are important, people must be motivated and willing to take part in these processes. Ultimately, to transition cities towards sustainability, knowledge of the risks of doing nothing is a prerequisite for change (Shiroyama et al., 2012).

With the potential of living labs to not only generate solutions but also improve and integrate end-user knowledge regarding sustainability, it is increasingly important that all *people* are included in the development and deployment of living labs. However, Veeckman & van der Graaf (2015) found that citizens who lacked formal education or technological and computer programming skills were excluded from the process. They explain that cities and research institutions, those actors involved in living labs for public good, need to target their user recruitment methodologies to optimise citizen engagement (Veeckman & van der Graaf, 2015). Literature suggests that engaging citizens with diverse skillsets and backgrounds leads to sharing of perspectives, increased understanding amongst stakeholder groups and strengthened civic engagement (Childers et al., 2014; Mensink et al., 2010; Veeckman & van der Graaf, 2015).

However, it is important to understand that the context of the community and the people within are important in the development and deployment of solutions tested in living labs. Neighbourhoods develop based on culture, income, religion, etc. Therefore, it is important to consider that solutions tested and successful in some context may differ from another. Inter-city comparison of solutions is one means of testing to ensure scalability of sustainability solutions (Childers et al., 2014).

For these reasons, the concept of the territorial living lab is a growing concept of interest. As alluded to in Table 3-1 in Chapter 3, territorial living labs apply the living lab methodology to a territory and its citizens for the purpose of regional development. For example, Alcotra Innovation, funded by the Alcotra Italy-France 2007-2013 territorial cross-border cooperation program in cooperation with the European Commission, looks to build cross-border collaboration and capacity building through the development of territorial living labs (The Alcotra Innovation Consortium, 2013). Known as the LEADERS approach, this process promotes a bottom-up development and has been implemented in many contexts in France, Italy and Spain (The Alcotra Innovation Consortium, 2013).

With much focus on regional development, sustainability transitions and the use of ICT in smart city solutions, it is important to bring it back to people and human capacity. Living labs are only as successful as the team that integrate and engage with the community. Therefore, institutional memory is important in the development of living labs. For example, a respondent to the survey stated they were unable to answer a variety of questions because their predecessor had been the one involved in the set-up and funding of the living lab. However, the experience of this individual had left the living lab leaving the respondent lacking this perspective. This impacts the viability of the living lab including continued funding and trust building capacity in the community. Therefore, there is a need to focus not only on

the engagement of people in the community but also to take care of the people responsible for the successful implementation of the living lab.

Lastly, while we argue people are important for continued innovation for sustainability, living labs need to have strategies to overcome the challenges associated with engaging all people, not just those with high income or education who are motivated to be involved. For example, self-interest is seen as a strong motivation for public involvement, especially within the realm of environmental activism (Campbell & Marshall, 2000). Further, as discussed in Chapter 2.2, co-opting of a venue for public participation similar to a living lab has the possibility of stifling innovation and supressing minority or silent majority groups. This was the case in the Corridor Manchester living lab elaborated on in Chapter 3.4.1. Recall, the Corridor Manchester Partnership brought together local universities, local government and industry. However, the project saw this partnership reinforce the divide between the "knowledge community" and the surrounding community (Evans & Karvonen, 2014). Further work in understanding the effectiveness of engagement strategies is needed in order to offer recommendations to avoid such pitfalls of public participation and collaborative innovation.

7.2 The Funding Battle: Project vs. Process

The European Commission has taken an active stance on the necessity of supporting and funding living labs. The Commission has published a position paper encouraging the national funding agencies and others to fund living labs (European Commission, 2014a). Further, the Commission shows commitment to the living lab methodology in that they financially supports the European Network of Living Labs (Jarmo Eskelinen, personal communication, August 11, 2015). Further, FP7 and Horizon 2020 have provided many millions of Euros to living lab initiatives. The Joint Programming Initiatives continue to focus on the transformative potential of urban living labs with JPI Urban Europe funding six projects out of twenty looking at living labs in their first two open calls (Jonas Bylund, personal communication, June 19, 2015). Further, within the last months, the European Commission has pledged EUR €80 million for climate services and living labs in cities through 2016 (Rob Swart, personal communication, May 12, 2015).

However, this research concludes that the current funding regime does not adequately support living labs for sustainability. This section seeks to make the case for an improved funding regime that supports processes and platforms for innovation and transformation towards sustainability over the traditional funding of projects. Further, two different funding scenarios are presented as potential improvements for the funding of living labs.

7.2.1 Making the Case

Obviously, there is a growing need for new innovations of products and processes that support and foster sustainability. The technosphere runs and operates on different wavelengths from that of the biosphere (Westley et al., 2011). Commoner (1992) in his book *Making Peace with the Planet* outlines the differences between the technosphere and the biosphere. Among them, Commoner highlights the cyclical nature of the biosphere and its ecological processes in contrast to the linear pathways present within the technosphere. Moreover, the biosphere is fundamentally interdependent representing a dynamic equilibrium while the technosphere's orientation towards growth and profit often discounts or does not consider the implications of an innovation on the market (Commoner, 1992). Therefore, the differing characteristics between the biosphere and technosphere contribute to the malalignment between governance structures in cities and the ecosystems they exist within (Westley et al., 2011).

While this is the case, living labs represent a genuine effort to address society's growing issues. The innovation paradox – innovation is the cause of unsustainability and the solution for sustainability – can be overcome through the development of these innovative demonstration projects. In part, in reference to Commoner's supposition regarding the technosphere, this is because living labs have an opportunity to develop in a way that is more representative of the cyclical and connected nature of the biosphere through processes iteration and adaptation.

However, while living labs organise in a more interconnected manner with often-complex community engagement strategies that build upon each other, their funding counterparts do not operate in a way conducive to support their work. Funding agencies work within the linear design of the technosphere funding initiatives to perform a task or project, which culminates in a particular outcome at some end-date.

While this strategy leads to innovations, the European Commission recognises that research and innovation funding currently does not lead to commercialisation and integration of products and processes that improve the quality of life for those living in cities (European Commission, 2014a). Living labs have the potential to upscale innovations and processes for sustainability in a way that traditional projects and outcomes do not.

Currently, living labs are funded primarily as projects. This funding typically lasts three to five years, as stated in the survey and among interviewees. However, living labs operate more as platforms that employ processes of user engagement and co-creation. This process "needs a lot of trust from end-users," which takes time to build. This trust and integration within a community is essential in the success of a living lab and their activities. However, the short-term funding cycle does not allow for living labs to develop trust. As discussed in Chapter 2.2, effective public participation requires relationship building, trust and commitment to the community. Therefore, there is a need to improve the current funding regime to support the funding of living labs for sustainability.

Two scenarios are presented in the following sections: improving funding of process and platforms and open and agile funding mechanisms.

7.2.2 Improving Funding of Processes and Platforms

A respondent to the survey concludes that there are "[n]ot many external financial partners willing to fund a platform. They want to fund projects, but not the vehicle of a LAB itself." All funding partners interviewed agreed, there was a focus on funding projects over processes or platforms. However, funding agencies have great responsibility to manage public funds in an appropriate manner, leading them to be risk adverse to try new avenues or mechanisms for funding (Jarmo Eskelinen, personal communication, August 11, 2015).

An improved funding programme would see any one or more of the following:

- Funding agencies able to offer long-term funding of ten years or more
- Conditional funding recurring overtime should the platform meet continued annual targets
- Co-financing obligations that encourage and incentivise industry and municipalities to partially support platforms
- Ideally, seek to support living labs to develop self-sustaining business models that can be continued without additional need for support
- Allow for more quick and agile processes for funding of living labs

If a funding partner were able to offer funding to a platform, such as a living lab, that supports continued innovation for sustainability over a long period of time, this would alleviate the burden of continually needing to establish and re-establish community networks of trust inherent with the funding of short-term projects. This allows for the living lab to establish meaningful trust and provide a long-term commitment to the community. Further, living labs responded to the survey discussing the uncertainty of continued funding and the administrative burden of applying for funding. A long-term solution would allow for living labs to focus on the activities they do best without the uncertainty and time devoted to finding funding.

If a long-term funding commitment is untenable, the introduction of a conditional funding mechanism may be suitable. Such a funding mechanism would offer funding if, and only if, the platform continues to meet previously agreed upon outcomes on an annual or sub-annual basis. This type of mechanism allows for the long-term funding of a living lab, ensuring the platform is meeting the motivations of the funding agency and verifying no misuse of public funds. Both of these long-term, conditional funding models may be better suited to actors who have previously operated or are currently operating a living lab / platform who have an existing track record of success (A. Alvsilver, personal communication, August 27, 2015).

Many open calls for funding may require some percentage of co-financing from industry or municipalities. For example, Formas, the Swedish Research Council, often requires an external actor to provide upwards of 25-50% co-financing in order to receive a grant (K. Björnberg, personal communication, August 19, 2015). This type of financing institutionalises public-private-people partnerships by requiring a diverse group of stakeholders to come together to generate solutions for sustainability. This model, while seemingly in practice by many living labs, is not communicated in a positive light and the benefits of such a model are not realised. Co-financing may discourage some actors from taking part in worthy innovation for sustainability. Yet, funding agencies see this as an indicator to assess the feasibility of some projects; if no or few actors are willing to invest resources, the project may not be viable (K. Björnberg, personal communication, August 19, 2015). Therefore, it is important for funding agencies to encourage and incentivise industry and cities to take part in co-financing schemes. This includes highlighting potential benefits in co-financing, negotiating shared-ownership of innovations and facilitating knowledge sharing between stakeholders. While this may be left to the platform themselves to negotiate, the centralisation of experience and best practices with the funding agency makes them a valuable stakeholder in supporting sustainable business models for living labs.

Ideally, living labs can gain the financial support needed early in their development process in order to implement self-sustaining business models and become financially independent. Forum Virium Helsinki is an example of a self-sustaining initiative that employs the living lab methodology. By matching the needs of the communities with the city and industry services available, the platform is able to, through living labs, create solutions that enable ICT in cities (J. Eskelinen, personal communication, August 11, 2015). Funding agencies, with the hope of seeing their funded platforms succeed, once again, can serve as a centralised receptacle of best practices that allow new initiatives to become self-sustaining.

The former President of ENoLL sees the need for funding agencies to be more supportive of innovators and SMEs that require quick access to funding (J. Eskelinen, personal communication, August 11, 2015). This implies that funding agencies need to have more open calls and a greater variety of funding mechanisms that meet the needs of practitioners through quick and agile processes. As reported by survey respondents and interviewees, living labs cannot afford to wait long periods of time to access funding, especially in a real-life

environment that changes quickly. Therefore, it is argued that the funding regime needs to support quick and agile funding mechanisms.

However, funding agencies see this as being difficult to implement. While Vinnova and others have funding mechanisms devoted to SMEs enabling quick access to cash, they are limited to offering open calls only a few times a year (R. Engström, personal communication, August 21, 2015). This requires great coordination with the necessary stakeholders who organise, market and evaluate the calls for funding. Further, because the calls are so broad, enabling a variety of disciplines and sectors to engage in the call, it is difficult to find evaluators with a similarly diverse background with enough knowledge to assess proposals in a timely manner. Therefore, a further solution would see a funding agency providing a sizeable endowment to an organisation established specifically to create open calls and assess proposals within a particular strategic agenda. This serves as the basis for the next scenario.

7.2.3 Open and Agile

A variety of projects in Horizon 2020 and FP7 served as an open and agile platform that initiated their own open calls for innovation in cities. For example, SmartSantander ran from September 2009 until November 2011 with EUR €6 million provided by the FP7. The aim of the platform was to create a "world city-scale experimental research facility" employing over 20,000 sensors throughout test-cities in Europe to leverage ICT to improve the future connectedness of cities including products and services (European Commission, 2014b). The project also had two open calls "to be used by researchers from outside the project and involvement of various types of users to develop new applications" (European Commission, 2014b). Each call was open for one month with assessment, evaluation, selection and fund dispersal concluded within the next month (SmartSantander, n.d.). The maximum funding was EUR €100,000 with eight projects being funded through these open calls.

This example illustrates a potential solution to the current lack of proper support for living labs provided by funding partners. By providing a large endowment to an entity or organisation similar to SmartSantander, this allows for more open and agile funding of living labs. In particular, this lowers the threshold of experience in writing proposals and navigating funding regimes needed to access funding for innovators and SMEs (J. Eskelinen, personal communication, August 11, 2015). Further, this reduces the burden on the funding agency to find appropriate evaluators; the small project, typically working in a specific and specialised field, has the expertise and network available to adequately assess the viability and potential for success of these projects. Ultimately, this leads to quicker funding that better serves living labs while potentially increasing the likelihood of successfully funded projects.

7.3 Reflections on Methodology

This thesis sought to answer three questions that aligned with the triple bottom line. These questions focused on identifying and understanding living labs for sustainability, exploring how the funding regime supports living labs and evaluating whether social equity issues persist within living labs. The thesis was supported by four research methods: literature analysis, survey, interviews and GIS analysis.

Literature analysis looked at those living labs included in the ENoLL database and those identified by the GUST project. This scope limited the study of living labs for sustainability to those only contained within these realms. For the purpose of this study, to begin to address the plethora of unanswered research questions surrounding living labs, this scope is adequate. However, for further and more long-term analysis, a more complete database of living lab initiatives is needed. ENoLL consists of those living labs willing to pay annual dues and the

GUST project relied on the team of researchers' personal experience within their host country to identify living labs. The survey revealed that 25% of respondents say their living lab has not always been framed as such; further, some still do not use the phrase despite meeting the academic and practical definition. Therefore, any further attempts to identify and locate living labs for sustainability will require a much more thorough and intensive process of engaging and interviewing experts on the ground in countries and cities throughout Europe to properly identify potential living labs for sustainability.

The interviews conducted were enlightening and useful for the purposes of this thesis. However, efforts to speak with more individuals representing funding agencies were made in hopes of getting a more varied cultural and geographical perspective. In total, nineteen individuals were contacted from fifteen different funding agencies throughout Europe. There was a lack of availability and enthusiasm to help in this research. Many replied stating they were unavailable due to their holiday plans. Others were apprehensive due to their perceived poor English skills or lack of knowledge regarding funding of innovation in cities. Meanwhile, many others declined to be interviewed or did not respond to interview requests. While there were legitimate reasons for unavailability, I would also conclude that, given the previous correspondence with funding agencies, there was a general lack of transparency and forthcomingness of information.

The survey gathered some valuable qualitative data to be used in this research. However, there was a generally low response-rate of 13.7% that should make the reader cautious in generalising statistics and percentages presented as true of the whole population of living labs. In reflecting on the low response rate, many possible explanations abound. In part, the survey may have been too long or did not accurately pertain to the activities of living labs. Moreover, there may have been an inability among survey respondents to answer the survey in a way that reflected the meaning they would use in their native languages due to limited vocabulary. Despite this, the qualitative data gleaned from the survey proved extremely valuable in answering the posed research questions, as there was no effort to generalise the population of living labs.

A living lab practitioner reached out to researchers to say he was unable to access the survey via the link provided. After consultation with the survey tool, numerous tests and surveys already submitted, it appeared that this was a localised problem. However, it is unclear if and how many other respondents were affected by similar issues, which would have reduced the number of people able to complete the survey. The survey tool used is offered by Lund University called the Artologik Survey & Report software. There was or is no reason to suspect a wide-scale problem relating to accessibility.

The nature of the survey administered to the living labs – large number of open-ended questions in a structured format – qualifies as an online interview (Flick, 2006, p. 256). Online interviewing is a growing methodology in the social sciences allowing for increased anonymity and a decline in demand on the time of interviewees (Flick, 2006). However, this approach is limited to only those willing to participate in such a manner (Flick, 2006) as found in this research. Regardless, the tool is a useful qualitative method that provided important insights into living labs for sustainability used throughout this thesis.

This analysis marks the first known attempt to leverage GIS in community-based research of living labs. This, in itself, is a large contribution to the field, along with the pertinent results showing living labs are embedded within disadvantaged communities; yet, they may not be engaging with these communities. While this attempt proved fruitful for the scale and ambition of this thesis, for further and more thorough investigation, more detailed and

complete GIS data is needed. Further, as suggested by Omer (2005), high-resolution household-level data is needed in order to accurately assess social equity issues at a neighbourhood level. This analysis is not yet possible until further efforts to harmonise and standardise EU geospatial data are completed.

In viewing living labs and social equity through the lens of accessibility, physical proximity cannot be the only factor contributing to involvement of end-users in a living lab. While physical proximity was used in this approach, this does not fully capture the characteristics of the end-users in living labs. In particular, since living labs often operate with particular motivations, engaged users may travel greater distances to participate in causes they identify with. For example, community-based research that uses Euclidean distance without understanding the neighbourhood and city context ignores cultural boundaries that prevent those with close physical proximity from being involved in living labs (Omer, 2006). Further, the emergence of ad-hoc groups with strong motivations for social justice or environment is typical within communities (Omer, 2006) and may be engaged in living labs while being outside of the community. While it is important to keep this in mind when conducting community-based research, this is more applicable to city-specific research as opposed to widespread analysis as conducted in this study.

7.4 Further Research

This section discussing further research could be endless. Literature alludes to a multitude of unanswered and unknown questions pertaining to living labs. However, to begin, the analysis and recommendations included here provide a good starting point for further research.

While living labs for sustainability tend to focus on energy efficiency and smart city solutions, the impact of these interventions is unknown. Perhaps living labs that focus on transport and mobility have seen more success and deserve greater attention due to their transformative potential. To underscore this, the effectiveness of experiments and activities performed by living labs is worth investigating. Since a variety of participatory methods are used, a set of best practices from successful living labs would help in the transferability of approaches, keeping in mind the varying contexts.

This thesis makes recommendations on how to better serve the funding of living labs to ensure that they do indeed realise their transformative potential. These recommendations require further analysis and investigation with a larger geographical and cultural perspective of funding agencies.

In this study, GIS is used to examine social and spatial equity of living labs already existing within cities. However, to ensure social and spatial equity, living lab practitioners can use GIS to identify the target neighbourhoods for their interventions. This approach was used in targeting neighbourhoods for community-based initiatives (see Table 3-1) in the Midwest of the United States (Huber et al., 2009). To improve community-based research of living labs, it is important to gain a better understanding of those individuals engaged in living labs. Further, more complete demographic data of populations in cities is needed.

The analysis contained here begins to answer more conceptual questions regarding the scalability and transferability of living labs as a mechanism for urban sustainability transitions. This is in line with the on-going work of the GUST project.

To conclude this section, it is important to include valuable reflections provided by interviewees on the state of research regarding living labs. Jarmo Eskelinen suggests that further research looks at a variety of social equity and ethical issues impacting living labs

(personal communication, August 11, 2015). In particular, he sees living labs continuing to use ICT equipment to engage and monitor end-users to help generate solutions. However, this raises ethical issues regarding a person's privacy, the role of surveillance and people's rights. I take this one step further to highlight the fact that people are engaged in co-creation and co-generation of innovations; yet, they do not see any of the financial returns associated with the innovation should the product or process become commercialised to a large degree.

Lastly, interviewees highlight the role of research in investigating living labs. All interviewees discussed the lag between research and innovation occurring in cities. In a fast-paced and evolving field of study, it makes sense that research would lag the quick and adaptive processes of living labs. Therefore, research needs to study what is happening from a theoretical point of view but avoid offering up new ideas and approaches as these are best tried and tested by practitioners (R. Engström, August 21, 2015). Further, some living labs discuss the feeling of being abused by researchers. Researchers have been characterised by having extreme interest in living labs and their activities. They extensively study the practices of living labs. However, living labs have expressed disappointment in not being included and better involved in the process after observation. Therefore, it is beneficial for researchers to follow-up with the living lab under investigation to continue the dialogue.

8 Conclusions

The concept of innovation is paradoxical in so far as that it is both a driver for our current unsustainable society and it is regarded as the necessity to transition to a new, more resilient and sustainable future. Living labs are seen as one mechanism that may contribute to urban sustainability transformations.

The purpose of this thesis was to contribute to the growing body of work describing living labs by investigating the environmental, economic and social factors contributing to the viability of living labs. To do this, three research questions were asked:

- How do living labs engage with sustainability?
- How does the current funding regime support living labs?
- To what extent do social equity issues arise in the implementation of living labs?

This thesis employed literature analysis, interviews, survey and GIS analysis as methods used to answer these posed research questions. The variety of methods was used to triangulate findings pertaining to funding and social equity issues in living labs.

Living labs for sustainability were found to focus on energy efficiency and smart city solutions. This focus makes sense considering the living lab methodology developed in response to the advancements made in the ICT sector. However, living labs engage in a wide-variety of sustainability aspects including transport, construction, low carbon futures, renewable energy, urban gardening, among others. Furthermore, living labs employ a wide-range of participatory methodologies to engage with end-users including co-creation workshops, interviews, surveys and emails.

Many actors support living exist at all levels of government from the European Commission to the municipal level along with industrial and private actors. However, the existing funding regime favours funding projects over processes or platforms. The funding of projects provides short-term support to living labs, yet, living labs require time to build substantial trust and relationships in order to optimally perform. Further, the funding of projects thus far has not fully capitalised in up-scaling innovation to meet the European Commission's and others' motivation for increased competiveness, improved employment opportunities and increased standard of living.

Lastly, GIS analysis of living labs within the Netherlands and the United Kingdom found that these living labs tended to be embedded in disadvantaged communities, those communities with low average household income, high population density and/or high levels of deprivation. This may suggest that living labs are including those disadvantaged communities most susceptible to climate change and urbanisation challenges. However, the survey of living labs and interviews revealed that this was not generally the case. While living labs are embedded in these communities, those engaged in the living labs are often higher income earners, highly educated, male and less ethnically diverse than their surrounding communities.

As a result of this research, Chapter 7 provided recommendations to living labs, funding agencies and researchers. Harnessing the living lab as a public-private-people partnership, this approach was integrated with the triple bottom line. This suggests that people are of utmost importance when implementing living labs for sustainability, drawing on open and social innovation theory. In part, living labs must rely on the input from all relevant people to co-create solutions that work best for those most impacted by environmental challenges. Further,

living labs employ processes that foster knowledge integration and social learning which can be used to overcome the knowledge-action gap.

Since funding agencies have been found to inadequately serve the needs of living labs, recommendations were made to improve the funding regime to support platforms and processes for innovation. In particular, this included long-term and conditional funding that allows living labs to build adequate trust without uncertainty and the administrative burden of reapplying for funding. Moreover, improved co-financing models and the funding agency serving as a receptacle for best practices of self-sustaining business models are suggested. Open and agile processes of funding are needed to meet the real-life nature of living labs that face uncertainty and require funding more quickly as challenges or projects arise. More small, localised or specialised calls can be implemented to enable for a more adaptive and quick funding response time. While this allows for more efficient allocation of funds in a targeted manner, it opens the door for potential corruption.

Lastly, this research begins to answer conceptual questions that help members of the research team associated with the GUST Project, among other academics, in assessing the transformative potential of living labs. More research is needed to address the effectiveness of living labs in spurring technological and social innovation for sustainability. Further, the impacts on governance of cities and best practices are needed to determine the transferability and interoperability of living labs within and among cities. However, researchers should ensure they keep living labs engaged in the research process so there does not become a point when living labs feel taken advantage of and refuse collaboration in future research.

Lastly, recommendations can be made to municipalities. These public actors may consider initiating living labs in order to improve their decision-making processes as living labs offer the ability to make contact with citizenry and to develop mutual trust and understanding. Further, municipal buy-in and community support is essential in the unravelling and integration of innovations from living labs for sustainability.

While living labs represent a pathway towards urban sustainability transformation, existing governance structures and regimes must possess the capacity to integrate and *maintain* sustainability initiatives in cities. Further, living labs only represent one tool to be used among a wide-range of methods to tackle the global and urban challenges we face as a society, in particular urbanisation and climate change. In fact, we need to test as many different ideas and solutions that may potentially trigger urban sustainability transformations. This research is only a starting point.

Bibliography

Amsterdam Smart City. (n.d.). City-zen. Retrieved August 20, 2015, from http://amsterdamsmartcity.com/projects/detail/id/78/slug/city-zen?lang=en

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., & Bloom, B. S. (2001). *A taxonomy for learning, teaching, and assessing : a revision of Bloom's taxonomy of educational objectives*. New York : Longman, cop. 2001.

Ballon, P., Pierson, J., & Delaere, S. (2005). Test and experimentation platforms for broadband innovation: Examining European practice. *Available at SSRN 1331557*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1331557

Bandura, A. (1977). Social Learning Theory.

Barthel, S., Folke, C., & Colding, J. (2010). Social–ecological memory in urban gardens—Retaining the capacity for management of ecosystem services. *Global Environmental Change*, *20*(2), 255–265. http://doi.org/10.1016/j.gloenvcha.2010.01.001

Bloom, B. S. (1956). *Taxonomy of educational objectives : the classification of educational goals*. New York : David McKay, cop. 1956.

Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change: *Government by experiment? Transactions of the Institute of British Geographers*, *38*(3), 361–375. http://doi.org/10.1111/j.1475-5661.2012.00535.x

Bush, I. G., Gillson, A., Hamilton, M., & Perrin, M. (2005). Public Participation - Drawing the Boundaries. *Water and Environment Journal*, *19*(3), 181–188. http://doi.org/10.1111/j.1747-6593.2005.tb01585.x

Campbell, H., & Marshall, R. (2000). Public Involvement and Planning: Looking beyond the One to the Many. *International Planning Studies*, *5*(3), 321–344. http://doi.org/10.1080/713672862

Centraal Bureau voor de Statistiek. (n.d.). Statistische gegevens per vierkant. Retrieved from http://www.cbs.nl/NR/rdonlyres/E29D852E-0AD5-40AD-AF57-C42F811487B6/0/Statistischegegevenspervierkantupdateoktober2014.pdf

Centre for Social Innovation. (n.d.). Social Innovation. Retrieved August 9, 2015, from http://socialinnovation.ca/about/social-innovation

Chesbrough, H. W. (2003). *Open innovation : the new imperative for creating and profiting from technology*. Boston, Mass. : Harvard Business School Press, cop. 2003.

Chesbrough, H. W., Vanhaverbeke, W., & West, J. (Eds.). (2006). *Open innovation: researching a new paradigm*. Oxford: Oxford University Press.

Childers, D. L., Pickett, S. T. A., Grove, J. M., Ogden, L., & Whitmer, A. (2014). Advancing urban sustainability theory and action: Challenges and opportunities. *Landscape and Urban Planning*, *125*, 320–328. http://doi.org/10.1016/j.landurbplan.2014.01.022

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., … Scholl, H. J. (2012). Understanding Smart Cities: An Integrative Framework (pp. 2289–2297). IEEE. http://doi.org/10.1109/HICSS.2012.615

Commoner, B. (1992). *Making peace with the planet*. New York : New Press, cop. 1992.

Cooke, P., Davies, C., & Wilson, R. (2002). Innovation Advantages of Cities: From Knowledge to Equity in Five Basic Steps. *European Planning Studies*, *10*(2), 233–250. http://doi.org/10.1080/09654310120114517

Delanty, G. (2001). *Challenging knowledge: the university in the knowledge society*. Buckingham [England] ; Philadelphia, PA: Society for Research into Higher Education & Open University Press.

Directorate General for Internal Policies. (2010). The Lisbon Strategy 2000-2010: An analysis and evaluation of the methods used and results achieved. Retrieved from http://www.europarl.europa.eu/document/activities/cont/201107/20110718ATT24270/20110718ATT24270EN.pdf

Ebbesson, J. (2011). Public Participation and Privatisation in Environmental Matters: An Assessment of the Aarhus Convention. *Erasmus Law Review*, *4*, 71.

Edwards, C. (2009). *Resilient Nation*. London: Demos.

Elkington, J. (1997). *Cannibals with forks : the triple bottom line of 21st century business*. Oxford : Capstone, 1997.

ENoLL. (n.d.-a). ENoLL: About Us. Retrieved August 3, 2015, from http://www.openlivinglabs.eu/aboutus

ENoLL. (n.d.-b). ENoLL Services. Retrieved August 7, 2015, from http://openlivinglabs.eu/enoll-services

European Commission. General Union Environment Action Programme to 2020 "Living well, within the limits of our planet," Pub. L. No. No 1386/2013/EU (2013). Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32013D1386&from=EN

European Commission. (2014a). The Digital Agenda Toolbox. Publications Office of the European Union. Retrieved from http://s3platform.jrc.ec.europa.eu/dae-toolbox

European Commission. (2014b, September 9). SmartSantander. Retrieved from http://cordis.europa.eu/project/rcn/95933_en.html

European Commission. (2015, June 22). Environment Action Programme to 2020. Retrieved August 8, 2015, from http://ec.europa.eu/environment/newprg/

European Commission. (n.d.-a). About INSPIRE. Retrieved August 20, 2015, from http://inspire.ec.europa.eu/index.cfm/pageid/48

European Commission. (n.d.-b). European Research Area. Retrieved August 19, 2015, from http://ec.europa.eu/research/era/index_en.htm

European Commission. (n.d.-c). What is Horizon 2020? - Horizon 2020 - European Commission. Retrieved August 19, 2015, from http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

European Communities. (2007). FP7 in Brief: How to get involved in the EU 7th Framework Programme for Research. Retrieved from http://ec.europa.eu/research/fp7/pdf/fp7-inbrief_en.pdf

Evans, J. (2011). Resilience, ecology and adaptation in the experimental city. *Transactions of the Institute of British Geographers*, *36*(2), 223–237.

Evans, J., & Karvonen, A. (2011). Living Laboratories for Sustainability: Exploring the Politics and Epistemology of Urban Transition. In *Cities and Low Carbon Transitions* (pp. 126–141). Routledge.

Evans, J., & Karvonen, A. (2014). "Give Me a Laboratory and I Will Lower Your Carbon Footprint!" - Urban Laboratories and the Governance of Low-Carbon Futures: Governance of low carbon futures in Manchester. *International Journal of Urban and Regional Research*, *38*(2), 413–430. http://doi.org/10.1111/1468-2427.12077

Finland's EU Presidency. (2006, November 20). The Helsinki Manifesto. Retrieved from http://elivinglab.org/files/Helsinki_Manifesto_201106.pdf

Flick, U. (2006). *An introduction to qualitative research* (3rd Edition). London : SAGE, 2006.

Fowler, F. J., Jr. (1993). *Survey research methods*. Newbury Park, Calif. : Sage, cop. 1993.

Fowler, F. J., Jr. (1995). *Improving survey questions : design and evaluation*. Thousand Oaks, Calif. : Sage Publications, 1995.

Fredline, L., Raybould, M., Jago, L., & Deery, M. (2005). Triple Bottom Line Event Evaluation: A proposed framework for holistic event evaluation.

Frick, J., Kaiser, F. G., & Wilson, M. (2004). Environmental knowledge and conservation behavior: exploring prevalence and structure in a representative sample. *Personality and Individual Differences*, *37*(8), 1597–1613. http://doi.org/10.1016/j.paid.2004.02.015

Fukuyama, F. (1995). *Trust : the social virtues and the creation of prosperity*. New York : Free Press, cop. 1995.

Gieryn, T. F. (2006). City as Truth-Spot: Laboratories and Field-Sites in Urban Studies. *Social Studies of Science*, *36*(1), 5–38. http://doi.org/10.1177/0306312705054526

Go: Smart | UbiGo. (n.d.). Retrieved August 9, 2015, from http://www.ubigo.se/las-mer/gosmart/

Governance of Urban Sustainability Transitions. (n.d.). Retrieved from http://www.urbanlivinglabs.net/

Grove, J. M. (2009). Cities: Managing Densely Settled Social-Ecological Systems. In C. Folke, G. P. Kofinas, & F. S. Chapin (Eds.), *Principles of Ecosystem Stewardship* (pp. 281–294). Springer New York. Retrieved from http://link.springer.com/chapter/10.1007/978-0-387-73033-2_13

Huber, M. S. Q., Egeren, L. A. V., Pierce, S. J., & Foster-Fishman, P. G. (2009). GIS Applications for Community-Based Research and Action: Mapping Change in a Community-Building Initiative. *Journal of Prevention & Intervention in the Community*, *37*(1), 5–20. http://doi.org/10.1080/10852350802498367

JPI Urban Europe. (2012). 1st Joint Call for Proposals: Urban Europe - creating attractive, sustainable and economically viable urban areas.

JPI Urban Europe. (n.d.). What is JPI Urban Europe? | Urban Europe. Retrieved August 19, 2015, from http://jpi-urbaneurope.eu/about/what/

Kastens, B., & Newig, J. (2008). Will participation foster the successful implementation of the water framework directive? The case of agricultural groundwater protection in northwest Germany. *Local Environment*, *13*(1), 27–41. http://doi.org/10.1080/13549830701581713

Kramers, A., Höjer, M., Lövehagen, N., & Wangel, J. (2014). Smart sustainable cities – Exploring ICT solutions for reduced energy use in cities. *Environmental Modelling & Software*, *56*, 52–62. http://doi.org/10.1016/j.envsoft.2013.12.019

Kranz, N., Ridder, D., & Patel, M. (2006, August). Ecological Briefs on International Relations and Sustainable Development: Public Participation in European River Basin Management. Ecologic.

Krathwohl, D. R. (2002). A Revision of Bloom's Taxonomy: An Overview. *Theory Into Practice*, *41*(4), 212–218. http://doi.org/10.1207/s15430421tip4104_2

Lagendijk, A., & Lorentzen, A. (2007). Proximity, Knowledge and Innovation in Peripheral Regions. On the Intersection between Geographical and Ogranizational Proximity. *European Planning Studies*, *15*(4), 457–466. http://doi.org/10.1080/09654310601133260

Lee, J., & Wong, D. W. S. (2001). *Statistical Analysis with ArcView GIS*. John Wiley & Sons.

Lee, M., & Abbot, C. (2003). The Usual Suspects? Public Participation under the Aarhus Convention. *The Modern Law Review*, *66*(1), 80–108.

Lennard, L. (2005). Talk to me. *Utility Week*, *23*(17), 26–26.

Lepik, K.-L., Krigul, M., & Terk, E. (2010). Introducing Living Lab's Method as Knowledge Transfer from one Socio-Institutional Context to another: Evidence from Helsinki-Tallinn Cross-Border Region. *J. UCS*, *16*(8), 1089–1101.

Liedtke, C., Jolanta Welfens, M., Rohn, H., & Nordmann, J. (2012). LIVING LAB: user-driven innovation for sustainability. *International Journal of Sustainability in Higher Education*, *13*(2), 106–118. http://doi.org/10.1108/14676371211211809

Lööf, H., & Nabavi, P. (2013). Increasing returns to smart cities. *Regional Science Policy & Practice*, *5*(2), 255–262. http://doi.org/10.1111/rsp3.12008

Loorbach, D., van Bakel, J. C., Whiteman, G., & Rotmans, J. (2010). Business strategies for transitions towards sustainable systems. *Business Strategy and the Environment*, *19*(2), 133–146. http://doi.org/10.1002/bse.645

Louka, D. E. (2008). *Water Law and Policy: Governance Without Frontiers*. Oxford University Press. Retrieved from http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780195374131.001.0001/acprof-9780195374131

Maastricht Lab. (n.d.). Maastricht Lab [http://www.maastrichtlab.nl/en/]. Retrieved August 20, 2015, from http://www.maastrichtlab.nl/en/

Massard, N., & Mehier, C. (2005). Proximity, accessibility to knowledge and innovation". In *paper for the 10th International Conference of Regional Studies Association on "Regional Growth Agendas", Aalborg (Denmark), May* (pp. 28–31). Retrieved from http://www.researchgate.net/profile/Nadine_Massard/publication/46527408_Proximity_and_Innovation_through_an_%27Accessibility_to_Knowledge%27_Lens/links/0912f511227237ae35000000.pdf

McLennan, D., Barnes, H., Noble, M., Davies, J., Garratt, E., & Dibben, C. (2011, March). The English Indices of Deprivation 2010. Department for Communities and Local Government. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6320/1870718.pdf

Meimeth, M., & Robertson, J. D. (Eds.). (2012). *Sustainable development - how to bridge the knowledge-action gap?: exploring the added value of social and cultural perspectives* (1st ed). Baden-Baden: Nomos.

Mensink, W., Birrer, F. A., & Dutilleul, B. (2010). Unpacking European living labs: analysing innovation's social dimensions. *Central European Journal of Public Policy*, (1), 60–85.

Morton, C. M., Peterson, N. A., Speer, P. W., Reid, R. J., & Hughey, J. (2012). Applying geographic information systems to community research. In L. Jason, D. Glenwick, L. (Ed) Jason, & D. (Ed) Glenwick (Eds.), *Methodological approaches to community-based research.* (pp. 205–220). Washington, DC, US: American Psychological Association. Retrieved from http://ludwig.lub.lu.se/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2011-21702-012&site=eds-live&scope=site

Mulvenna, M., Martin, S., McDade, D., Beamish, E., Oliveira, Á., & Kivilehto, A. (2011). *TRAIL Living Labs Survey 2011: A survey of the ENoLL living labs.* University of Ulster.

Murray, R., Caulier-Grice, J., & Mulgan, G. (2010). *The open book of social innovation.* National endowment for science, technology and the art. Retrieved from http://blog.eisco2012.eu/home/european/library/literature/Social_Innovator_020310.pdf

Omer, I. (2006). Evaluating accessibility using house-level data: A spatial equity perspective. *Computers, Environment and Urban Systems*, *30*(3), 254–274. http://doi.org/10.1016/j.compenvurbsys.2005.06.004

Pezzoli, K. (1997). Sustainable Development: A Transdisciplinary Overview of the Literature. *Journal of Environmental Planning and Management*, *40*(5), 549–574. http://doi.org/10.1080/09640569711949

Pol, E., & Ville, S. (2009). Social innovation: Buzz word or enduring term? *The Journal of Socio-Economics*, *38*(6), 878–885. http://doi.org/10.1016/j.socec.2009.02.011

Robrecht, H. (2015, May). *Get to know about climate services, living labs and learning alliances*. Presented at the The 2nd European Climate Change Adaptation Conference.

Rogers, M., & Ryan, R. (2001). The Triple Bottom Line for Sustainable Community Development. *Local Environment*, *6*(3), 279–289. http://doi.org/10.1080/13549830120073275

Rowe, G., & Frewer, L. J. (2000). Public Participation Methods: A Framework for Evaluation. *Science, Technology & Human Values*, *25*(1), 3–29. http://doi.org/10.1177/016224390002500101

Salter, R., & White, S. (2014). Collaborative research in the real world: Review of Living Laboratories. Low Carbon Living. Retrieved from http://www.lowcarbonlivingcrc.com.au/resources/crc-publications/reports/collaborative-research-real-world-review-living-laboratories

Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M., & Oliveira, A. (2011). Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation. In *The Future Internet* (Vol. 6656, pp. 431–446). Berlin, Heidelberg: Springer Berlin Heidelberg. Retrieved from http://link.springer.com/10.1007/978-3-642-20898-0

Schliwa, G. (2013, September). *Exploring Living Labs through Transition Management: Challenges and Opportunities for Sustainable Urban Transitions*. Lund University. Retrieved from http://www.lunduniversity.lu.se/lup/publication/4091934

Science Park of the University of Valencia. (n.d.). Evomobile. Retrieved August 9, 2015, from http://www.pcuv.es/en/evomobile/inicio.html

Shiroyama, H., Yarime, M., Matsuo, M., Schroeder, H., Scholz, R., & Ulrich, A. E. (2012). Governance for sustainability: knowledge integration and multi-actor dimensions in risk management. *Sustainability Science*, *7*(1), 45–55. http://doi.org/10.1007/s11625-011-0155-z

SmartSantander. (n.d.). Open Calls. Retrieved August 23, 2015, from http://www.smartsantander.eu/index.php/open-calls

Smulian, M. (2012, March 21). Budget 2012: First "city deal" gives Manchester tax back. Retrieved August 20, 2015, from http://www.lgcplus.com/budget-2012-first-city-deal-gives-manchester-tax-back/5042972.article

Ståhlbröst, A., & Holst, M. (2012). The Living Lab Methodology Handbook. Luleå University of Technology. Retrieved from http://www.ltu.se/cms_fs/1.101555!/file/LivingLabsMethodologyBook_web.pdf

Stocker, T. F., Qin, D., Plattner, G. K., Tignor, M., Allen, S. K., Boschung, J., … Midgley, B. M. (2013). IPCC, 2013: climate change 2013: the physical science basis. Contribution of working group I to the fifth assessment report of the intergovernmental panel on climate change.

The Alcotra Innovation Consortium. (2013). How to set up Cross-Border Living Labs: The Alcotra Innovation Experience Handbook. Retrieved from http://www.alcotra-innovation.eu/livingLabs/dwd/Alcotra_Innovazione_Handbook_2013.pdf

TLL-Sicily. (n.d.). Retrieved August 6, 2015, from http://tll-sicily.ning.com/

Tom Beer, & Ismail-Zadeh, A. (2002). *The Budapest Manifesto on Risk Science and Sustainability*. Springer Science & Business Media. Retrieved from http://books.google.com/books?hl=en&lr=&id=6gE4ZcsRcRgC&oi=fnd&pg=PR7&dq=%22of+cities+to+natural,+technological+and+to+social+threats.+We,+as%22+%22of+knowledge+exchange+and+communication.+Risk+evaluation+must%22+%22that+underlie+them.+In+many+cases+the+interaction+between+science,%22+&ots=YA6fNchewA&sig=QKviRxZoa0ISgA9nP3yyxP9kl28

Triple bottom line. (2009, November 17). *The Economist*. Retrieved from http://www.economist.com/node/14301663

Tsou, K.-W., Hung, Y.-T., & Chang, Y.-L. (2005). An accessibility-based integrated measure of relative spatial equity in urban public facilities. *Cities*, *22*(6), 424–435. http://doi.org/10.1016/j.cities.2005.07.004

UbiGo. (2015, May 24). UbiGo – Mobility as a Service in reality. Retrieved from http://www.ubigo.se/wp-content/uploads/2015/06/About_UbiGo_May2015.pdf

United Nations, Department of Economic and Social Affairs, & Population Division. (2014). *World urbanization prospects: the 2014 revision: highlights*.

urb@exp. (n.d.). About Urban Labs. Retrieved from http://www.urbanexp.eu/urban-labs

Veeckman, C., Schuurman, D., Leminen, S., & Westerlund, M. (2013). Linking Living Lab Characteristics and Their Outcomes: Towards a Conceptual Framework. *Technology Innovation Management Review*, *3*(2). Retrieved from http://timreview.ca/article/748

Veeckman, C., & van der Graaf, S. (2015). The City as Living Laboratory: Empowering Citizens with the Citadel Toolkit. *Technology Innovation Management Review*, *5*(3), 6–17.

Vinnova. (n.d.). Strategically important knowledge areas [text]. Retrieved August 19, 2015, from http://www.vinnova.se/en/Our-acitivities/Strategically-important-knowledge-areas/

Voytenko, Y., McCormick, K., Evans, J., & Schliwa, G. (2015). Urban living labs for sustainability and low carbon cities in Europe: towards a research agenda. *Journal of Cleaner Production*. http://doi.org/10.1016/j.jclepro.2015.08.053

WCED. (1987). Report of the World Commission on Environment and Development: Our Common Future. Retrieved from http://www.ask-force.org/web/Sustainability/Brundtland-Our-Common-Future-1987-2008.pdf

Welp, M. (2001). The use of decision support tools in participatory river basin management. *Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere*, *26*(7–8), 535–539. http://doi.org/10.1016/S1464-1909(01)00046-6

Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., … van der Leeuw, S. (2011). Tipping Toward Sustainability: Emerging Pathways of Transformation. *AMBIO: A Journal of the Human Environment*, (7), 762. http://doi.org/10.1007/s13280-011-0186-9

Wiek, A., Kay, B., & Forrest, N. (in press). Worth the Trouble?! An Evaluative Scheme for Urban Sustainability Transition Labs (USTL) and an Application to the USTL in Phoenix, Arizona. In *Urban Sustainability Transitions*.

Wolch, J. R., Byrne, J., & Newell, J. P. (2014). Urban green space, public health, and environmental justice: The challenge of making cities "just green enough." *Landscape and Urban Planning*, *125*, 234–244. http://doi.org/10.1016/j.landurbplan.2014.01.017

Appendix I. Personal Communications

Interviews with Funding Agencies and Relevant Stakeholders

1. Jonas Bylund, *JPI Urban Eurpope* - June 19, 2015
2. Jarmo Eskelinen – *Former President of European Network of Living Labs | CEO or Forum Virium Helsinki Living Lab* – August 10, 2015
3. Kristina Björnberg, *Senior Associate Researcher, Formas* – August 19, 2015
4. Rebecka Engström, *Senior Programme Mannager, Vinnova* – August 20, 2015
5. Alexander Alvsilver, *Programme Manager, Vinnova* – August 27, 2015

Informal Discussions and Email Correspondence

1. Jonas Bylund, *JPI Urban Europe* – May 12, 2015 | October 8, 2015
2. Rob Swart, *Coordinator – International Climate Adaptation Research, Alterra | Chair, JPI Climate Working Group* – May 12, 2015

Appendix II. Survey of Living Labs

Living Labs – What is your impact?

The purpose of this survey is to connect living lab practitioners to on-going academic research on living labs for sustainability. Your project has been identified for further study as a project for sustainability and may be considered a living lab. A living lab is broadly defined as a venue devised to design, test and learn from social and technical innovation in real time.

The survey explores user involvement and funding strategies for this type of innovation for sustainability. The results of the survey will be used to verify information about living labs provided in interviews by those in academia, funding agencies and fellow living labs.

Completion of the survey is voluntary; you may answer any question(s) you wish. No information submitted to the survey will be shared with any funding agency. The purpose is to investigate and advance living lab methodology.

This survey is conducted as a part of research for a Master's thesis titled *Mapping Urban Futures*. The research is supported by the International Institute for Industrial Environmental Economics (IIIEE) at Lund University in Lund, Sweden. The thesis is written in collaboration with the Governance of Urban Sustainability Transitions (GUST) project (http://www.urbanlivinglabs.net/), which is funded by JPI Urban Europe and includes partners from Lund University (Sweden), Dutch Research Institute for Transition (the Netherlands), University of Durham (the United Kingdom) and Joanneum Research (Austria). The project aims to investigate and advance urban living labs.

For more information, please contact Steven Curtis at steven.curtis.436@student.lu.se.

Living Lab Information

This section aims to gather biographical data about your project for sustainability. You may consider yourself a living lab or use participatory methodology similar to that of a living lab. The information provided in this section will help to develop a greater understanding of strategic focus and trends among living labs for sustainability.

JPI Urban Europe defines a living lab as "a forum for innovation, applied to the development of new products, systems, services, and processes, employing working methods to integrate people into the entire development process as users and co-creators, to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts."

1. *When did you begin the project?*
2. *Have you always framed your project as a living lab?*
   Yes
   No
      a. *If not, since when did you call your activities / project a living lab?*
3. *Could you briefly explain how you understand the concept of a living lab?*

4. *Is your living lab still operating and active?*
   Yes
   No
   Since when?
5. *Could you briefly explain the concept of your living lab?*
6. *Sustainability Focus:*

   Transport / Mobility

   Building / Construction

   Renewable Energy

   Energy Efficiency

   Recycling / Waste

   Equality / Societal Issues

   Low Carbon Futures / Climate

   Urban Agriculture

   Smart City Solutions

   Housing

   Other: _____

Comment, if relevant:

7. What is the primary research focus of your living lab?

   Systems

   Processes

   Products

   Services

   Other: _____

      Please comment, if relevant

8a. Which of the following organizations are involved in the delivery of your living lab?*

Local Government

University

Private Sector

National Government

European Commission

NGOs

Civic Society / User-driven

If other, please specify:

8b. Which organization/actor has most influence? Please, explain.

User Involvement

Academia seeks to understand who is involved in living labs and whose knowledge is being accessed. This section of the survey examines the stakeholders involved and the type, frequency and number of end-users or participants engaged. An end-user is defined as a person outside of living lab management who engages in the co-production and co-creation of knowledge through community engagement activities.

9. On average, how many engagement activities with end-users do your living lab conduct every month? Please, comment:

10. Approximately, how many end-users are involved in your living lab every month? Please, comment:

11. Do you have an evaluation procedure in place to find out how end-users view their experience of being involved in your living lab?*

Yes, formal (e.g. surveys, focus groups)

Yes, informal (e.g. conversations, meetings)

No process in place

If other, please specify:

12. What type of participatory methodologies do you use to engage with end-users (if any)? Please try to list as many ways of how you engage with users as possible starting with the most frequent.

13. How easy or difficult has it been to engage with end-users?*

Very Easy

Easy

Difficult

Very Difficult

We do not engage with end-users

Please specify why that is:

14. Some living labs have been described as "demonstration projects [that] are simply 'dropped into' urban areas rather than integrated with their local contexts." How would you respond to this characterization?

15. How does your living lab make an effort to engage and integrate with your communities?

16. On average, how far (time/distance) do you think end-users travel to engage with your living lab and its activities?

Time

Distance

17. How would you describe end-users / participants in your living lab from a demographical perspective?

Gender: ___ % women / ___ % men

Age: ___ to ___

Estimated Income: ___ to ___ Euros

Average level of education:

Included races and ethnicities:

Funding of Living Labs

This section seeks to understand the relationship between the living labs and their funding partners. By understanding who funds a living lab, how competitive the process of securing the funding is and what expectations both parties have, the funding system can be better designed to ensure adequate funding mechanisms that advance those successful living labs.

18. How long do you have funding for your project?

19. What are the plans for the project beyond the funded period? (ex. end of living lab, seek further funding, self-sustaining, etc.)

20. Has access to funding been a problem for your living lab?*

Yes, major problem.

Yes, minor problem.

No, not a problem.

If other, please specify

Comment:

21. How has access to funding changed over time, if at all?

22. What has been your main source of funding?*

Government

Other Public Sector Organizations (local council, etc.)

Academia

Private Sector Organizations

European Commission

Crowd funding (ex. membership-based)

If other, please specify

23. Which program or organization provides your funding?

24. Could you provide more detail on the funding process? For example, how did you learn about the funding opportunity? How long did it take to receive funding? Etc.

25. What kinds of requirements are placed on your living lab by the funding partner? (ex. midterm reports, regular e-mail communication, deliverables, etc.)

26. From your perspective, what motivates the funding partner to provide financial support to your living lab?

27. From your perspective, how does your funding partner view success of their investment? What are their expectations?

Respondent Information

This section of the survey is optional but appreciated. The survey seeks to be anonymous; however, you are welcome to leave your name and contact information if you would like to receive further updates regarding the results of the survey or more information from the Governance of Urban Sustainability Transitions (GUST).

Name of Living Lab:

Address:

Respondent Name:

Contact E-Mail:

Would you be available for a brief interview?

Yes

No

Appendix III. Email to Living Labs with Survey

Living Labs - What's your impact? View this email in your browser

Living Labs - What is your impact?

Cities throughout Europe face growing social and environmental challenges. Issues relating to sustainability are of mounting importance including waste recovery and recycling, renewable energy and energy systems, food and water, infrastructure and urbanization, etc. Many of these issues are deeply entrenched within communities and societies.

Living Labs are regarded as a place where real people work to solve real issues impacting real communities. But, what sustainability issues do Living Labs seek to address? What impacts do Living Labs have within their local communities? Why and how do Living Labs begin? How do Living Labs impact urban sustainability transitions? These questions and more are being asked by researchers throughout Europe.

In particular, researchers seek to integrate and include you, the practitioners, into the academic narrative surrounding the transformative potential of Living Labs in cities. To begin, we ask for your involvement in a survey to examine the support structure and funding mechanisms for Living Labs. Moreover, we seek to examine methods of user involvement and engagement.

Please complete the following survey by July 31st. Your inputs and perspectives are important to us!

To the Survey

Did this email get to the right person? If not, please forward this survey to someone suited to provide perspective on your Living Lab. Your help is greatly appreciated!

Governance of Urban Sustainability Transitions (GUST)

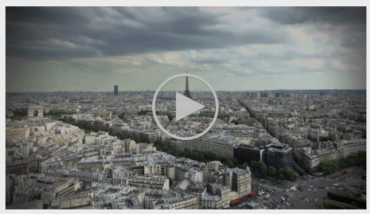
The above research is done as a Master's thesis in collaboration with the GUST Project at Lund University. The GUST Project is a joint research venture funded by JPI Urban Europe bringing together leading European research partners and practitioners to investigate and advance Urban Living Labs.

The aim of the GUST Project is to examine, inform and advance the governance of sustainability transitions through Urban Living Labs, which are proliferating across Europe as a means for testing innovations in buildings, transport and energy systems, etc.

We hope to learn more about the work you do and you may hear from us again soon!

Want to learn more?

Meet the GUST team, explore the ongoing research and be a part of the narrative!



GUST in 2 Minutes!

Motivation | Research | Outcomes

GUST Governance of Urban Sustainability Transitions

LUND UNIVERSITY

20 YEARS ANNIVERSARY 1995-2015

iiiee

THE INTERNATIONAL INSTITUTE FOR INDUSTRIAL ENVIRONMENTAL ECONOMICS

Website Twitter

Problems viewing this email:
Survey Link: https://sunet.artologik.net/lu/Survey/8887

You received this email because of your involvement with <<First Name>>

unsubscribe from this list update subscription preferences

MailChimp

Appendix IV. Semi-Structured Interview Guide

Interview Guide – Name of Organisation

Interviewee:

Organisation:

Title:

Interview Date:

Introduction:

This interview is in conjunction with a thesis as a part of the Master's programme in Environmental Management and Policy at the International Institute for Industrial Environmental Economics of Lund University. As alluded to in our previous communication, the thesis looks to examine three things: identify living labs for sustainability; map and understand funding mechanisms for living labs; and, using GIS, begin to discuss potential social equity issues in relation to living labs. The purpose of this interview is to gain insight into your work with Formas and the overall perception of living labs by those funding agencies.

Let's plan to complete the interview in 30-45 minutes and if it is ok with you, may I record this call? Does this sound agreeable? Any questions before we get started.

Reference: JPI Urban Europe Definition of a Living Lab - *"It is a forum for innovation, applied to the development of new products, systems, services, and processes, employing working methods to integrate people into the entire development process as users and co- creators, to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts."*

Background Information:

Highlight existing knowledge of organization and their role, past experience?

- **Can you elaborate on your role at _____?**
- **What do you see is the primary role of your organization (ex. ENoLL)?**
- **There are so many issues facing urban environments. In your eyes, what particularly motivates you to focus on funding research and innovation?**
- **What is your involvement with other local, national and EU funding agencies?**

Living Labs and Funding:

- **Are you familiar with the term living lab?**
- **When was the first time you heard the term living lab?**
- **What does the term living lab mean to you?**

- **What other terms have you heard to describe a living lab?**
- **Academic literature and practitioners describe user-driven innovation in a variety of ways. City labs. Urban labs. Change labs. Transition labs. Etc. How do you think this impacts how living labs are perceived in society and how do you think this impacts the proliferation of living labs?**
- **With people using the term living labs in a variety of ways to mean many things, do you think this is an impact on the funding of living labs?**
- **Why do you think living labs are being as widely used in Europe in relation to the rest of the world?**
- **What do you see as the potential of living labs in urban sustainability transitions?**
- **What are the desired outcomes of funded projects?**
- **What is your opinion of living labs as a buzzword? Does the use of the term impact how evaluators look at proposals?**
- **How are funded projects evaluated?**
- **Do you see any obstacles or problems in the current way living labs are funded?**
- **Building trust in the communities living labs operate is important. A criticism of the current funding regime is that they fund projects over platforms and processes. How do you respond to this criticism? Is there any validity to it? How can it be overcome?**
- **What do you think is the future of living labs? What can we expect to see in five years?**

Social Equity Issues and Continued Research:

- **Living labs have been described as demonstration projects that are dropped into their local communities without integrating with their local contexts. What is your opinion of this critique of living labs? How do funding agencies consider issues of social equity in choosing which projects to fund?**
- **Does the funding agency have a role in ensuring social equity and inclusion within the projects they fund?**
- **Are you familiar with the term territorial living lab? How does a funding agency view the promise of a territorial living lab?**
- **How can living labs be able to become self-sustaining? What is your opinion of co-financing? Conditional funding?**
- **Among the motivations for funding living labs, funding agencies and the EU want to see increased EU and national competiveness, innovation and employment. Further, commercialisation is important when discussing innovation. Do you have any insights in how funding agencies can facilitate the up-scaling and proliferation of solutions for sustainability from living labs?**
- **How do you see academics looking to research living labs working together with practitioners of living labs? How can the process be improved?**

Appendix V. Living Labs for Sustainability

Name of Living Lab	Country	City
Smart City Project Graz	Austria	Graz
VIsion Step I	Austria	Villach
Lakecity Aspern Vienna	Austria	Vienna
Smart District Gnigl	Austria	Salzburg
Smart City Hartberg	Austria	Hartberg
E-Mobility: Greater Graz	Austria	Graz
Erntelaa, Wien Liesing	Austria	Vienna
Vienna Shares	Austria	Vienna
Urban Farm	Austria	Leonding
ICEC: Interethnic Coexistence in European Cities - Gumpendorf	Austria	Vienna
ICEC: Interethnic Coexistence in European Cities - Hippviertel	Austria	Vienna
ICEC: Interethnic Coexistence in European Cities - Breitensee	Austria	Vienna
Flemish Living Lab Platform	Belgium	Mechelen
Ghent Living Lab	Belgium	Ghent
Virtual Services and Open Innovation	Bulgaria	Sofia
Rijeka iLiving Lab	Croatia	Rijeka
WIRELESSINFO – Czech Living Labs	Czech Republic	Cholinská
Copenhagen Living Lab	Denmark	Copenhagen
Regional strategic impact through creative use of ICT (LLMidt)	Denmark	Viborg
Helsinki Living Lab - Forum Virium Helsinki	Finland	Helsinki
Agro Living Lab	Finland	Seinäjoki
Kainuu Living Lab (Snowpolis)	Finland	Sotkamo
Northern Rural-Urban Living Lab (NorthRULL)	Finland	Oulu
HumanTech LivingLab	Finland	Jyväskylä
TAMK Living Lab	Finland	Tampere
Smart City Living Lab	France	Paris
Lorraine Smart Cities Living Lab	France	Nancy
Live with Risk Living Lab	France	Tarascon
Paris Region Lab	France	Paris
Espace et Living Labs - E2L (PATS - E2L)	France	Toulouse
Design Creative Living Lab (DCC-L)	France	Saint-Etienne
CIMLAB	France	Le Marigot
OFF-ROAD MEMORY Living Lab	France	Nantes
Urban Living Lab (Versailles Saint-Quentin-en-Yvelines)	France	Versailles
CAREEP LIVING LAB	France	Saint-Mande
Bremen Ambient Assisted Living Lab	Germany	Kaiserslautern

Name of Living Lab	Country	City
Homokháti Rural Living Laboratory	Hungary	Szeged
Green Living Lab	Hungary	Szombathely
Iceland LL	Iceland	Reykjavik
Dublin Living Lab	Ireland	Dublin
Enerlab	Italy	Monte San Giusto
X-Lab	Italy	Bologna
Knowledge-based Lifecycle Innovation living Lab (KLIO Lab)	Italy	Lecce
City of the Future Living Lab	Italy	Milan
Leaning Lab	Italy	Pisa
Living Piemonte	Italy	Torino
C.LAB - Piedmont Community Labs	Italy	Torino
Torre Guaceto Living Lab: the living lab in the Natural Reserve	Italy	Milan
Research Innovation Centre	Italy	Rome
Green Schools	Italy	Treviso
Living Lab Malta	Malta	Kalkara
Amsterdam Living Lab	Netherlands	Amsterdam
Eindhoven Living Lab	Netherlands	Eindhoven
Foundation the Hague Innovation Motor (HIM)	Netherlands	Rotterdam
Concept House	Netherlands	Rotterdam
Open Ebbinge Lab	Netherlands	Groningen
Maastricht Lab	Netherlands	Maastricht
Veerkracht Carnisse	Netherlands	Rotterdam
Living Lab Nieuw West	Netherlands	Amsterdam
Living Lab Buiksloterham	Netherlands	Amsterdam
European Urban Transportation Experience Lab, or the EU/t ELab	Netherlands	
Urban Gro Lab	Netherlands	Groningen
Stadslab Leiden	Netherlands	Leiden
RENER Living Lab – Portuguese Smart Cities Network	Portugal	Lisbon
Lighting Living Lab	Portugal	Agueda
Sustainable Construction Living Lab	Portugal	Sintra
ECO LivingLab@Chamusca	Portugal	Chamusca
Smart Rural Living Lab	Portugal	Penela
ISaLL - Intelligent Sensing and Smart Services Living Lab	Portugal	Coimbra
E-zavod Living Lab	Slovenia	Ptuj
Tragsa R&D Labs	Spain	Madrid
Subbética Cordobesa Living Lab	Spain	Cordoba
Living Lab La Serena	Spain	Castuera
Platja de Palma Living Tur (PdP LL)	Spain	Palma
Man & Earth Living Lab	Spain	Madrid

Name of Living Lab	Country	City
Living Lab Campiña de Jerez	Spain	La Barca de la Florida
RURAL LIVING LAB PIRINEUS	Spain	Solsona
EVOMOBILE	Spain	Valencia
BIRD LIVING LAB	Spain	San Sebastian
Cudillero Living Lab	Spain	Madrid
IoT Smart Santander Living Lab	Spain	Santander
Guadalhorce Living Lab	Spain	Malaga
AGDR Sierra de las Nieves	Spain	Sierra de las Nieves
Málaga Living Lab	Spain	Malaga
LivingCAR Living Lab	Spain	Madrid
Malmö Innovation Platform	Sweden	Malmö
Shape your world Urban Living Lab	Sweden	Botkyrka
New light on Alby Hill Urban Living Lab	Sweden	Botkyrka
Vacant space Alby Urban Living Lab	Sweden	Botkyrka
Living Lab UbiGo	Sweden	Gothenburg
Living Lab Fabriken (The Factory)	Sweden	Malmö
Experimental house Hållbarheten	Sweden	Malmö
Färgfabriken	Sweden	Stockholm
Norrby Innovation Platform	Sweden	Borås
TEEA-LL	Sweden	Malmö
The Elis Platform: Enabling Energy Efficiency Apps	Sweden	Malmö
HS 2020	Sweden	Hammarby Sjöstad (Stockholm)
iHomeLab Living Lab	Switzerland	Horw
Energy Living Lab	Switzerland	Sierre
Centre for Sustainable Technologies (CST)	United Kingdom	Newtownabbey
City Lab Coventry	United Kingdom	Coventry
Future City Glasgow	United Kingdom	Glasgow
MK: SMART	United Kingdom	Milton Keynes
Future Cities Catapult	United Kingdom	London, Glasgow, Birmingham, Leeds, Manchester, Bristol, Aarhus, Santander, etc.
Sensing London (Fiture Cities Catapult)	United Kingdom	London
OrganiCity (Future Cities Catapult)	United Kingdom	London, UK (together with Aarhus, Denmark, and Santander, Spain)
Newcastle Science City	United Kingdom	Newcastle upon Tyne
London Electric Mobility	United Kingdom	London
Muswell Hill (Haringey) Low Carbon Zones (one of 10 London Low Carbon Zones*)	United Kingdom	London
NW Bicester Ecotown (Phase One: NW Bicester Exemplar)	United Kingdom	Bicester, Oxfordshire
Eco Bicester Living Lab	United Kingdom	Bicester, Oxfordshire

Name of Living Lab	Country	City
Eco Bicester	United Kingdom	Bicester, Oxfordshire
Bristol Energy Network	United Kingdom	Bristol
The Selby Trust: The Community Energy Lab	United Kingdom	London
Greening Wingrove	United Kingdom	Newcastle upon Tyne
Greater Manchester Low Carbon Hub	United Kingdom	Manchester
Corridor Manchester ('Lighthouse Project')	United Kingdom	Manchester
York Without Walls	United Kingdom	York